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STUDY OF MUTATIONS IN THE 23 S rRNA GENE ARE ASSOCIATED WITH CLARITHROMYCIN RESISTANCE IN *H.PYLORI*

Abstract: Uzbekistan living in patients diagnosed with atrophic gastritis and stomach ulcers caused by *H.pylori* bacteria clarithromycin 23S rRNA gene that provides resistance to the domain V 2142 A/G/C, 2143 A/G mutations Multiplex Real-Time PCR method. 114 atrophic gastritis and gastric ulcer patients out of 109 (95,6%) caused by *H.pylori* bacteria and 114 samples, 19 (16,6%) caused by *H.pylori* 23S rRNA gene isolated from the domain V 2142 A/G/C, 2143 A/G mutations. Of them, 15 (78,9%) A2142G, 3 (15,79%), A214G and 1% (5,268) A2142C mutation was present.

Keywords: *H.pylori,* clarithromycin, 23S rRNA, multiplex Real-time PCR, gene ureC.

Helicobacter pylori is one of the most studied bacteria in the world today. Approximately 60% of the world's population is infected with *H.pylori.* For example, the infection of the adult population of Russia ranges from 50 to 80%, and in some regions it approaches 100% [1, p. 2–12; 2, p. 41]. In infected people, *H.pylori* causes a disease associated with asymptomatic carriage. At the same time, epidemiological data obtained in various countries show that almost 100% of duodenal ulcers and more than 80% of gastric ulcers are associated with persistence of *H. pylori* [1, 2–12; 2, 41]. Today, it is proved that *H.pylori* infection is the most important etiopathogenetic factor not only of a peptic ulcer, but also of chronic gastritis associated with *H.pylori* in 75–92% of cases of gastroduodenitis, stomach cancer [2, 41].

H.pylori has a wide range of genetic factors that provide it with the ability to adapt and survive in an acidic environment, colonizing the mucous membrane of the stomach and duodenum, and cause disease. It is known that in modern medicine the treatment of patients with Helicobacter-associated diseases, provides for anti-Helicobacter therapy, which, as a rule, is carried out without determining the sensitivity of H. pylori to antibacterial agents.

However, to increase the effectiveness of treatment of patients with this pathology, it is necessary to take into account the resistance of *H.pylori* to antibacterial drugs. It is known that the Maastricht Agreement-5 is the main advisory document on the diagnosis and treatment of diseases associated with H.pylori infection. This scientific work provides for the empirical use of antibacterial drugs for therapy at a known level of H.pylori resistance and makes it possible to accurately predict the effectiveness of therapy [3, 1–25.]. The resistance of H. pylori to antibacterial drugs is a major factor in the failure of treatment of Helicobacter-associated diseases. This paper presents data on the resistance of H.pylori strains to clarithromycin in the region, which is associated with a decrease in the effectiveness of standard therapy regimens.

The aim of this work is to determine the prevalence of A2142G/C and A2143G point mutations that form

clarithromycin resistance in Uzbekistan based on Real-Time polymerase chain reaction (PCR-Real-time PCR).

Materials and methods

In 2016–2017 in the department of Gastroenterology of the Republican Specialized Scientific and Practical Medical Center for Therapy and Medical Rehabilitation of the Ministry of Health of the Republic of Uzbekistan, endoscopy collected samples from epithelial cells and gastric juice in 114 patients diagnosed with atrophic gastritis and gastric ulcer. DNA samples were isolated from biopsy samples using the AmpliPrim RIBO-prep reagent kit (InterLabService, Russia), according to the manufacturer's instructions. The concentration and purity of the isolated DNA samples were checked on a BioSpec-nano spectrophotometer (Shimadzu Biotech, Japan). The presence of H. pylori in the samples was confirmed by PCR using specific primers to the nucleotide sequence of the ureC gene described in [4, 1–6].

A multiplex Real-Time PCR with specially selected primers and probes (scorpion primers) was conducted to identify point mutations A2142G/C, A2143G, in the functional domain V 23S rRNA-gene responsible for the formation of HP resistance to clarithromycin [5, 2–7]. In each sample, an amplifier 7500 Fast Real-Time PCR System (Applied Biosystems) reads 4 channels (FAM, Cy3, ROX, and Cy5) fluorescence.

Results and its discussion

In all 114 samples of biopsy collected, the presence of the bacterium *H.pylori* was detected, the infection rate was 109 (95.6%). Of these, the resistance of *H.pylori* to clarithromycin was determined in 19 cases, which was 17.4%. The most common mutation was A2142G, which was detected in 15 patients (78.95%). The A2143G mutation was noted in 3 patients (15.79%).

To a large extent, resistance to clarithromycin in Uzbekistan is due to the presence of a point mutation A2142G. This mutation is present in 78,95% of resistant strains, and its presence in most cases explains the ineffectiveness of eradication therapy. The remaining 95 patients were infected by *H.pylori* bacteria in his stomach all of 2142 and 2143 precincts mutation detected in these patients ET scheme clarithromycin.

Patients who do not have point mutations, i.e. The resistance of *H.pylori* to clarithromycin in the appointment of the scheme can be recommended antibiotic clarithromycin. In the next series of experiments, sequencing of the strains of the bacterium H. pylori was carried out. Sequencing of the strains of the bacterium *H.pylori* resistant to clarithromycin in the 23S rRNA gene revealed several mutations, of which 2142 A/G/C, 2143 A/G mutations were most common, and the mutation 2142 A/C was not detected [6, 1–6; 7, e29694].

The sequencing of resistant strains of the bacterium *H.pylori* to clarithromycin revealed mutations A2147 G (79.8%), A2146G (17.2%) and A2146C (2%). Bacteria *H.pylori* resistant to clarithromycin were not detected [8, 2–5]. From the discussions of the above literature data one can see that, even in one infected population, the indicators of bacterial resistance to antibiotics are different [9, 164–174]. During the sequence of strains of the bacterium *H.pylori* resistant to clarithromycin in the 23 S rRNA gene, several mutations were identified, of which 2142 A/G/C and 2143 A/G mutations were the most common. For example, in the countries of Bulgaria [6, 1–6], Northern Iran [7, e29694] mainly identified mutations 2142 A/G, 2143 A/G, and mutation 2142 A/C was not identified. In Northern Spain, from 1986, cultures of isolates of H. pylori 349 (17.6%) were resistant to clarithromycin.

The sequencing of resistant bacteria *H.pylori* to clarithromycin revealed mutations A2147G (79.8%), A2146G (17.2%) and A2146C (2%) [10, 43–46]. In Italy, according to E-test, 82 cultures of *H.pylori* isolates were studied, of which 42 patients showed resistance of *H.pylori* to clarithromycin. In addition to the mutations A2142C, A2142G and A2143G, new mutations A2115G, G2141A and A2144T were detected in these isolates of cultures [11, 453–457]. Resistant bacteria *H.pylori* to clarithromycin that were not detected by the microbiological method E-test was determined by the method of Scorpion Real time PCR [12, 2320–2326].

Thus, on the basis of the obtained results, it can be concluded that in Uzbekistan it is necessary to conduct a study of the resistance of *H.pylori* not only to clarithromycin, but also to other antibiotics, since this will give the opportunity to choose the right ET regimens, which will lead to an increase in efficiency and monitoring therapy. In the future, for a broader study of molecular genetic aspects of the resistance of the bacterium *H.pylori* to clarithromycin, it is necessary to sequence the 23 S rRNA gene in domain V, as well as implement the Real Time PCR test systems for the most frequently encountered *H.pylori* mutations in Uzbekistan.

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VERTICILLIUM WILT RESISTANCE OF COTTON PLANTS ON THE BASIS OF INTERSPECIFIC HYBRIDIZATION

Abstract: It has been shown that fine–fiber cotton varieties and interspecific hybrids (*G.hirsutum* L. x *G.barbadense* L.) exhibit high field resistance to the Verticillium wilt. In the interspecific hybrids, dominance and overdominance of economically valuable traits was observed.

Keywords: introgressive hybrids, interspecific hybridization, wilt races, infectious background.

Introduction

In the practical breeding work interspecific and intergeneric hybridizations it is still considered as a general line for obtaining resistant varieties and disrupting, to varying degrees, the biological compatibility between the pathogen and higher plant.

Despite considerable difficulties that the breeder has to overcome during hybridization, this method now is very often used in cases where it is necessary to drastically improve the immunological properties of a particular crop, and within its species there are no such forms that could be used as a stable parent for hybridization. Breeders are often forced to use as a resistant parent an immune or highly resistant variety belonging to another species, often very distant in genetic terms, including from the wild flora.

The richest variety of sustainable plant forms created by nature is widely used today as a starting material in breeding works for the development of wilt–resistant varieties.

Material and methods

The resistance of parental samples and reciprocal F_1–F_3 plants to verticillium wilt was studied in the naturally strong infectious background. Every year, at the end of the growing season (October 1–10), the susceptibility of plants to verticillium wilt was determined by cutting of the main stem around the cotyledon leaf and assessment of disease severity according to the four–point scoring system: 0 (I) – healthy; II – mildly affected; III – moderately affected; IV – severely affected. The inheritance of resistance trait to verticillium wilt s wilt was analyzed.

Research results

Feasibility and success of distant interspecific hybridization for the transfer of useful genes is evidenced by the results of works concerning involvement of representatives *G.barbadense* L. species into the hybridization [1–5]. As many authors noted this species is characterized by high resistance to wilt. We conducted a study of the resistance of the hybrids derived by hybridization of the Tashkent-6 variety (*G.hirsutum* L.) and the C-6037 variety (*G.barbadense* L.) in several generations on artificial infectious backgrounds infected with the most aggressive races of the fungus *V.dahliae* Kleb.

As can be seen from the data presented in (Table 1), the parent variety Tashkent-6 in the background of race I showed a considerable high degree of wilt resistance – the percentage of healthy plants was more than 60%, in contrast to the background of race II, where the number of strongly and weakly affected plants was more than 50%. In variety C-6037, on the background of race I, the percentage of healthy plants was more than 60%, and on the background of race II, more than 75%. It should be noted that this variety showed lack of infected plants with high degree of wilt infection on the background of race I and race II and a very low percentage of cases with a moderate degree of wilt lesions on the background of race I. In contrast to a representative of the G.barbadense L species, C-6037 variety, Tashkent-6 (G.hirsutum L) variety was affected with the wilt on 2 backgrounds to a much greater extent.

Table 1. – Wilt resistance of parental forms and their interspecific hybrids (F_1–F_4)

Parental forms and hybrids	**Background of Race I Incidence of wilt disease (according to the wilt disease severity),%**				**Background of Race I Incidence of wilt disease (according to the wilt disease severity),%**			
	0	**1**	**2**	**3**	**0**	**1**	**2**	**3**
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
Tashkent-6	63.5	35.7	0.8	–	21.5	23.4	48.3	6.8

C-6037	61.2	35.8	3.0	–	75.5	24.5	–	–
F_1 Tashkent-6 × C-6037	47.8	47.8	4.4	–	30.0	45.0	25.0	–
F_2	62.0	28.0	10.0	–	55.0	32.5	12.5	–
F_3	31.3	56.2	10.4	2.1	50.0	31.6	15.8	2.6
F_4	14.3	45.7	40.0	–	53.6	26.2	13.0	7.2

To characterize the investigated interspecific hybrids for the wilt resistance, the studies were conducted on artificially infected wilt background together with the parental varieties. Sowing was performed with single–row 20–hole plots in 3 replicates and randomized blocks. Assessment of wilt disease intensity was carried out on 15 IX on a 4–point scale, on the background of race I and race II.

In F_1 plants of the interspecific hybrid, dominance of wilt resistance was observed – on the background of race I and race II, there were no plants that were severely affected by wilt, wherein a high percentage of plants was not affected, or weakly affected.

In F_2, wilt resistance on two backgrounds was inherited as a polygenic trait – the number of unaffected plants ranged from 55 to 63%. In subsequent generations of hybrids, there was a slight decrease in the number of healthy plants in the background of race I. There were no diseased plants in F_2. Under the background of race II, the trait of the wilt resistance of the hybrids was observed up to 4 generations.

From the plants of the third generation of hybrids (Tashkent-6 (*G.hirsutum* L.) × C-6037 (*G.barbadense* L.)), the L-27 line, promising in a number of indicators, was identified. In order to improve the early ripeness and technological qualities of the fiber, the selected line was backcrossed with the Tashkent-6 variety.

The obtained results showed that hybrids retain relative wilt resistance, expressed in the mixed infectious background. Backcrossing of the line L-27 allowed to enrich the gene pool with forms characterized by a number of economically valuable traits. The results of the study of the wilt resistance of introgression lines are shown in (*Table* 2).

Table 2. – Estimation of severity and incidence of wilt disease in the introgressive hybrids on the mixed background

Introgressive hybrids	**Incidence of wilt disease (according to the wilt disease severity),%**			
	0	**1**	**2**	**3**
L-27FB_1 [(F_3 Tashkent-6 × C-6037) × Ташкент-6]	62.0	30.0	8.0	–
FB_2	50.5	42.5	7.5	–
FB_3	42.0	48.0	10.0	–

0 – healthy plants, 1 – mildly affected, 2 – moderately affected, 3 – severely affected

The high wilt resistance of *G.hirsutum* L. x *G.barbadense* L. hybrids makes it possible to cultivate highly heterotic in productivity, early ripeness and fiber quality of hybrids in heavily wilt-infected areas, where medium-fiber varieties give very low yields as a result of massive damage. All actual data show that by appropriate selection of more early ripening varieties of medium-fiber cotton and varieties with zero type of fruit branches of fine-fiber cotton, there is a real opportunity to create highly heterotic American-Egyptian hybrids in terms of ripeness, yield, wilt resistance and fiber quality.

Discussion and conclusion

Fine-fiber cotton varieties and interspecific hybrids (*G.hirsutum* L. x *G.barbadense* L.) exhibit high field resistance to Verticillium wilt. In total, wilt disease incidence of fine-fiber varieties, depending on the variety, is 3.8–19.3% versus 25.5–85.9%, in varieties of medium-fiber cotton. In general, wilt disease incidence of the fine-fiber varieties and introgressive hybrids is zero, while for medium-fiber ones it ranges from 10.4 to 40.3%.

Hybrids developed with involvement of fine-fiber varieties were distinguished by a minimum susceptibility to the wilt; therefore, it is advisable to cultivate the early maturing, high-yielding interspecific cotton hybrids on heavily wilt-infected lands.

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MATERIAL ON THE ECOLOGY OF SHIKRA *ACCIPITER badiuS* IN THE LOWER STRETCHES OF THE AMUDARYA

Abstract: The article provides material on shikra's ecology collected in the Lower Amudarya area in 2004, 2005, 2015 and 2016. It also describes the results of research into shikra's distribution, number, breeding biology and diet. The work gives recommendations for the conservation of this bird.

Keywords: shikra, bird of prey, lower stretches of the Amudarya, rare bird, tugai, cultural landscape, rook, carrion crow, jackdaw, tall trees, nest construction, courtship display, egg laying, nestlings, post-embryonic development, useful bird.

1. Introduction

Shikra *Accipiter badius* is a rare bird breeding in Uzbekistan. It usually builds nests in tugai forests, on man-planted tall trees, in orchards, gardens and parks in towns, cities and villages. As well as with other birds of prey, the ecology of this species is little-studied in Karakalpakstan [1; 3; 4; 7].

2. Materials and methods

Material on the ecology of shikra was collected in 2004, 2005 and 2015 in Kegeyli District and in Nukus and its neighbourhood.

Shikra arrives in Uzbekistan, and in the Lower Amudarya areas in particular, in April [8]. The first records of the arrival of shikra were made on 14 April 1967, 21 April 1969 and 18 April 1970 [1]. In the following years the bird was observed at about this time. According to M. Ametov (1993), shikra came to its breeding areas near Nukus on 22 April 1973, 24 April 1974, 28 April 1975, 19 April 1983, 8 April 1985 and 12 April 1986.

3. Results and discussion

According to our research, shikra arrives in Karakalpakstan starting from the second half of April (26 April 2004, 22 April 2005, 16 April 2015, 18 April 2016). According to literary sources, shikra used to arrive in the Middle Amudarya areas between 2 and 10 April [5].

Shikra leaves Uzbekistan starting from September (Karakalpakstan from late August to the end of the first third of September [1, 9]. The departure lasts for a short period. The latest dates shikra was observed near Nukus were 8 September 1973, 20 September 1975, 17 September 1983, 26 September 1986 [4].

We observed the latest individuals in the lower stretches of the Anudarya on 25 September 2004, 23 September 2005, 16 September 2015 and 19 September 2016.

Shikra is quite rare in Karakalpakstan. T. Abdreymov (1981) recorded only two individuals on an 8-kilometre transect. However, in the Samarkand area and Bukhara oasis the birds are far more numerous. So, in Sharikan District 10 nests were recorded on a 15-km survey, 2 nests on a 3-km transect near Vardanza Reserve and 1 nest was registered on an area of 0.6 ha near the Bukhara airport [6].

According to our observations, the density of shikra populations in Karakalpakstan is the following: in April we encountered 1.48 individuals on an area of 10 ha in tugai and 1.2 birds in cultural landscapes. In July, when nestlings learn to fly, the numbers of shikra grows 2 times. At this time of year the average density in tugai is 3.35 individuals per 10 ha, and 2.5 individuals in cultural landscapes.

In 8–10 days after arrival in their breeding areas, shikra begins constructing nests. Thus, the birds that arrived on 26 April 2004 began building nests on 4 May, while those that came on 16 April 2016 began the construction on 26 April.

Generally, shikra builds nests itself, but, according to literary sources, it sometimes uses old ones constructed by other birds, such as rook, carrion crow, jackdaw and black kite [2]. In our observations shikras built 6 nests themselves.

Usually, shikra constructs its nest on a tall tree. According to literary data, the bird builds the nest at a height of 6–15 metres above the ground (most often 7–8 m). In the Zeravshan valley shilra's nests were recorded on acacias (6), willows (3), poplars (2), apricot trees (1) and oleasters (1) [8].

In the tugai of Karakalpakstan shikra usually builds nests on an elm, willow or poplar. The nests we observed were constructed at a height of 8–16 metres (12 m on average).

It takes the bird from 7 to 11 days to build a nest (9 days on average). While building a nest shikra demonstrates a

specific behavior. Male flies in circles above the nest, lowering close to it and returning back into the sky. It accompanies its courtship display with permanent cry.

The material shikra uses in the construction is the dry twigs of various plants, such as Asiatic poplar, willow, elm and poplar. The observed nests (5) had the following dimensions: height 24–31 cm (average 27.5), outer diameter 30–38 cm (34), inner diameter 15–21 cm (18), depth 3–11 cm (7).

After they finish the construction of the nests, they immediately begin laying eggs. According to literary data, shikra arrives in Uzbekistan in early April and begins laying eggs in the end of this month. Most of the eggs are laid in May. According to our research, in 2016 in Karakalpakstan the first eggs were laid on 4 May.

Shikra lays 1 egg in two days, and the laying lasts 5–8 days. In Uzbekistan, a clutch comprises 2–5 eggs [8], in Turkmenistan 3–6 eggs [5], in Karakalpakstan 3–4 eggs (usually 4). Of the six nests we studied 4 contained four eggs, and 2 three eggs.

Usually shikra lays eggs once a year. In case the nest is damaged, it can produce another clutch. However, the second clutch usually contains fewer eggs.

Shikra's egg is oval in form and bluish in colour. The egg (n = 16) has the following dimensions: length 39.0–42.5 mm (average 40.7), width 31.0–32.5 mm (31.7), the weight of a newly hatched egg is 20.4–25.3 g (average 22.8).

Female alone hatches the eggs, while male guards the nest and feeds female. The hatching begins after the laying of the first egg and lasts 29–32 days (average 30.5) According to Mitropolsky et al. (1987), the hatching lasts 30–34 days (average 32.4), while according to M. Ametov (1981), 28–31 days. During the incubation period, the eggs' weight decreases by 5.2% on average.

The chicks emerge within 3–5 days. In the first hours after hatching, the chicks are very weak, and have closed eyes and open acoustic meatus. The body is covered with white neoptile feathers, the bird's weight is 14.4–17.9 g (average 16.1).

In 2005 we studied post-embryonic growth and development in 3 nestlings from one nest (Table 1). The nestlings' eyes begin to open on the second day and become fully open by the end of the first week. The wings begin to grow on the seventh day. The nestlings fledge in 31–33 days. The increase of the size and weight of the nestlings' body and certain organs is provided in Table 1 and (Figure 1).

Table 1. – Development of the body and organs of shikra's nestlings (n = 3)

Nestlings' age, days	Body weight, g	Length of certain organs (mm)			
		Tarsometatarsus	Beak	Wing	Tail
1	16.2	11	5.5	–	–
3	29.6	14.4	6.2	–	–
5	47.2	17.7	6.8	–	–
7	64.5	24.3	8.9	27.1	–
9	92.2	31.2	10.6	40.4	9.4
11	102.2	35.8	11.7	54.1	20.1
13	131.2	41.3	13.1	78.2	39.4
15	135.9	44.2	13.5	86.5	42.2
17	143.5	45.9	13.8	98.5	46.2
19	152.5	47.2	14.2	113.2	54.3
21	167.8	48.3	14.6	123.8	64.3
23	182.9	49.5	15.0	133.7	72.6
25	201.6	51.2	15.4	141.2	79.4
27	220.5	52.0	15.8	150.3	88.4
29	228.2	52.4	16.3	159.1	94.7
31	227.3	52.6	16.8	162.2	98.5

On the first twelve days in the post-embryonic period nestlings grow very fast, and afterwards their growth slows (Figure).

The tables and figure show that on the first day the nestlings' weight was 16.2 g, on the third day 29.6 g, on the fifth day 47.2 g, and on the seventh day 64.5 g. The weight of fledgelings was 210–220 g.

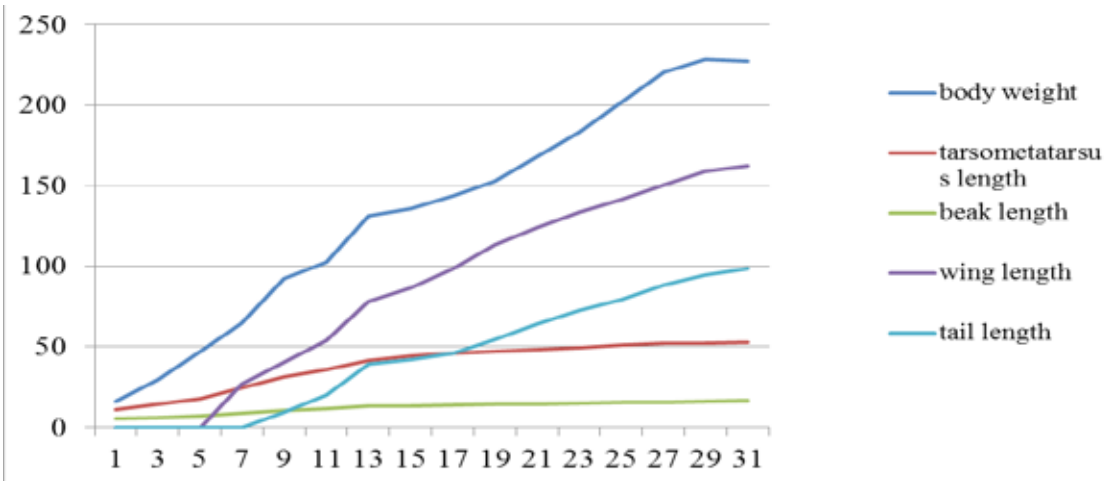

Figure 1.Growth of some of theshikra nestling's organs (n = 3) (g and mm)

In the course of the research we studied the nestlings' diets by comparing their neck ligatures. During the first 8–9 days the nestlings were fed by invertebrate animals. After that vertebrates were added to their diet (Table 2).

Table 2 shows that invertebrates comprise 57.2% of shikra nestling's diet, and vertebrates 42.8%. The invertebrates are dominated by beetles (12%), mole crickets (9.9%), locusts (8.8%) and dung beetles (6.6%). Among the vertebrates the commonest were rapid fingertoed lizzard (8.85%), Indian house sparrow (7.7%), tree sparrow and house mouse (6.6% each), steppe agama and southern booted warbler (5.5% each) and others.

Our research demonstrated the following successfulness of shikra's reproduction in Karakalpakstan: of the 22 eggs laid in six nests 1 was rotten, 2 were thrown onto the ground by wind and three were destroyed by carrion crows. Thus, 16 chicks emerged from 22 eggs (72.7%). However, 3 of the 16 nestlings were taken by humans. The other 13 nestlings (59.09%) developed successfully into fledgelings and left their nests.

Shikra is a useful bird. It is a true adornment of tugai and orchards. Since this species is quite rare, it should be protected in every way throughout its range.

Table 2. – Diet of shikra's nestlings

Food type	Food quantity, № of individuals	%
1	**2**	**3**
Invertebrates	**39**	**42.8**
Beetles	11	12
mole crickets	9	9.9
Locusts	8	8.8
dung beetles	6	6.6
dragonfly	3	3.3
Ants	2	2.2
Vertebrates	**52**	**57.2**
Amphibians	3	3.3
lake frog	3	3.3
Reptiles	16	17.6
rapid fingertoed lizzard	8	8.8
steppe agama	5	5.5
Ablepharus kitaibelii	3	3.3
Birds	24	26.4
Indian house sparrow	7	7.7
tree sparrow	6	6.6

1	*2*	*3*
southern booted warbler	5	5.5
barn swallow	4	4.4
lesser whitethroat	2	2.2
Mammals	9	9.9
house mouse	6	6.6
Tamarisk jird	3	3.3
Total:	**91**	**100**

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THE RESULTS OF ORNITHOLOGICAL SURVEY IN THE SUDOCHYE LAKE SYSTEM (2014–2015)

Abstract: The article contains material collected in the Lake Sudochye area in 2014–2015. The distribution and abundance of the commonest and rarest birds was studied. For the first time in Uzbekistan the authors found the largest breeding colony of flamingos and studied their breeding ecology. Recommendations for the protection and conservation of rare birds are provided.

Keywords: Area description, orders, bird, location, drought, illegal hunting, fishing, Sudochye lake system, Ustyurt plateau, Kizilkum desert.

1. Introduction

The unique geographical location of the Sudochye Lake System, which neighbours the Aral Sea in the south, Ustyurt Plateau in the west, Kizilkum Desert in the east and Amudarya River in the south, accounts for its high degree of biodiversity. Lake Sudochye is an important habitat and nesting place for a number of hydrophilic species of animals and the main resting place for migrating birds on their West Asian migration. Among them there are a number of rare and threatened species of birds.

There up to 230 species of birds have been recorded, with about 86.000 individuals aggregating on the lake shores during migration. It's worth mentioning that in 1999–2005 the number of individuals in some groups of migrating White-headed Ducks was over 4.000, which comprises almost half of this bird's world population [6; 7].

In recent years, the unstable water level, illegal hunting and fishing have led to a significant transformation of the natural habitats of this wetland system. Consequently, the territorial distribution of animal species, including rare and endangered ones, has changed.

The facts stated above confirmed the necessity of carrying out a survey of the lake and marshy territories around it, as well as its practical importance for hunt planning and rational use of biological resources.

Many researchers had run numerous ornithological surveys on this lake [1; 4, 5; 6; 7].

2. Materials and methods

Ornithological research into the Sudochye Lake system, including the Ustyurt escarpments, was conducted in the spring-summer of 2014–2015 (18–27 May 2014 and 12–13 July 2014, 21–25 May 2015 and 16–20 October 2015). The research was carried out using the standard methods of stationary and transect survey [8; 11].

The total length of the car survey was 410 km. The stationary survey was conducted in 134 places; the total duration of the survey was 22 days. The coordinates of all survey places and reference points were recorded using a Garmin GPS navigator.

3. Results and discussion

Area Description. The Sudochye Lake System consists of Big Sudochye, Karateren, Begdulla Aydin and Akushpa which are situated 220 km north-west of Nukus. The area of the lake is 50,000 ha, the depth is 1.0–2.2 m.

At present Sudochye is a group of shallow lakes varying in area and water salinity. The water comes to this wetland from Kungrad and Sudochye drainage canals.

According to our data, the salinity of the lake is almost 6 g/l, and in its far end near Lake West Karateren it reaches 14.01 g/l, with a smell of hydrogen sulphide present.

Birds. The escarpments of the Ustyurt plateau and the desert area around the lake are inhabited by Saker Falcon (*Falco cherrug*), Lesser Kestrel (*Falco naumanni*) and Houbara Bustard (*Chlamydotis undulata*). The first nest of White-

tailed Sea-eagle (*Haliaeetus albicilla*) in Uzbekistan was found in this area [7; 9]. During the spring and autumn migrating large numbers of White Spoonbill (*Platalea leucorodia*), Glossy Ibis (*Plegadis falcinellus*), Night Heron (*Nycticorax nycticorax*), herons from the family Ardeidae, Great White Pelican (*Pelecanus crispus*), Dalmatian Pelican (*Pelecanus onocrotalus*), Pygmy Cormorant (*Phalacrocorax pygmaeus*), Great Cormorant (*Phalacrocorax carbo*), Anseriformes, Flamingo (*Phoenicopterus roseus*), *Numenius, Limosa* and Black-winged Pratincole (*Glareola nordmanni*) can be observed.

During the 2014–2015 survey period in spring, summer and autumn we recorded a total of 111 species of birds belonging to 15 orders and 36 families.

By their behavior 94 species (84.68%) are nesting birds, 16 (14.4%) of which are settled species. The other 17 species (15.32%) are purely migrating ones that do not breed in the area.

Among the mentioned orders of birds recorded in the lake area the commonest are Passeriformes – 42 species or 37.83%, Charadriiformes – 20 species (18.01%), Anseriformes – 11 (9.90%), Ciconiiformes – 9 (8.10%) and Falconiformes – 6 species (5.40%). Together all these 5 orders make up 79.24% of all species of birds. After them come Gruiformes – 4.5%, Pelecaniformes – 3.6%, Podicipediformes and Coraciiformes (2.7% each), Galliformes and Columbiformes (1.8% each). The portion of each of the remaining four groups is less than 1%.

Of the mentioned 111 species, 13 were entered in the Red Book of the Republic Uzbekistan in 2009. They are Great White Pelican (*Pelecanus onocrotalus*), Dalmatian Pelican (*Pelecanus crispus*), Pygmy Cormorant (*Phalacrocorax pygmaeus*), Little Egret (*Egretta garzetta*), White Spoonbill (*Platalea leucorodia*), Glossy Ibis (*Plegadis falcinellus*), Flamingo (*Phoenicopterus roseus*), Mute Swan (*Cygnus olor*), Ferruginous Duck (*Aythya nyroca*), White-headed Duck (*Oxyura leucocephala*), White-tailed Sea-eagle (*Haliaeetus albicilla*), Golden Eagle (*Aquila chrysaetos*) and Great Black-headed Gull (*Larus ichthyaetus*). Dalmatian Pelican (*Pelecanus crispus*), Pygmy Cormorant (*Phalacrocorax pygmaeus*), Ferruginous Duck (*Aythya nyroca*), White-headed Duck (*Oxyura leucocephala*) and White-tailed Sea-eagle (*Haliaeetus albicilla*) are present in IUCN's international list of globally threatened species [10; 12].

On 23 May 2014 for the first time in Uzbekistan we discovered a big nesting colony of Flamingo *Phoenicopterus roseus* in the north extremity of Lake Sudochye, on a small island in a shallow brackish body of water (N43°38.702′ E058°27.087′). We counted about 7,000 flamingos. That is 1.4% of the world population of this bird, as across the world there are about 500 thousand individuals of this bird [10]. Kazakhstan is a home for 50 to 100 thousand birds [2; 3]. The total number of nests found on the island was 2,985, with 2,594 (86.9%) having eggs in them. 391 nests were empty of eggs (13.1%). In 2,570 nests (99.07%) there was only 1 egg, 23 nests had 2 eggs and there was only one nest (0.03%) with 3 eggs.

The nests were built of clay and had round bowl-like shape. The diameter of the bottom was a little larger than the diameter of the hollow. The nests had the following dimensions (n = 17): height – 8.2–51.4 cm, diameter – 37.6–54.3 cm, diameter of the hollow – 17.1–28.7 cm, depth of the tray 3.4–6.4 cm. The eggs were white and ellipsoid. The eggs had the following dimensions (n = 28): 83.0–96.2 × 51.5–59.3 mm, 89.4 × 55.3 mm on average, weight of newly hatched eggs – 129.7–159.6, 144.7 g on average [4].

In 2015 we didn't find any of these nests but we counted 3.000 birds during one day. We suppose that it could be because of the high level of water, as in that year the lake was full. As a result, all islands favorable for the nesting of flamingos were underwater.

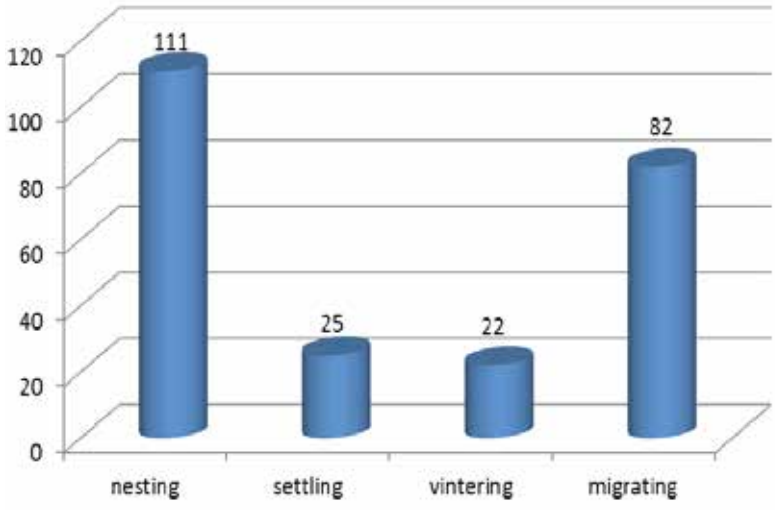

Figure 1. The character of birds staying on Lake Sudochye

Also, a considerable number of aquatic and semi-aquatic birds were recorded on the lake. During the first expedition (May 2014) for one day we recorded 838 Red-nosed Pochards, 237 Great Cormorants, 222 Pygmy Cormorants, 191 Swans, 169 Common Terns, 148 Little Terns and 136 Glossy Ibises. In the course of the second expedition we recorded 340 Great Egrets, 280 Little Egrets, 258 White Spoonbills, 96 Great White Pelicans and 75 Dalmatian Pelicans.

By the end of the autumn survey (16–20 October 2015) the total number of birds recorded near the Sudochye Lake system reached 159.649.

Based on the survey data, the following aquatic and semi-aquatic birds can be regarded as numerous. On 17 and 18 October during one day we recorded 103 Great Crested Grebes, 154 Great Cormorants, 100 Pygmy Cormorants, 200 Garganeys, 1.000 Common Pochards and 350 Black-Headed Gulls. The most numerous were Red-Crested Pochards and Coots, as during one day we recorded 30.000 Red-Crested Pochards and 40.000 Coots.

As we analysed literary data and the results of our survey we came to the conclusion that at present the Sudochye Lake System is inhabited by 240 species of birds belonging to 18 orders and 48 families. Among them 113 species are hydrophilic, 111 nesting, 22 wintering, 25 non-migratory and 82 transient (Figure).

The birds are divided into the following orders; Podicipediformes-5 species, Pelecaniformes-4, Ciconiiformes-10, Phoenicopteriformes-1, Anseriformes-24, Falconiformes-21, Galliformes-3, Gruiformes-7, Charadriiformes-56, Columbiformes-7, Cuculiformes-1, Strigiformes-3, Caprimulgiformes-2, Coraciformes-4, Upupiformes-1, Apodaformes-1, Piciformes-2, Passeriformes-88.

As usual, the list includes vulnerable, rare and near-extinct species of birds present in the Red Book of Uzbekistan and IUCN. They comprise 28 species [12].

The main threats and problems in bird protection. The shores of Lake Sudochye are not inhabited by people, except for single fishing teams.

Drought is the main limiting factor constantly affecting on the lake. The existence of all components of biodiversity here is completely dependent upon the water volume.

Illegal hunting is one of the more crucial factors for wildlife, especially for birds. Year after year the lake attracts the increasingly large numbers of poachers who hunt aquatic birds and cut shrubs for fuel, which causes some threat to the fauna and flora.

Fishing is conducted using illegal types of fishing nets, which results in the death of many diving aquatic birds.

Based on the analysis of our material and other data we recommend that conditions should be created for adequate water supply to Lake Sudochye for flamingoes and other rare birds (White-headed Duck, Great White Pelican, Dalmatian Pelican, Mute Swan Glossy Ibis and others) to use them as breeding areas. We also recommend that birds be treated with care, their nests be protected and poaching control become stricter.

The Sudochye Lake System must be included in the list of Ramsar bodies of water, as it meets all the requirements of the Ramsar Convention. We also hope that, as a result, this will attract more of the Government's attention towards the protection of the lake.

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THE BRIEF HISTORY OF THE STUDY OF SPIDERS (ARACHNIDA: ARANEAE) IN FERGANA VALLEY

Abstract: The spiders of Uzbekistan comprise 221 taxa of species ranks belonging to 118 genera and 32 families. They differ from each other in their external structure and distribution of various biotopes. The information of different researchers about species of spiders found in Uzbekistan are different. A variety of indicators can be explained by the fact that the arachnofuna of Uzbekistan has not been studied sufficiently, and the scientific arguments about spiders are outdated.

Keywords: Spiders, Uzbekistan, Fergana Valley, Central Asia.

Fergana Valley is a territory surrounded by the Kurama and Chatkal mountain ranges in the north-west, Fergana mountain ranges in the north-east, Turkistan and Alay mountain ranges in the south. The nature, relief, fauna and flora are distinguished from the other ecological areas.

Though the faunistic scientific investigations began at the end of the XIX century in the area, the planned studied have not been organized or have not been ended. Mainly, the information about the arachnofauna is so scant in the Fergana Valley that the zoologists are put the aim to study the arachnofauna of the area biologically, morphologically, biogeographically and bioecologically in the systematic order.

The arachneological studies have had a long history. However, in comparison with some other areas the study of arachnids in Uzbekistan, including in the Fergana Valley is relatively low.

The founder of the investigations of the arachnids in Uzbekistan was A. Kroneberg [10]. He used the materials of the work "Journey to Turkistan", collected by A. P. Fedchenko in Turkistan area and discovered 146 species of the spiders. He noted only 127 species of spiders existing in Uzbekistan. 50 years later D. E. Charitonov [5] found out 37 species of spiders in the area. According to the research of N. Ergashev [6] on the bases of the method of the biological predictions there is an assumption that the quantity of species of spiders in Uzbekistan is nearly 700. However, the arguments of N. Ergashev did not have any substantiation.

There is no enough information about the total quantity of spiders in the territory of Uzbekistan. Using the international catalogue of spiders [37] we made the list of spiders, inhabiting in the territory of Uzbekistan and in Central Asia. It became known that the total number of species of spiders in Uzbekistan is 221. Among them 63 (28.5%) species of spiders of 22 families inhabit in the territory of Uzbekistan. One hundred and 32 (59.7%) species of spiders are named differently by the various researchers. Of 221 spider species, 89 (40.3%) of them have a single holotype or paratype.

Analyzing the inhabiting areas of spiders, we can maintain that in the Fergana Valley there are 33 species of spiders of 28 genera and 18 families.

In the study of the species of spiders spread in the territory of Uzbekistan and the historical dates of the conducted research we obtained the following information. The first representatives of 221 species of the spiders in Uzbekistan were introduced into the science in 1757(*Alopesosa trablis, Pxillon-eta sisiphua*), 5 species (2.26%) from 1757 till 1800.83 species (37.55%) from 1800 till 1900.87 species (39.36%) from 1900 till 1990.46 species (21.26%) from 1990 up to present.

As it is seen, the study of the spiders was accelerated within the period of 1900 and 1990. We can cite as an example the scientific studies of S. A. Spasskiy, M. P. Dunin, D. Y. Charitonov, A. B. Tanasevich, S. L. Zonstein, A. B. Nenilin, Y. M. Marusik and A. S. Utochkin [3; 8; 9, 11; 12; 18; 20; 26; 27; 28; 29; 32; 36].

Especially the research, conducted by D. Y. Charitonov during his expeditions to Uzbekistan, made a great contribution to the replenishing of the data.

The researchers, mentioned above, gave the information about the structure of the population in the biocoenosis, the growth dynamics and the distribution of the spiders. A. Kroneberg [10] studied the distribution of the spiders in the areas, while D. Charitonov [5] was engaged in discovering the new species of spiders in Uzbekistan. N. Ergashev [6] paid attention to the study of the venomous spiders and adduced 18 species of them in Uzbekistan.

Analyzing the sources we observed the differences in the areas of distribution of the spiders. Mainly, the families of *Linyphiidae, Lycosidae, Salticidae* are met in the mountains [4; 5; 10; 13; 15; 17; 30; 31; 33; 34]. The spiders of families *Araneidae*, *Corinnidae, Dictynidae, Palpimanidae* inhabit

in the foothills and plains [4; 5; 21; 22]. The species of spiders of the family *Gnaphosidae* are spread both in mountains and plains [5; 10; 25; 38]. The quantity of the spiders in the steeps is low and they belong to the families of *Philodromidae, Salticidae* [14; 16]. However, there are some species, which can be met in the mountains, plains and steeps. For example, to these species of spiders belong *Synaphosus turanicus* of the *Gnaphosidae* family, studied by Ovsharenko, Levy and Platsnik in 1994 [24], Marusik and Fomichev in 2016 [19]. There is no information about the species inhabiting in the riparian woodland. The only information was given about the species *Zodarion bekuzini* of the family *Zodariidae,* found in the damp places [23]. The discovery of the species of spiders *Ipa spasskyi* of the family *Linyphiidae* by Tanasevich in 1986 in the areas of the Aral Sea give the possibility to deduce the distribution of the species in the damp areas too.

Furthermore, there is information about the distribution of the species of spiders of the families *Sparassidae, Theridiidae, Thomisidae, Zodariidae* in the regions of Uzbekistan, however the exact ecological area was not shown [1; 2; 5; 10].

In the study of the biological and ecological data about the spiders the information on the areas is rather scarce.

We did not find the information about the distribution of the following species of the spiders in the territory of Uzbekistan such as *Argiope ahngeri* from the family ***Araneidae***, *Leviellus caspicus, Zygiella montana, Clubiona juvenis* from the family ***Clubionidae***, *Dysdera subcylindrica* from the family *Dysderidae, Micaria coarctata* from the family ***Gnaphosidae***, *Acartauchenius monoceros* from the family ***Linyphiidae***, *Oxyopes globifer* from the family *Oxyopidae*) *Nita elsaff* from the family ***Pholcidae***, *Aelurillus nenilini* from the family ***Salticidae***, *Chalcoscirtus kamchik, Logunyllus validus, Pellenes allegrii, Plexippus strandi, Rudakius afghanicus, Theridion genistae* from the family ***Theridiidae***, *Xysticus ninnii* from the family ***Thomisidae***, *Titanoeca lehtineni* from the family *Titanoecidae, Trachelas minor* from the family *Trachelidae*.

It is difficult to adduce arguments about the endangered species because of the insufficient information on the spiders' biology and distribution. In spite of it, the species *Latrodestus tredesimguttatus* of the family Theridiidae (Rossi, 1790) was included in the Red Data Book of the Republic of Uzbekistan [35].

In the survey of the literature there are no contradicting materials. On the contrary, the data about spiders complement each other. Especially, the information of Kroneberg completed the information, given by Charitonov, while Tanasevich complemented Charitonov's survey. The differences found out in the survey of one species of the spiders also complement each other. It is clearly seen from the range of synonymous names of the spiders.

The survey of the literature has shown that the fundamental studies of the arachnids were conducted in Uzbekistan, mainly in Fergana Valley. According to it, we have the following tasks:

– To systematically study the widespread spiders in the territory of Fergana Valley;

– To conduct the planned seasonal monitoring of the species and to biogeographically study them;

– To increase the data on the field, studying the biology of the territorial spiders;

– To reveal the place of the spiders in the natural and artificial ecosystem;

– To find out the endangered species of spiders, to reveal the factors of decreasing the species of the spiders and to work out the scientific approach to avoid the decrease.

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INFLUENCE OF HYPOBARIC HYPOXIA ON THE CEREBROSIDES AND SULFATIDES COMPOSITION OF RAT CARDIAC TISSUE

Abstract: The purpose of the study was to analyze the qualitative and quantitative composition changes of cerebrosides in the cardiac tissue in the process of its adaptation to chronic hypobaric hypoxia. The experiments were carried out on white rats, males, hypobaric hypoxia was reproduced by "lifting to a certain height" in a special chamber. Increase in the number of total cerebrosides and the absolute content of sulfatides was observed during adaptation to chronic hypoxia of various intensities.

Keywords: hypobaric hypoxia, cerebrosides, sulfatides, cardiac tissues.

Today, the main cause of morbidity, disability, and mortality in the world are cardiovascular diseases. They are the prime cause of death among industrialized countries population, being cause of approximately 30 to 50% deaths [8].

Diseases progression severity, as well as their outcome is ultimately determined by the characteristics of secondary nonspecific metabolic diseases, as well as the degree of destabilization of cell membranes suffering from hypoxic conditions. A wide variety of human diseases cause hypoxia which is considered the most universal pathological condition. Hypoxia determines severity of ischemic heart disease due to the fact, that it is the main pathophysiological feature of various cardiovascular diseases [10].

Recent studies of the pattern and progression of pathological processes related to cardiovascular hypoxia, indicate that changes in the structure and function of cell membranes is an important link in understanding the manifestation of this pathology [4, 7]. In many cases, the cause of these conditions is the violation of the integrity of the lipid phase of the bilayer membrane, which shows the importance of lipids in the pathogenesis of hypoxic states [11]. Cell membranes have an extremely complex composition and structure, due to participation in a wide range of cellular processes. Sphingolipids, glycerolipids and sterols are the main component of these membranes, but their chemical structure, physical properties and specialized enzymatic mechanism differ from other lipids. They are one of the most diverse types of lipids in chemical structure and biological function. This category includes hundreds of compounds with the sphingoid base as a common fragment. The recent interest in studies of the selected sphingolipids categories role, which are sulfatides and cerebrosides, is attributed to a number of properties of these lipids. Due to this interest, our understanding of the functions and metabolism of cerebrosides has significantly increased over the past few years. Their participation in the regulation of the physical properties of cell membranes, the activity of membrane enzymes and signal proteins has already been proven. However, little is known about in various pathologies that cause disorder in their homeostasis [5, 9, 12].

The purpose of this study is to investigate the effect of hypobaric hypoxia on the content of the total amount and percentage of cerebrosides and sulfatides in the heart tissues of experimental animals.

Materials and techniques. The experiments were carried out on outbred adult male rats weighing 250–280 g. Hypobaric hypoxia was caused in animals of the experimental group

by the daily 4-hour exposure in hyperbaric chamber [1] for 10 days. The pressure in the chamber was 462 mm Hg for the first group ("height" of 4000 m above sea level), 405 mm Hg for the second ("height" of 5000 m above sea level), 354 mm Hg for the third ("height" of 6000 m above sea level), and 308 mm Hg for the fourth ("height" of 7000 m above sea level). The control group of animals was kept under normal conditions in animal quarters. Animals were killed by the method of decapitation. The extracted hearts were weighed and homogenized in liquid nitrogen.

Extraction of total lipids and their purification from non-lipid impurities was carried out according to the Folch extraction procedure [6] modified by Kates [2], using chloroform-methanol mixture (2:1). Extraction was carried out in 60 minutes, at room temperature, during the extraction; the contents of the flasks were occasional shaking. The technique allows sufficiently complete (98–100%) extraction of tissue lipids. Total lipid extract (TLE) was stored at 0–4 °C and used to measure the amount of lipids and their fractionation. The amount of total cerebrosides and their individual fractionations was determined by the galactose content, which was determined according to the method proposed by Radin and associates, in combination with the method of Svennerholm [3].

Results and discussion. The literature shows that prolonged exposure to hypoxic conditions causes the occurrence of adaptive changes at various levels of cellular structure in both humans and animals to allow maintenance of the required homeostasis level under oxygen starvation [11].

Our research has shown that hypobaric hypoxia led to an increase in the number of total cerebrosides (Figure 1.) and changes in the content of individual fractions (Table 1.).

Table 1 shows a clear trend of increase in the total number of cerebrosides in the heart of animals subjected to hypoxia, although these changes were not always statistically significant ($P \geq 0.05$). The first group and the second group had a slight increase in the total content of glycolipids in the heart by 1.1% and by 1.5% respectively. The total cerebrosides content was significantly different from the control in only 3 and 4 groups (10.61 and 10.68 mmol/kg of raw tissue versus 90.90 mmol/kg in the control group).

Table 1. – Total cerebrosides content changes in the tissues of the heart during hypobaric hypoxia (galactose mmol/kg of tissue, n=12)

	Total cerebrosides content					
	Absolute values	**% vs control**	**T**	**T**	**T1**	**T3**
Control group (n =12)	9.90 ± 0.27					
Group I (гипоксия 4000 м, n=12)	10.01 ± 0.25	101.11	0.30			
Group I (гипоксия 5000 м, n=12)	10.05 ± 0.25	101.52	0.41	0.11		
Group I (гипоксия 6000 м, n=12)	10.61 ± 0.22	107.17	2.04	1.80	1.68	
Group I (гипоксия 7000 м, n=12)	10.68 ± 0.18	107.88	2.40	2.17	2.05	0.25

Table 2. – Changes in the cerebrosides content in the tissues of the heart after 10 exposures to hyperboric hypoxia for 4 hours (cerebroside mmol/kg of raw tissue, n=12)

	Sulfatides		Cerebrosides	
	Cerebroside mmol /kg of raw tissue	%	Cerebroside mmol /kg of raw tissue	%
Standard	2.66±0.08	26.86	7.24±0.19	73.14
4000 m	2.94±0.08	29.39	7.07±0.17	70.61
5000 m	3.03±0.09	30.16	7.02±0.14	69.84
6000 m	3.52±0.10	33.19	7.09±0.13	66.81
7000 m	3.60±0.06	33.70	7.08±0.12	66.30

In order to study this process deeply, we created fractional separation of cerebrosides and sulfatides in our experiments by the means of thin-layer chromatography. Data in table 2 shows the similarity in nature of the changes observed in the glycolipid fractions. An increase in the relative content of the sulfatide fraction can be seen in all groups; the sulfatide fraction increased by 10 and 13% respectively in groups with moderate hypoxia (4000 and 5000 m), whereas, the increase in sulfatide was 32 and 35% in groups with intensive hypoxia (6000 and 7000 m). A decrease of cerebroside content (both percentage and absolute) was detected in the fraction of cerebroside, regardless of the intensity of hypoxia.

The literature shows that the quantitative ratio of cerebrosides and sulfatides depends on the activity of enzymes of the glycosidase group, in particular, galactocerebroside-3-O-sulfatase, which catalyzes the abstraction of the sulfatide group

from galactose residues in sulfatides, and thereby maintains the balance between these compounds. The detected increase of sulfatides in these pathologies indicates that the activity of this enzyme is suppressed in these cases, which ultimately leads to the accumulation of sulfatides in the cell membranes [8].

Therefore, the results of the conducted study allow us to conclude that the cerebroside composition of the cardiac tissue undergoes a change, which is in direct correlation with the intensity of hypobaric hypoxia.

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MORPHOFUNCTIONAL INDICATORS IN CHILDREN IN THE CONDITIONS OF SOUTHERN ARAL SEA REGION

Abstract: This article studies the state of functional indicators of children in various ecological zones of the South Aral Sea region. The analysis of the erythron system in children living in this region was performed.

Keywords: Southern Aral Sea Region, morphofunctional indicators, blood-vascular system.

One of the integrative systems that allow monitoring shifts at different levels of functioning is the blood-vascular system. Children have an increased sensitivity, which determines not only their health, but also influences the further morphofunctional development of children and adolescents. At present time, most effective way to assess the state of the body according to the state of the blood-vascular system. The main goal of this research was to study the indicators of the erythron system of children that live in adverse environmental conditions of the Southern Aral Sea Region.

Change of environment causes an increase or decrease of the amount of bone marrow production in organism, depending on its needs in red blood cells.

Individual adaptation is a process that develops in the course of life, as a result of which the body acquires resistance to environmental factors and is able to live in conditions previously unsuitable for life.

Many researches [1; 2; 3] have proven that along with genetic factors, environmental factors have a great influence on the development of children. The scientific merit of researches of the physical development of children has increased in particular in recent years [4; 5]. The acceleration process has slowed down considerably or even stopped, deeming a new scientific research necessary.

Numerous data shows that there was a decrease in the indicators of physical development and the state of health of certain groups of children in the past two decades [6]. Moreover, the specification of the situation in terms of timely and reliable information about the state of physical development of children and adolescents is necessary for the organization of preventive work.

The physical development of children and adolescents is currently being studied in various directions, and one of the most topical is the issue of studying its characteristics in adverse environmental conditions, for example, in the Southern Aral Sea Region. The study of the functional status of children and adolescents in different geographical areas of the Southern Aral Sea region will ultimately provide a broader systemic approach in the organization of preventive work to preserve the health of the population.

The study of adaptive reactions of children is determined by the ability to diagnose and predict the development of the disease at the prenosological level and carry out preventive and curative measures more successfully [7; 21].

Children have potentially more opportunities to adapt to different climatic and geographic conditions, if their actions do not go beyond the limits of biologically determined boundaries. Therefore, at an early age, the children's body is more labile, meaning that new ecological and social conditions can significantly affect the state of the functional systems of the body, including the erythron system, which manifests itself in various quantitative indicators of the cardiovascular system [8; 14].

In order to properly assess a child's condition, to make a clear diagnosis and to timely detect abnormalities, it is necessary to know the peripheral blood composition of healthy children of all ages, due to the fact that each age period has its own specifications. There is no doubt that when evaluating peripheral vascular system, one should use standards, which are designed for children based on their age and climatic conditions, which have a definite influence on the composition of the peripheral vascular system of a child [11; 13].

Analysis of the obtained parameters of the red blood of the examined adolescents showed that the characteristics of the cellular composition of the peripheral blood mainly follow the laws studied in detail and well known in the literature [10; 22]. In relatively healthy children living in Karakalpakstan, although the number of red blood cells did not go beyond the physiological norm, it was close to its lower limit [16]. In addition, it was found that in 13–14 years old boys, the

number of red blood cells is higher than that of 15–16 years old, and in the group of 10 years old children, this number was significantly lower than that of 8 years old ($p < 0.05$). The hemoglobin concentration (Hb) in the healthy children we examined was at the upper limit of the physiological norm and did not have significant differences depending on age and gender.

When studying the incidence of diseases of the upper respiratory tract in the examined children, it was found that such pathologies as tonsillitis and acute bronchitis are more common [18]. Considering that the respiratory and blood-vascular systems are aimed at performing one function – supplying oxygen to tissues, we tried to find out the effect of respiratory diseases in children on the blood-vascular system.

Examination of children suffering from diseases of the upper respiratory tract has shown that the number of red blood cells and the concentration of hemoglobin do not go beyond the indicators of healthy children. It was found that in 15 year old boys of 15 years the number of erythrocytes is significantly higher than in 13 and 14 years old children ($p < 0.05$), and the concentration of hemoglobin in 14 year old boys is higher than in 15 year old children ($p < 0.05$). The average content of hemoglobin in the erythrocyte in children with diseases of the upper respiratory tract does not go beyond the physiological norm, since this indicator is more determined. The average hemoglobin concentration in the erythrocyte in children suffering from respiratory diseases is lower than in healthy children in the same region. Apparently, this is due to an increase in the volume of erythrocyte cells in sick children.

In summary, changes in the erythron system are observed in the examined children, which, for the most part, do not depend on the type of disease and are determined mainly by the direct presence of the pathological process. The most pronounced changes are in the average volume of the erythrocyte and in the average concentration of hemoglobin in the erythrocyte. This fact points to that, in any disease of the respiratory organs, compensatory mechanisms are activated to increase the supply of oxygen to tissues, since, in the opinion of Agadzhanyan et al. (1990) an increase in the average volume of the erythrocyte cell leads to an increase in the respiratory surface of the erythrocyte, and, consequently, a better supply of oxygen to the tissues. The erythron system is sensitive to changes in the oxygen supply and plays a large role in the transport of oxygen from the lungs to all cells of the body and the transfer of carbon dioxide from the tissues to the lungs.

Therefore, on the basis of the conducted research the following conclusions can be drawn:

1. The environmental conditions of the Southern Aral Sea Region cause issues in the regulation and the very function of erythropoiesis, as well as lead to unfavorable functioning possibilities of both the hematopoietic apparatus and the erythron system.

2. In diseases of the upper respiratory tract, an increase in the average red blood cell volume is noted with a simultaneous decrease in the average concentration of hemoglobin in the red blood cell.

3. Changes in the erythron system parameters in the examined children under the environmental conditions of the Southern Aral Sea Region are one-directional, regardless of the type of diseases.

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GENETICS – BREEEDING ASPECTS OF THE INTERSPECIES HYBRIDIZATION

Abstract: The results of the experiments showed that the greatest productivity of cotton is formed in hybrid offspring obtained with the participation of interspecies hybrids. During the cleavage from hybrid progeny, the transgressive individuals are more easily split into individual or complex of features, and in F_3–F_4, the probability of separating families and forms with a partially fixed heterosis by one or another quantitative trait appears.

Keywords: cotton, wild species, cultivated varieties, interspecific hybridization, resistance genes, donors, hybrids.

Searching for new initial material is one of the main tasks of the modern breeding. Remote and interspecies hybridization is one of the real sources for new living forms.

Wild species are involved in hybridization in order to give modern varieties such qualities as strength and toning of fiber, resistance to agricultural pests, verticillium and fusarium wilt, resistance to stress factors of the environment.

Over the past 30 years, the laboratory of Genetics of Plant Productivity and Plant Adaptability in the Institute of Genetics and Plant Experimental Biology, Uzbek Academy of Science has conducted studies on the creation of a collection of lines and forms of medium resistant to stress factors (heat, salt and drought resistance). This collection includes about 40 different lines, created on the basis of interspecies hybridization from crossings of wild species with cultivated varieties. As species-carriers of unique resistance genes were 6 species; *G.thurberi* Tod., *G.raimondii* Ulbr., *G.stocksii* Mast., *G.anomalum* Wawra et Peur, *G. arboreum* L., *G. harknessii* Brang.

For example, *G.thurberi* Tod. (D_1) is a wild kind of American cotton, it is frost-resistant, able to grow at low temperatures, is resistant to the box worm and wilt. When crossed with cultivars, hybrids produce forms with high technological parameters of the fiber.

G.raimondii Ulbr. (D_5) is a wild species of American cotton. Thanks to the strong leaf opacity, it is resistant to sucking

pests, has a thin, durable, high-yield fiber. Seeds have a fairly high percentage of oil. Has increased drought resistance.

G.anomalum Wawra et Peyr (B_2) is a kind of African type of cotton, adapted to the conditions of low water availability, has a very thin, elastic fiber, is resistant to piercing sucking pests, easily crossed with many species, gives a wide variety of genetic forms with useful economic – valuable features.

G.sturtii Mull (C_2) is a wild Australian type of cotton. Resistant to wilt and sucking pests, as well as to conditions of increased salt-supply. It has a fiber with increased strength and fineness.

G.harknessii Brang (D_2–2) is a wild species of American cotton. Bracts of this species fall long before the opening of the capsules, the period from flowering to maturation is very short (40–45 days), characterized by high wilt stability. This species is used in crossings as a donor in breeding varieties with a natural wound by deciduousness.

Table 1.– Improvement of economic-valuable traits in the generations of interspecies cotton hybrids

№	Hybrid combination	Genomic constitution	Fiber output (%) X ± x	Technological properties of fiber		
				Fiber length (mm) X ± x	Specific breaking load (G / tex)	Micronaire (Mic)
1.	F_1 (*G.thurberi* × × *G.raimondii*)	$2(D_1 D_5)$	25.4 ± 0.42	23.1 ± 0.21	23.3	4.8
2.	F_2 (*G.thurberi* × × *G.raimondii*) freely flowering	$2(D_1 D_5)$	31.7 ± 0.31	27.4 ± 0.36	28.3	4.5
3.	F_3 (*G.thurberi* × × *G.raimondii*) freely flowering	$2(D_1 D_5)$	31.9 ± 0.64	32.1 ± 0.24	37.1	4.0
4.	F_3 (*G.thurberi* × *G.raimondii*)] × C-4534	$2(D_1 D_5)(AD)_1$	36.9 ± 0.41	33.1 ± 0.36	27.9	3.8
5.	F_3(F_1*G.hirsutum* × × *G.anomalum*) × *G.harknessii*	$(AD)_1 B_1 D_{2-2}$	37.4 ± 0.44	31.5 ± 0.28	31.0	4.5
6.	F_3 (F_1*G.hirsutum* × × *G.sturtii*) × C-4880	$(AD)_1 B_1 C_1 (AD)_1$	32.1 ± 0.64	29.0 ± 0.33	34.9	3.9
7.	F_3 (F_1*G.hirsutum* × × *G.anomalum*) × *G.raimondii*] × C-4534	$(AD)_1 B_1 D_2 AD)_1$	30.4 ± 0.64	31.5 ± 0.37	31.0	4.5
8.	F_2(F_1*G.arboreum* × × *G.thurberi*) × × Acala-4–42	$A_2 D_1 (AD)_1$	24.0 ± 0.48	25.0 ± 0.32	38.3	5.7

G arboreum L. (A_2) – a cultivated species of Indo-Chinese cotton, possesses high resistance to viticulture, fiber strength, the ability to form offspring with a strong variability of traits, is a good basis for creating new varieties of cotton. It should be noted that in all these species, when crossing them with varieties of medium-fibrous cotton in the hybrid progeny, there is a very large transgressive variability in the course of which forms-donors-capable of improving the selectable material arise. There are many new forms with different unique characteristics that are absent in parents [1, 205–216; 2, 40–45; 3, 156–160].

However, it is known that it is not so easy to convey these useful properties of wild species to cultural forms. Carrying out such crosses is associated with many difficulties, such as sterility of hybrids, strong cleavage in the offspring, the appearance of harmful properties, along with useful due to the coupling characteristics and other problems.

Taking into account the donor value of wild species, we studied the formative process in this amphidiploid by self-pollination (Table 1, B. 1), free flowering (Table 1, B. 2, 3) and backcrossing with C-4534 variety of tetraploid species (Table 1, B. 4). The offspring of the F_1 F_2 F_3 hybrids, as can be seen, from the averaged characteristics of the fiber yield, the length of the fiber has been improved from generation to generation. B. F_4 (Table 1, B. 4) under the influence of grade c-4534 in the hybrid progeny, the percentage of fiber yield

increased sharply – to an average of 37.4. The yield of fiber in this hybrid population ranged from 21 to 47 percent. A similar pattern was observed along the length of the fiber. The length of the fiber increased from generation to generation and reached a maximum towards the backcrossed generation of F_4(B. 4, Table 1).

In hybrid combinations of complex hybrids (F_3 (F_1 *G.hirsutum* x *G.anomalum*) x *G.harknessii*; F_3 [(F_1 *G.hirsutum* × *G.sturtii*] × C-4880; F_3 [(F_1 *G.hirsutum* x *G.anomalum*) × × *G.raimondii*)] × C-4534; F_2 (F_1 *G.arboreum* x *G.thurberi*) × × Acala-4–42) the study of the direction and features of the formation, showed that complex hybrids in earlier populations form valuable economic-useful Signs. Transgressive variability is given, in the course of which donor forms that can improve the selectable material, starting with F_2, arise. The inheritance of traits in interspecific hybrids, to some extent, exceeds intraspecific hybrids. From a theoretical point of view, this can be explained, firstly, the variation of all characters in interspecific hybrids is greater than that of intraspecies hybrids; Secondly, as the genotypic alignment of the population increases, the indicators of heritability of signs decrease in generations, that is, stabilization of hybrids occurs. Consequently, gene transfer into a homozygous state in intraspecific hybrids is achieved earlier than in interspecies hybrids.

As a result of multiple selection and genetic analysis of forms in hybrid populations of F_2–F_{10}, resistance to moisture deficiency, salinity and elevated line temperatures – donors of resistance genes to extreme environmental factors – were isolated. On the basis of these, Gulbahor-2, Navbahor-2, Armugon-2, Sadaf and Gulshan types, combining high seed oil yields with productivity, vitreous stability, fiber quality, adaptation to the conditions of water deficiency of salt redundancy.

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DISTRIBUTION AND SEASONAL DYNAMICS OF SOIL COLLEMBOLAN IN THE SOILS OF SOUTHERN REGIONS OF UZBEKISTAN

Abctract: The amount and type of collembolans hve researched in the 0–30 cm of wheat agroocenosis soil of the Kashkadarya region of Uzbekistan. There are clarified 30 types and 26 generations of collembolans including, their belonging for 5 families. Also, here is observed, the variation and types of collembolans in summer season, actually on July will be higher than winter and spring saeason.

Keywords: collembol, agroocenos, soil, seasonal dynamics, pattern, wheat.

Introduction

Footsteps or collembol-insects belong to Insesta's class, collembols – Collembola. They are very widespread on the earth and spread to tropical forests, from algae and lycutelaceous to all kinds of soil and vegetation. Their range of land, high mountains and plains, also occur in mountaineering mountains. Even in the frozen ground of the earth. Their place of residence is mainly the upper layer of soil where organic material is collected [1; 2]. The legs are widely used in the humusous and mineral-rich part of the soil layer and can reach up to 1.5 to 2 meters deep in the conditions favorable for them. In addition, legumes have been shown to be active in increasing soil fertility and soil formation [3; 4]. The size of all scarves is about 1 mm in diameter, the smallest is 0.2 to 0.7 mm, and the largest one is 5 to 9 mm long. Their bodies are closer to typical insects, with their three-legged joints. They are of great importance in increasing the amount of humus soil. In addition, collembola acts as an indicator for the detection of environmental degradation in anthropogenic zones, such as other microorganisms. Therefore, learning them is one of the most important tasks [6].

Materials and methods

Soil samples for the study of collembolans Samples from the soil layers of wheat agrocoenosis of Kashkadarya region in December 2017, April and June 2018 were obtained. Soil samples 0–10 cm, 10–20 cm, 20–30 cm. 5 samples were taken from the soil layer 1 dm^3. The soil samples were used in collecting collembolans – Berleze-TulgrenaThe essence of this device is that the smaller soil in the soil is moved down the hill as the soil samples drawn on the varonge down the top. Then the fixer falls into a container of 70–80 ° ethyl alcohol. Small collaterals falling into the collector container are inserted into the petri dish and collected and harvested under a DN-300M binocular microscope. Subsequently, continuous preparations were prepared to determine their species composition [6; 7]. The obtained results were statistically processed. Agoschemical analysis of humus and mobile nitrogen, phosphorus, and potassium content of soil samples of wheat agrosenases of Kashkadarya region. According to the agrochemical analysis of the cultivated soil, the amount of humus in the sown of wheat in Kashkadarya region. According to the agrochemical analysis of the cultivated soil, the amount of humus in the sown of wheat in Kashkadarya region is 2.75%, which is determined by average amount of soil humus (1 table). Characteristic of nitric acid wheat is the double soil spp. 6.75 mg/kg, 14.0 mg/kg, potassium microbes, 103 mg/kg, containing nitrogen, phosphorus and potassium oxygen.

Table 1.

Example №	Thickness of film	The humus%	Inactive, mg / kg		
			$N\text{-}NO_3$ mg / kg	P_2O_5 mg / kg	K_2O mg / kg
Wheat Kashkadarya	0–30	2.75%	6.75	14.0	103

Guzar district of Kashkadarya region is wheat agroocenosis of soil layers 0–10, 10–20, 20–30 cm. up to 660 cm up to 10 cm in layers, up to 1880 cm in layers up to 0–10 cm in the summer and up to 20–30 cm in layers, up to 1 m^2 per

1 m² in winter an average of 2380 exemplary collembolans were detected. In April, in the spring of 0 to 10 cm in the soil, 1820 exemplary, in the 10 to 20 cm layers, that is, 3300 exemplary on the average wheat agroocenosis soil per 1 m². In layers between 20 and 30 cm, 2100 exemplary were seen.

Table 2. – Seasonal dynamics of collembol levels in soisl substrates of wheat agrocenes in Kashkadarya region

Soil layers	December	April	June
0–10 cm	660*	1820	460
10–20 cm	1880	3300	5220
20–30 cm	2380	2100	4300
Total	2280	2420	12380

In June, it was found that in the depths of 0–10 cm in the soil 460 exemplary, in layers 10–20 cm in the layers of 5220 exemplary, and in the 20–30 cm layers, average 4300 exemplary collembolans per 1 m² (Table 2).

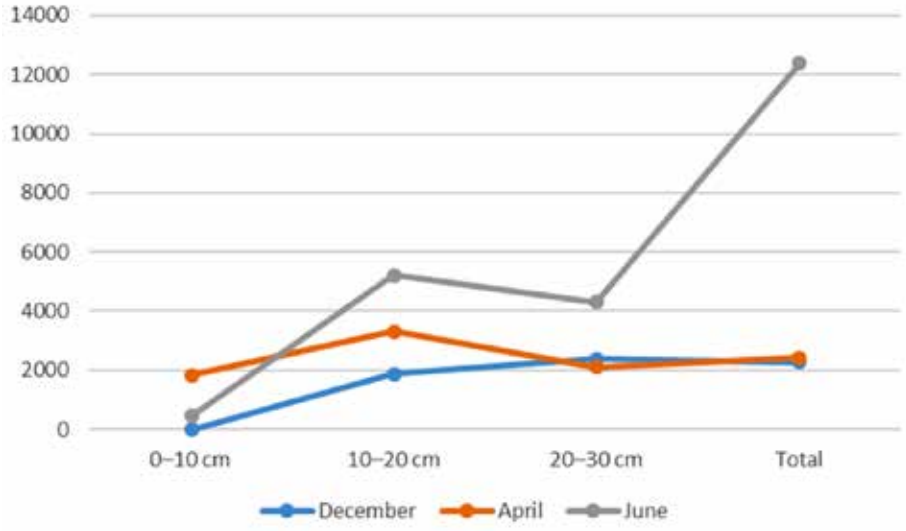

Figure 1.

Also, here is observed, the variation and types of collembolans in summer season, actually on July will be higher than winter and spring saeason. As a result of the study of the species' composition, colleagues studied the occurrence of aggregation of wheat agroocenos in the Kashkadarya region in aggregates of 0–10 cm, 10–20 cm, 20–30 cm in total 30 species, 26 generations and 5 family collembolans groups (Table 3).

Table 3. – Collembolans species of wheat agrocenos in the soil layers

№	Tours	Wheat Agrocenos								
		December			April			June		
		0–10 cm	10–20 cm	20–30 cm	0–10 cm	10–20 cm	20–30 cm	0–10 cm	10–20 cm	20–30 cm
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1.	Family: Hypogastruridae *Achorutes inermis* Tulberg, 1871.			+					+	+
2.	*Triacanthella michaelseni* Schaffer, 1897.					+			+	+
3.	*Achorutes ununguiculatus* Tullberg, 1869.				+	+		+		
4.	*Achorutes viaticus* Tullberg, 1872.	+	+						+	+
5.	*Willemia anophthalma* Borner, 1901.				+			+		

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
6.	*Xenylla maritima* Tullberg, 1869.	+	+						+	+
7.	*Xenylla affiniformis* Stach, 1930.					+		+	+	
8.	*Pseudacherontides zenkevitchi* Djanaschvili, 1971.					+			+	+
9.	Отд: Onychiuridae *Lipura groenlandica* Tullberg, 1876.				+	+			+	+
10.	*Uralia schilovi* Martynova, 1976.	+	+					+	+	
11.	*Lipura armata* Tullberg, 1869.					+			+	+
12.	*Podura ambulans* Linnaeus, 1758.			+	+				+	
13.	*Stenaphorura japygiformis* Absolon, 1900.			+		+		+		
14.	*Tullbergia tricuspis* Borner, 1902.							+	+	+
15.	*Granuliphorura obtusochaeta*Rusek, 1976.							+	+	+
16.	Отд: Odontellidae *Odontella ewingi* Folsom, 1916.				+	+			+	+
17.	*Xenyllodes armatus* Axelson, 1903.				+				+	+
18.	Отд: Neanuridae *Brachystomella maritima* Agren, 1903.						+	+	+	
19.	*Triaena mirabilis* Tullberg, 1871.					+			+	+
20.	*Pseudachorutes suberassus* Tullberg, 1871.	+	+			+		+	+	
21.	*Anurachorutes martynovae* Kuznetzova et Potapov, 1988.		+			+	+		+	+
22.	*Achorutes maritimus* Guren in Lucas et Gurerin 1838.				+	+			+	+
23.	*Micranurid pygmaea* Borner, 1901.							+	+	+
24.	*Grananurida tuberculata* Yosii, 1954.		+	+		+	+		+	
25.	*Achorutes tetrophthalmus* Stach, 1929.					+	+		+	+
26.	*Ghirkanura chernovae* Kuznetzova et Potapov, 1988.		+	+		+	+			
27.	Отд: Isotomidae *Folsovina onychiurina* Denis, 1931.							+	+	+
28.	*Anurophorus laricis* Nicolet, 1842.						+	+	+	
29.	*Isotoma minor* Schafer, 1896.							+	+	
30.	*Isotomodella pusilla* Martyonova, 1968.					+	+		+	+

Conclusion

Thus, according to the data in Table 2, we can conclude that wheat agrocenos in the soil layers was more common in the summer months compared with the winter and spring seasons. Guzar district of Kashkadarya region has studied the presence of 30 species, 26 generations and 5 families collembol coats in wheat agroocenos. Also, here is observed, the variation and types of collembolans in summer season, actually on July will be higher than winter and spring saeason.

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THE ROLE OF NEUROPEPTIDE DERMORPHINE IN THE PROCESSES OF HIGHER NERVOUS ACTIVITY IN FALSE HEAT (HEMIECHINUS AURITUS)

Abstract: The role of neutropened dermorphine in the treatment of upper respiratory tract (Hemiechinus Auritus). In the article, the authors point out that the pelvic dystrophy of the upper nervous activity may have a negative effect on dermorphine injection, in addition to the normal analgesic effect.

Keywords*:* dermorfin, opioids, phelomedusa, refleks, thermoregulation, hibernation, organism, neyropeptids, mammals.

Dermorphin (DM) is one of the most active natural opioids, isolated from the skin of frog Phylomedusain 1980. However, its impact on the behavioral activity of mammals is least studiedtill date. In earlier work [1, 3–5] it has been reported that the introduction of DM to rats is accompanied by a pronounced analgesic effect and change in motor activity. It is interesting to study the effect of DM on conditioned-reflex activity of insectivores – hedgehogs, the lowest organized mammals belonging to the group of hibernating animals.

Methods. The work was performed on 9-year-old hedgehogs on a model of obtain food. In hedgehogs, positive conditioned reflexes, various types of internal inhibition were studied: extinctive, differentiating, delayed in normal conditions, with pathological disorders of higher nervous activity (HNA) and changes in these forms of nervous activity after the introduction of DM. Neurotic changes in hedgehogs were caused by the development of fine differentiation or delayed inhibition with a lag time of more than 30 s. Dermorfin (Serva) with saline was injected subcutaneously at a rate of 0.1 mg/kg immediately, prior to the experiment. At the end of the experiments, the experimental data wasobtained and processed employing accepted statistical methods using student's criterion.

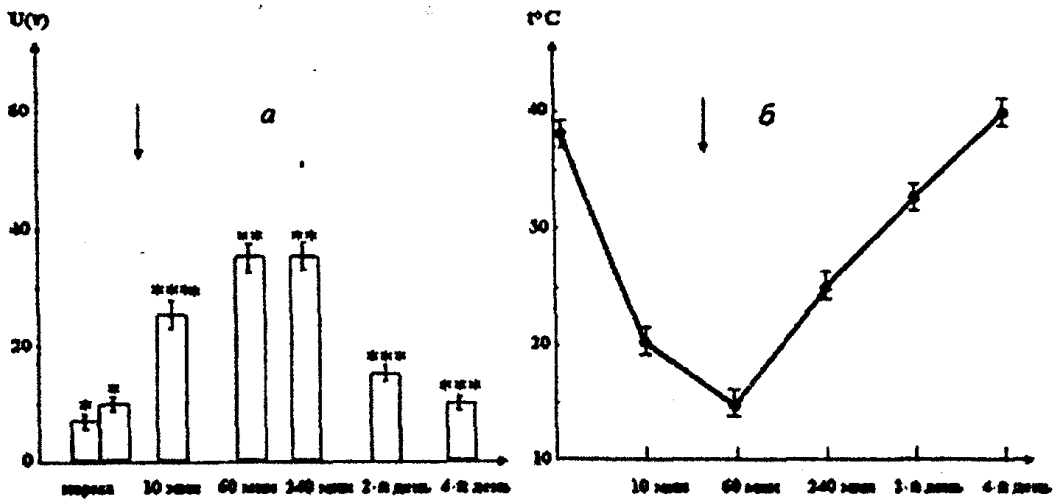

Figure 1. Changes in the analgesic threshold of the motor reaction in hedgehogs after administration of dermorphin. The ordinate is the irritating current (V) in volts; abscissa – time in minutes and days; the arrow is the moment of introduction of the demorphine. Asterisks indicate confidence levels: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

Results: It has been established that the development of fine or absolute differentiation, as well as delayed conditional reactions, wasa difficult conditional-reflex task for hedgehogs, leading to disruptions of HNA. The development of pathological disorders of HNA is accompanied bychanges in the temporal parameters of the conditioned reaction of food obtain (1st stage), the appearance of vegetative disturbances, an increase in the number of intersignal reactions, the occurrence of cardiac reactions (2nd stage), a fall in food unconditional reactions, the emergence of trophic and somatic disorders (3rd stage).

The introduction of dermorphin to neurotic hedgehogs caused pronounced behavioral changes, some can be conditionally divided into 3 periods.

The first period is the period of maximum changes – from 5 minutes to 4 hours after administration. It was characterized by pronounced vegetative, somatic and behavioral disorders, consisting of the initial appearance of such sympathetic effects as: tachyrhythmia, tachypne ($P < 0.05$), hyperemia and injection of auricular vessels. After 30 min of introduction, the sympathetic effects were replaced by parasympathetic, such as: salivation, significant decrease in respiration (on 54 ± 2.5%), decrease in heart rate (on average by 37 ± ± 0.27%). The animals plunged into a sleepy state. Tactile sensitivity decreased: there were no reactions to touching the animal with the hands of the experimenter or the hot plate (hot plat test). During this period, the body temperature dropped gradually from 37–36 °C to 20–17 °C by the first hour after injection. Food excitability was absent.

On the background of the introduction of DM in hedgehogs, a pronounced analgesic effect is revealed. The threshold of nociceptive irritation of the forepaw with its subsequent withdrawal reaction (paw flick) increased 5–7 times compared with the preinjection period and remained at this level for 4 hours after administration (Fig. 1).

The second period was characterized by a partial recovery of conditioned reflex activity, unconditional food reactions, the emergence and intensification of neurotic disorders. The increase in neurotic disorders was particularly pronounced from the 6th to the 10th day after the introduction of DM. It consisted of a significant shortening of latent period of time the hedgehog emerged from the starting compartment to (1–2) ± 0.3 s with neurosis of an excitable type or its lengthening to (12–15) ± 0.8 s (at a rate of 4.2 ± –0.5 s) with neurosis on the brake type. The time of return of hedgehogs to the starting compartment was significantly lengthened up to 35–60 s (at a rate of 15–18 s).

The appearance of paradoxical and ultra paradoxical relations was observed. In animals, motor anxiety was detected, the number of intersignal actions increased to 25–30 in one experimental day (at a rate of 4–6). Endless carding reactions were detected.

From the 6th to the 10th day, food excitability was reduced, despite prolonged food deprivation. So, in response to a conditional signal, the hedgehog ran out from the starting compartment, approached the reinforced feeder, performed a food-producing reaction, but did not eat food, or, going up to the reinforced feeder, made intense carding reaction. One of the characteristic features of the effect of dermorphin during this period is a significant violation of all the studied types of internal inhibition. Differentiation inhibition, as a rule, was absent. Delayed conditioned reactions were disinhibited. This could be most clearly illustrated by the example of extinguishing inhibition.

It has been found that in hedgehogs after the introduction of DM, there is a significant difficulty in the formation of extinctive inhibition and a change in its dynamics. Unlike intact animals, the use of 20 non-reinforcements did not lead to a lengthening of the temporal parameters of the conditional food-producing reaction: the exit time from the starting compartment continued to be short (1–2 s). There was only a gradual shortening of the time for the hedgehog to return to the starting compartment, which shortened to 6–13 s instead of 40–50 s by the 14th to 15th time instead of 40–50 s, which occurred when the first back-up was presented. The extinction of conditional food-receiving reactions against the background of the introduction of DM came after 30 refusals at a rate of 15–17 reflexes (Fig. 2).

An interesting feature of the changes in HNA in the second period is the strengthening of orientational research activities. So, hedgehogs "examined" the experimental chamber, took "vertical racks". Similar phenomena did not occur in hedgehogs before the administration of the drug. It should be noted that despite significant conditioned reflex changes, the analgesic effect during this period was absent. The body temperature of the animals was within the normal range.

The third period from the 10th to the 20th day after the introduction of dermorphine was characterized by normalization of the conditioned reflex activity, some general calming of the animal. Neurotic reactions did not completely disappear, but they did not manifest themselves to such a bright degree as was observed in the second period. Food excitability was fully restored. Thermoregulation and vegetative (heart rate and respiratory movements) indicators were at the level of intact animals.

The antinociceptive effect was completely absent. However, the development of extinctive inhibition had a slightly different dynamic than that of intact animals. Thus, it was found that the development of extinctive inhibition for hedgehogs is a difficult task. With the increase in the

number of necks, the appearance of neurotic reactions, manage movements, intersignal reactions and motor anxiety was observed. The introduction of physiological solution in the control experiments did not change neither the conditioned reflex activity, nor the thermoregulation and vegetative indices. Thus, the data presented indicate that at the insectivorous level, the introduction of dermorphine leads to significant behavioral disorders, accompanied by changes in the vegetative-vascular and thermoregulatory systems.

A comparison of the data obtained with the literature, performed in the same aspect in rodents [3, 7–11], suggest that the effect of DM is more pronounced and significant in insectivores. It can be assumed that this opioid peptide has a species-specific effect: its effect is more pronounced in hibernating animals. This assumption is supported by the results of our studies on lizards [2, 12–15]. These data are generally consistent with the hypothesis of Lipman [5, 6–8], according to which,, the action of dermorphin can be considered as a primitive mechanism of protein synthesis previously used in evolution.

Thus, the data presented indicate that the introduction of an opioid peptide – DM, according to a typical analgesic effect, has a significant impact on the functional state of insectivores. With the introduction of DM, significant changes in innate and acquired forms of nervous activity were found. The internal braking processes are more affected. Is this effect on GNI processes secondary, due to the effect of DM on the hypothalamic, in particular, thermoregulatory centers of the anterior hypothalamus, as evidenced by a significant drop in body temperature, andas a consequence, the animal's falling into a shearing state, * or such changes are the result of the binding of DM to opiate receptors of structures the limbic brain, or finally, this change in the functional state is a species-specific reaction, characteristic only for hibernating animals, it is a question of the future special comparative physiology based surveys, using both electrophysiological and immunohistochemical methods. A partial answer to it will be given in our next messages with the use of DM conjugate in insectivorous and various species (winter-sleeping and non-sleeping) rodents.

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STUDY OF THE PATHOGENIC IMPACT OF NEMATODE *MELOIDOGYNE ARENARIA* CHITWOOD, 1949 ON THE TISSUE SYSTEMS OF THE HOST PLANT

Abstract: When the root system of aubergine is infected experimentally with *Meloidogyne arenaria* Chitwood, 1949, certain functional and structural changes occur in the plant's cells and tissues. At the first stages after infection the nematode mechanically damages the cells of the host plant, while at the second stage pathologic changes in the cells and tissues of the root system can be observed.

Keywords: Meloidogyne arenaria, meloydoginosis, pathology, plants, host, mechanisms.

1. Introduction

Parasitic nematodes rank among the most dangerous parasites of agricultural plants. The damage caused annually by parasitic nematodes to the global economy is estimated at 77 billion US dollars [5]. Particularly threatening are nematodes from the genus *Meloidogyne* Göldi, 1887 (Nematoda: Meloidogyninae) parasitising plants on both open and protected ground. This is why to study the morphofunctional mechanisms of interaction between parasitic nematodes, including the genus *Meloidogyne*, and the host plant is highly important from the scientific and practical aspects, contributing to the development of new methods of treating and preventing helminthiases of plants.

The **goal of the research** is to study the mechanisms of pathogenic impact of *Meloidogyne arenaria* Chitwood, 1949 on the tissue systems of the host plant represented by aubergine *Solanum melongena* L. in our research, and to describe the morphology of the cells and tissues of an infected plant.

2. Material and methods

The object of the research was aubergine (*Solanum melongena* L.) of the "diamond" variety, which was experimentally infected with *Meloidogyne arenaria* Chitwood, 1949. The plant was infected at the early vegetative stage, on an experiment site in the Botanical Garden of the Faculty of Biology, National University of Uzbekistan. For the experiment we took 20 pots (10 for reference samples and 10 for experimental ones), 0.6 m^3 in volume each. We planted 5 seedlings into each pot, and 7 days later we infected the experimental samples with nematodes. Each of the experimental plants was treated with water suspension containing 3.500 ± 200 larvae. The larvae and eggs of the nematode for the experiment were taken from a laboratory, where they had been bred for the purpose in the roots of tomato plants. The nematodes were extracted from the tomato plants using the method developed by O. Z. Metlitsky (1979). We first cut the infected roots into segments (2–3 cm), put the segments into Petri dishes, dissected them with a sharp scalpel and needle controlling the process with a binocular microscope, and then collected the nematodes (Motic B1–220A-2). We grew all the experimental groups of objects in a hothouse on the same plot in equal conditions. The reference group of plants uninfected with the nematodes was cultivated on the same plot, where they had no contact with the infected plants. For each object of research we took samples from 50 infected plants, which had been selected beforehand by similar external anatomic features. We collected the material 3 months later, when the plants were at the fruiting stage.

The anatomic structure of the plant's roots was studied using material kept in 70% ethanol. The preparations were made up out of the main and lateral roots of the aubergine of the diamond variety cut longitudinally and across. The cuts 5–6 microns thick were made with the use of a microtome (Microm HM 340 E) out of the middle part of the lateral roots of the infected plants, where the galls had formed. A total of 1.600 cuts were prepared and then painted with methyl blue and safranin. Separately, 35 micropreparations were made out of them following the common method [1].

3. Results and discussion

Nematodes from the genus *Meloidogyne* are obligate parasites of plants, whose life cycle includes four juvenile stages. The first stage (J_1) and the evolution into a larva take place inside the egg. The larva that exits the egg is capable of infecting plant roots. A part of the infective larvae that develop at stage 2 (J_2) leave the infected root into the ground, while the other part may stay within the root system. From the ground they actively penetrate into the sprouting root of a plant near the root cap. Then they move head first to the vessels of the vascular bundle, where they feed and grow into the third-stage (J_3) and then fourth-stage (J_4) larvae. The latter evolve into

females, which are 1 mm long and have the form of a bottle, sphere or pear [3].

The process of the infection of a plant with the nematode consists of two phases. At the first phase the parasite penetrates into the plant's tissues, while the second stage is characterised by the development of certain relations between the parasite and the host. The host plant responds to the infection in different ways: galls formation, tissue maceration or necrosis. The external display of the parasite-host relations depends on the parasite's specific features [4]. In our research the commonest reaction of the aubergine infected with nematode *Meloidogyne arenaria* was the formation of galls in the main and lateral roots. As we studied the mechanisms of the pathogenic impact of nematodes from the genus *Meloidogyne* on aubergine's tissue structure, we established that pathologic changes occur in the root tissues of the host plant. When the nematodes penetrate into and migrate within a plant, nonspecific changes take place in the tissues of their roots, such as the damage of the epidermis, loosening of the parenchyma, maceration of the tissues, formation of cavities, hypertrophic growth and subsequent decomposition of the parenchyma. These are basic changes that occur in areas with the strongest concentration of the infection [5; 6]. As it enters the root of a host plant, the second-stage larva initiates the formation of a feeding zone. Most pathologic changes take place in the cells and tissues of the vascular bundle and parenchyma around it, as well as in the walls of the phloem and xylem. Analysing the results of our study and comparing aubergine roots infected and uninfected with nematodes from the genus *Meloidogyne* we came to a conclusion that the plant's root system changes greatly. The changes consist in the rupture of cellular walls, hypertrophy of parenchymal cells which includes thickening of their walls and specific destruction, all of which may be observed in various sections of the tissues of plants' roots. As the plant develops, the damaged area in these organs extends, involving intergumentary and strengthening tissues and the conducting system.

As we studied the transverse section of the lateral roots of infected plants we found out that externally it is covered with 3–4 layers of phellogen, under which the cortex parenchyma constitutes 50% of the central cylinder. Cambium functions in the central cylinder and forms secondary xylem, while between the vessels there is thin-walled parenchyma consisting of 5–6 granules. The radial rays consist of 1–3 rows. The phloem constitutes around 10% of the central cylinder. The root conducting vessels are not deformed (fig. 1a). The nematode second-stage larvae (J_2) penetrate through the cellular walls into the vascular cylinder and migrate to the root parenchyma, where they create for themselves a growth and feeding zone. This can be easily seen on the picture (fig. 1b).

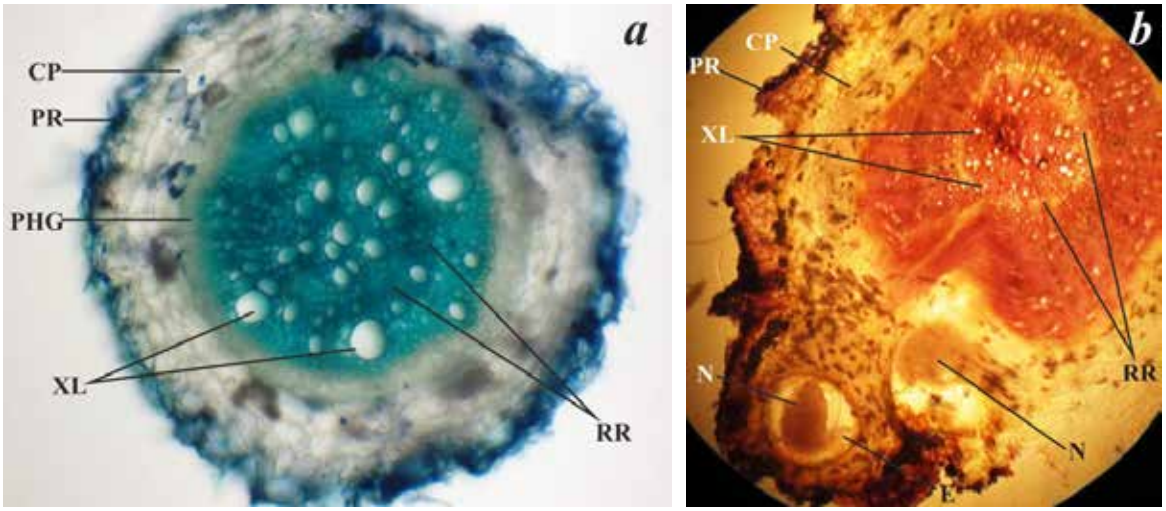

Figure 1. Transverse cut of aubergine roots uninfected a) and infected with *Meloidogyne arenaria;* b) CP – cortex parenchyma, PR – periderm, PHG – phellogen, XL – xylem, RR – radial rays, N – nematode, E – eggs

The head of the nematode larva is usually situated in the centre of the gall. Not far from the head gigantic multinucleated cells (**ГК**) can be observed in the xylem. From 4 to 7 gigantic cells can be found near one nematode. Hydrocytes (water cells) can also be observed around the head (fig. 2 a, b). Pathologic changes in tissues and cells in plant roots occur initially in root ducts and the parenchyma. The walls of the phloem and xylem in infected roots are considerably thicker and deformed.

Transverse cuts in infected roots are highly important for the study of plant tissue and cells, while longitudinal cuts are necessary to visualise areas where the nematode penetrates, settles and acts.

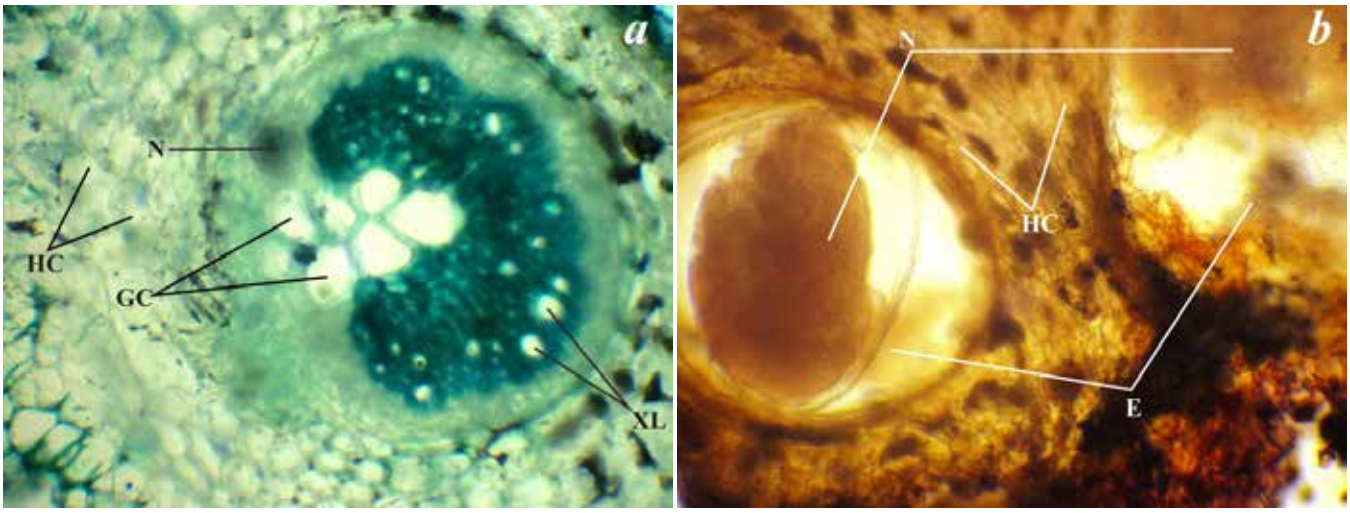

Figure 2. Transverse cut of the infected roots of aubergine: gigantic cells a) and hydrocytes; b) N – nematode, HC – hydrocytes, GC – gigantic cells, E – eggs

Analyzing the longitudinal cuts of a damaged root we found in the root parenchyma several female nematodes and an ootheca with eggs. Each nematode larva forms a special feeding zone, which leads to pathologic changes in the root parenchyma of the vessels around the larvae. Nematode larvae are usually located near parenchymatous cells, close to the central cylindrical area of the root. The larvae's growth and development, when the gigantic cells are forming, leads to the tightening and deformation of root conducting vessels, which results in larger distances between the vessels. The infectious larva of nematode *Meloidogyne arenaria* migrates within the root, where it evolves into an egg-laying female. This process repeats several times, which results in an increase of the number of females. Mature females are fertilized. After being fertilized the female first discharges some jelly-like substance, which forms into an ootheca – an egg sack. After that the female lays eggs into the ootheca. Figure 3 clearly shows an ootheca and mature eggs (fig. 3a). When nematode larvae develop and the gigantic cells form on plant roots, it leads to a malfunction of the root's conducting tissues. A large number of nematodes can be found near the vessels of the conducting bundle, whose walls are thickened. Nematodes from the genus *Meloidogyne* directly impact the plant in the course of the entire period of its growth. A few individuals can always be found in infected organs. This also results in the break of correlations in physiological processes going on in the organs of a plant, and affects the differentiation of cells and tissues. The host plant's response to the penetration of nematodes can be seen in the formation of galls, maceration of tissues and necrosis (fig. 3b).

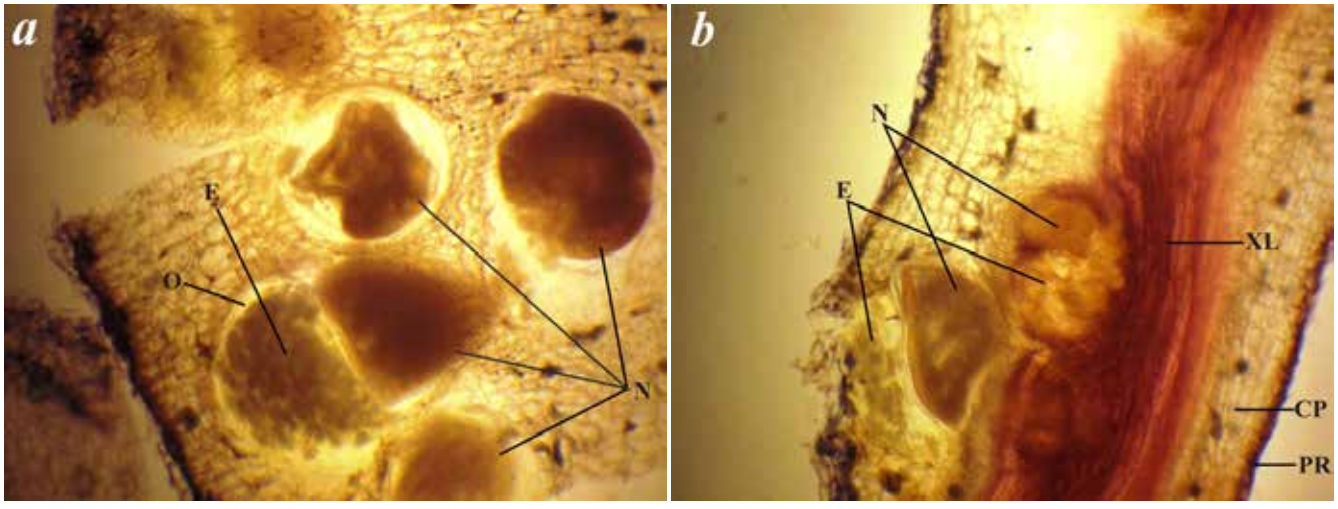

Figure 3. Longitudinal cut in the infected root of an aubergine of the diamond variety: ootheca: a) and galls, tissue maceration and necrosis; b) PR – periderm, XL – xylem, CP – cortex parenchyma, N – nematode, L – larva, E – eggs

4. Conclusion

To summarise, the experimental infection of aubergine roots with nematode *Meloidogyne arenaria* results in structural and functional changes in the plant's cells and tissues. At the first stage the nematodes mechanically damage the cells of the host plant, while at the second stage pathologic changes can be observed in the cells and tissues of plant's root system.

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EFFECT OF FUNGICIDES AND MICROBIOLOGICAL PREPARATIONS ON SOIL BIOAGROCENOSE

Abstract: Biopreparation of complex action Rizokom-2 in comparison with chemical fungicides and microbiological preparation Baikal EM-1 positive influenced on pH of soil solution, balance of soil microbial community and biogenic elements.

Keywords: wheat, fungicides, microbiological preparations, soil, microbial and agrochemical composition.

Introduction

Currently, the productivity of wheat, as a rule, low. The reason for this is a significant decrease in soil fertility due to the deterioration of the water and nutrient regimes of the soil, an increase in the weediness of crops and an intensification of the infectious background. The main prerequisites for reducing the yield of wheat are unfavorable conditions of mineral nutrition and non-compliance with the system of plant protection against diseases.

It is known that soil elements such as nitrogen, phosphorus, potassium, calcium, magnesium, etc. have a beneficial effect on the productivity of winter wheat. *Nitrogen* is part of the molecule of chlorophyll, vitamins, alkaloids, increases the green (vegetative) mass of plants and yield. Phosphorus plays a decisive role in photosynthesis, the transfer of energy and hydrogen (respiration), rooting, accelerates the transition of plants to the reproductive phase of development, increases the yield, quality and resistance of plants. *Potassium* positively affects the resistance of plants to drought, low temperatures, pests and fungal diseases, allows plants to use water more economically and more efficiently, increases the transfer of substances in the plant. Calcium is involved in water, carbohydrate and nitrogen metabolism in the plant, regulates metabolism, water and physiological balance of the cell. *Calcium* is also necessary for the plant to form nucleic acids, photosynthesis and energy metabolism are closely associated with it. *Magnesium* participates in the biosynthesis of chlorophyll, enhances the absorption of potassium by the root system. However, in many soils these nutrients are inaccessible. Both the lack of nutrients and their excess causes stress in crops of crops, reducing their potential productivity. Particularly great is the effect of imbalance of nutrients in critical periods of development of grain crops: bushing, flowering, grain filling.

Lack or excess moisture, diseases and pests of plants and soil fertility are the main factors that limit crop yields. To achieve a balanced agriculture, it is necessary to pay attention to such processes as the biological transformation of nutrients, and also to remember how important it is to maintain biodiversity in ecosystems.

The existing methods of farming, such as the introduction of fertilizers, especially mineral fertilizers, limit the biodiversity of rhizobial bacteria. In addition, the roots of plants from balanced agroecosystems contain more bacteria that suppress diseases than the roots of those from highly-equipped agrocenoses [1].

At present, in connection with the increasing anthropogenic impact on the soil and, as a consequence, the deterioration of the ecological situation, the development of biotechnological methods for optimizing the growth of agricultural plants, including the development and introduction of highly productive strains of microorganisms, the use of which is environmentally friendly, has become very important. Numerous experiments show that associative and symbiotic microorganisms due to complex action on plants are able, and sometimes significantly, to increase the productivity of the latter [2].

One of the ways to increase the productivity of crops is the optimal selection of complex treatment of seed. Unfortunately, chemical plant protection products among the anthropogenic factors are characterized by the greatest pressure on the populations of phytopathogens in agrobiocenoses.

Some disinfectants have a negative effect on the germination of seeds, the growth and development of plants, which ultimately affects the yield and quality of products.

In order to increase the yield of wheat, it is of great importance in the delivery of properly developed and properly organized crop cultivation technology, as well as new methods of presowing seed treatment with biological products that stimulate plant growth, improve seed quality of seeds, increase productivity and yield.

At present, the role of non-pathogenic microorganisms in preserving soil fertility, increasing the yield of various crops, obtaining environmentally safe products and, ultimately, in normalizing and improving people's livelihoods is being intensively studied [3].

The obtained data also indicate that effective microorganisms are also able to purposefully interfere with the circulation of carbon, nitrogen, phosphorus and other nutrients. Soil microorganisms ensure the restoration of soil fertility, prepare the nutrient medium and transfer it from the soil solution to the root system, and process flora and fauna into useful soil components. Therefore, in technology of cultivation of agricultural crops, it is necessary to give due attention to soil microflora.

In the laboratory of soil microbiology of the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan within the framework of the applied project FA-A6-T215 (2012–2014) a biopreparation of complex action Rizokom-2 was created on the basis of an association of 3 local effective strains of phosphorus and potassium-mobilizing wheat rhizobacteria of g. *Bacillus*.

The active basis of the biopreparation are local active strains of wheat rhizobacteria having the following polyfunctional properties: phosphorus and potassium mobilizing ability, destructive activity to organochlorine pesticides, root-forming and growth-stimulating activity, increasing plant immunity, soil fertility and wheat productivity. The new biopreparation is intended for pre-sowing seed treatment in order to optimize the conditions of root nutrition of winter wheat [4].

Within the framework of the innovative project I5-FA-0–19521 (2013–2014) a biotechnology has been developed for obtaining a Serhosil biopreparation based on green microalgae g. *Scenedesmus* as foliar application to increase crop productivity [5].

In connection with the foregoing, the main purpose of the research was to study the effect of chemical fungicides and microbiological preparations on the soil microbial community, the agrochemical composition of soils, the incidence level and productivity of wheat.

The object of the research was: pure, non-treated seeds of Bardosh variety of winter wheat, chemical fungicides Bahor (Uzbekistan), Celest Top (Italy), microbiological fertilizer Baikal EM-1 (Russia), biopreparation Rizokom-2 (Uzbekistan, IMB), soil of the experimental site of the Institute genetics and experimental biology of plants of the Academy of Sciences of Uzbekistan, biologic Serhosil. Field experiments with winter wheat conducted on the background of NP_{200} kg/ha and were carried out in 3-fold replication according to the following scheme of variants:

1. Control – traditional wheat sowing (dry seeds);
2. Experiment- seed treatment with fungicide Bahor;
3. Experiment – seed treatment with fungicide Celest Top;
4. Experiment – seed treatment with microbiological fertilizer Baikal EM-1;
5. Experiment – seed treatment with biopreparation Rizoko m–2 + 3 time foliar application of biopreparation Serhosil.

Pre-sowing treatment of wheat seeds with chemical fungicides and microbiological preparation Baikal EM-1 was carried out according to the instructions, by biopreparation RIZOKOM-2 with titer of 6×10^7 CFU/ml during the 1 hour in field conditions, by following drying the seeds in natural conditions and sowing on the field.

The microbial community of the soil was studied according to the generally accepted method of D. G. Zvyagintsev [6].

Agrochemical analyzes of soils were carried out according to methods generally accepted in agrochemistry. The value pH – the hydrogen index is measured by a standard chloride-mercury electrode with automatic temperature compensation. In soil samples, the pH value is measured in an aqueous suspension of 1:5. The humus content was determined by the Tyurin method, the determination of the total forms of nitrogen and phosphorus was carried out according to the method of Ginzburg et al., The content of mobile nitrogen N-NH4 and the mobile phosphorus – P_2O_5 – by calorimetric method, exchange potassium K20 – by flame photometry.

The degree of soil salinity was determined by analyzing the water extract. The method is based on the content of water-extractable salts in the soil (TSS). Cations and anions were determined using a gravimetric method. The content of toxic salts was calculated by the method of determining hypothetical salts in mg. eq/100 g of soil [7].

The results of the research and their discussion

Soil samples of the initial soil were selected before sowing of winter wheat seeds. The salt and agrochemical composition was studied (Tables 1–2), as well as the microbial community of the initial soil (Table 3).

As can be seen from (Table 1), the initial soil before sowing wheat is non-saline, but with predominance of Ca and Mg sulfates, with a slightly alkaline reaction of the soil solution – 7.7.

Table 1.

Place of sampling	Degree of salinity in ECe, dS/m	Type of salinity	pH
Initial soil	0.79	not saline, prevalence of sulphates Ca and Mg: $CaSO_4$–37%, $MgSO_4$–29%, Na_2SO_4–3%, NaCl-16%	7.7 Slightly alkaline

Table 2.– Agrochemical analysis of soil:

Humus content:

Name of the sample	Humus,%	Carbon of humus,% (C_t,%)	Evaluation of the provising
Initial soil	1.03	0.60	medium-sized

According to the content of gross (total content) forms of nitrogen – the initial soils are poor. According to the availability of mobile (assimilated by plants) forms of nitrogen – very low.

Nitrogen content:

Name of the sample	Gross forms of nitrogen,%	Evaluation of the provising	Mobile, assimilable to plants forms of N-NH_4, mg/kg	Evaluation of the provising
Initial soil	0.068	oor	15.6	very low

According to the content of gross (total content) forms of phosphorus – the initial soils are rich. According to the availability of mobile (assimilated by plants) forms of phosphorus – the average.

Phosphorus content:

Name of the sample	Gross forms of phospho-rus %	Evaluation of the provising	Mobile, assimilable to plants forms of P_2O_5, mg/kg	Evaluation of the provising
Initial soil	0.237	rich	31.2	middle

According to the content of gross (total content) forms of potassium, the initial soil is very poor. According to the availability of mobile (assimilated by plants) forms of potassium – low.

The content of non-toxic salts in the soil is 52% of the total amount of salts, the content of toxic (easily soluble and harmful to plants) salts is 48.5% of the total amount of salts. Among the toxic (harmful) salts, magnesium sulphate – $MgSO_4$, which is 29% of the total amount of salts and 60% of the amount of toxic salts, is predominant.

Potassium content:

Name of the sample	Gross forms of phospho-rus %	Evaluation of the provising	Mobile, assimilable to plants forms of K_2O, mg/kg	Evaluation of the provising
Initial soil	0.615	very poor	118	mean

Salt content,%

Name of the sample	$Ca(HCO_3)_2$	$CaSO_4$	Amount of non-toxic salts	$MgSO_4$	Na_2SO_4	NaCl	$MgCl_2$	Amount of toxic salts	Amo-unt of the total salts
Initial soil	0.016	0.038	0.054	0.030	0.003	0.016	–	0.050	0.103

Microbiological monitoring included the study of the number of major agronomically important groups of soil microorganisms involved in the nitrogen, phosphorus and potassium cycle, as well as other microelements in the soil-ammonifiers, oligonitrophils, phosphorus mobilizing bacteria, actinomycetes, and micromycetes in the arable (0–30 cm) layer of parent soils.

According to microbiological indices – in the initial soil only ammonifiers and actinomycetes are normal, phosphorus mobilizing bacteria are lower by 2 orders of magnitude, oligonitrophils are lower than the norm by 1 order, micromycetes are above the norm by 1–2 orders of magnitude, which may indicate a high content of micromycetes in the initial soil, among There are also pathogenic fungi that cause plant diseases (Table 3).

As can be seen from the data presented in Fig. 1, the number of ammonifiers was at the same order of magnitude and was from 8.2 to 9.9 lg CFU/g soil. The number of oligonitrophils increased by 1 order (from 6.7 to 7.1 lg CFU/g soil), phosphomobilizing bacteria – by 2 orders (from 6.6 to 8.1 lg CFU/g soil) only in the variant with Rizokom-2. The number of actinomycetes was at the same level in the original soil and in variants using microbiological preparations (5.4–5.5 lg CFU / g soil) and decreased by 1 order in the control and in variants using chemical fungicides (from 5.4 to 4.0–4.3 lg CFU/g of soil).

Table 3. – The number of main groups of soil microorganisms in the original soil before planting wheat (CFU/g of soil)

Name of the sample	Ammonifiers	Phosphorus mobilizing bacteria	Oligonitrophils	Micromycetes	Actinomycetes
Initial soil	1.9×10^8	6.0×10^6	6.9×10^6	1.5×10^4	3.7×10^5

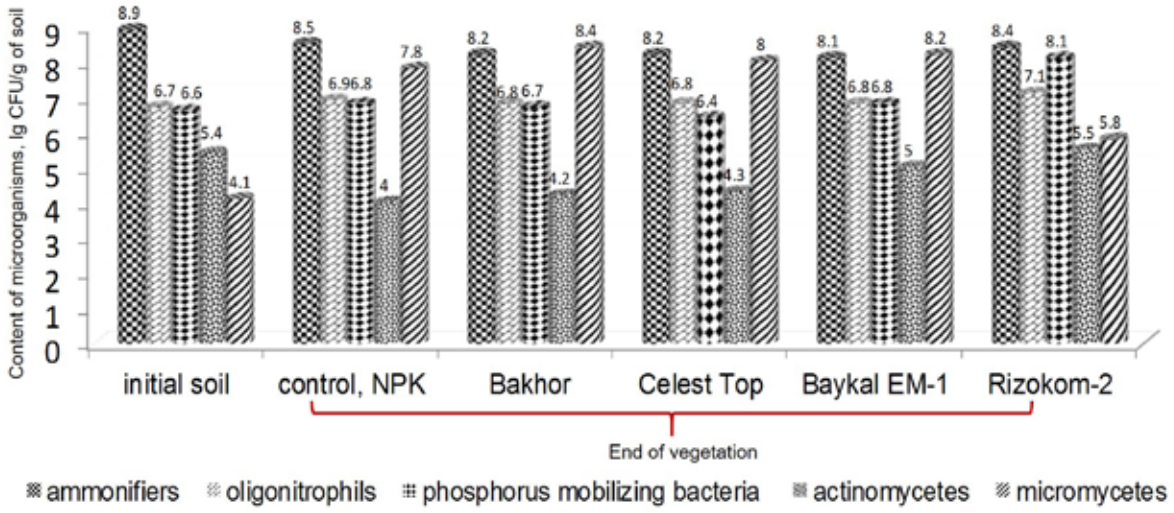

Figure 1. Influence of chemical fungicides and microbiological preparations on the number of soil microorganisms in soil under wheat (lg CFU/g of soil, arable horizon, 0–30 cm)

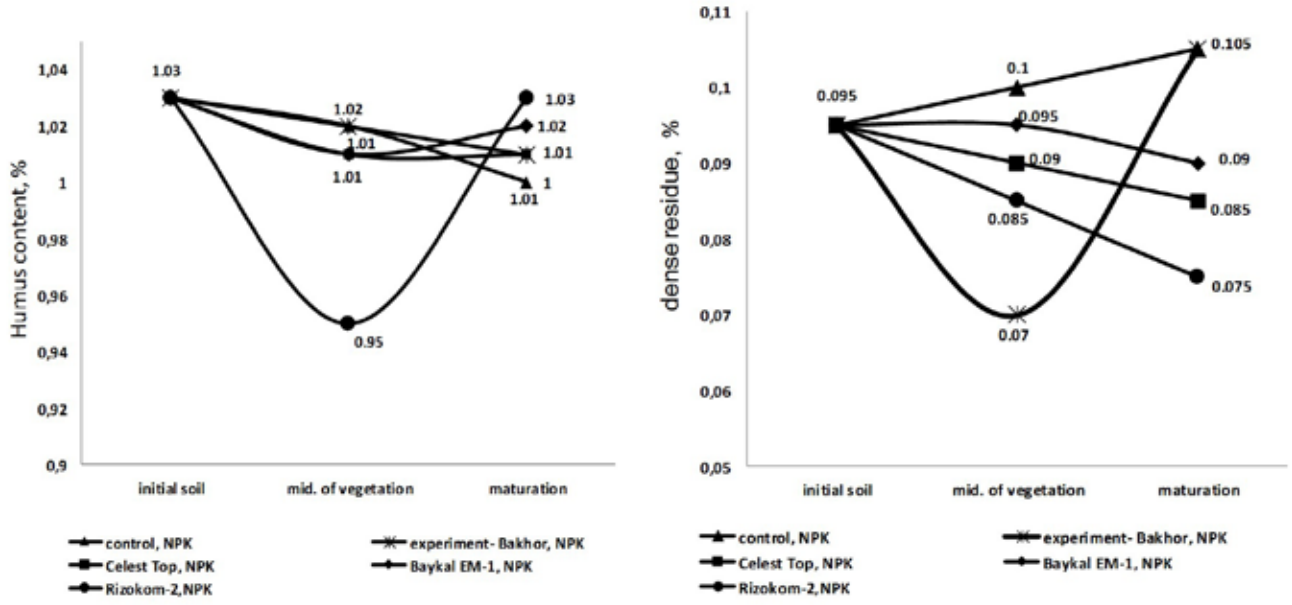

Figure 2. The effect of chemical fungicides and microbiological preparations on the content of humus and dense residue in the soil under wheat during vegetation (%, arable horizon, 0–30 cm)

During the growing season (the middle and the end of the growing season), the microbial community and the agrochemical composition of the soil were studied using chemical fungicides and microbiological preparations during the pre-sowing treatment of wheat seeds of the Bardosh variety. Figure 1–4 shows the end-of-vegetation data in comparison with the initial soil.

The humus content in the arable layer of soil under wheat was reduced in the middle of vegetation by 0.08% only in the variant using Rizokom-2, but by the end of the vegetation the humus content increased to the level of the initial value. This fact indicates that under the action of the Rizokom-2 biological preparation, oligonitrophiles and phosphor-mobilizing bacteria actively multiplied in the soil, due to which carbon and phosphorus were released from humus and assimilated by plants (Fig. 2 A). The content of the dense residue in the soil most decreased from the initial value by 0.02% in the version using Rizokom-2, which indicates a decrease in the level of soil salinity (Fig. 2 B).

The study of the content of toxic and non-toxic salts in the soil under wheat also showed their decrease only in the variant with the use of Rizokom-2, where the amount of salts decreased by 0.03%, and in the variant with the use of chemical fungicides – increased by 0.02–0.03%, in the variant with application of Baikal EM-1 the amount of salts did not change in comparison with the initial soil and with the control (Fig. 3).

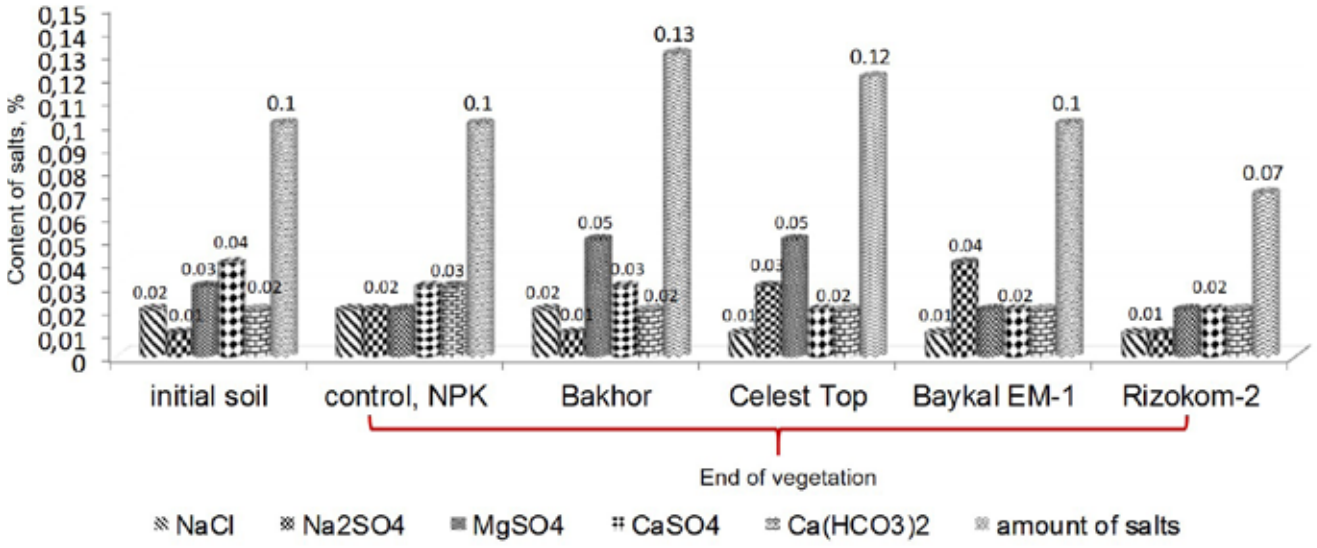

Figure 3. The effect of chemical fungicides and microbiological preparations on the content of salts in the soil under wheat (%, arable horizon, 0–30 cm)

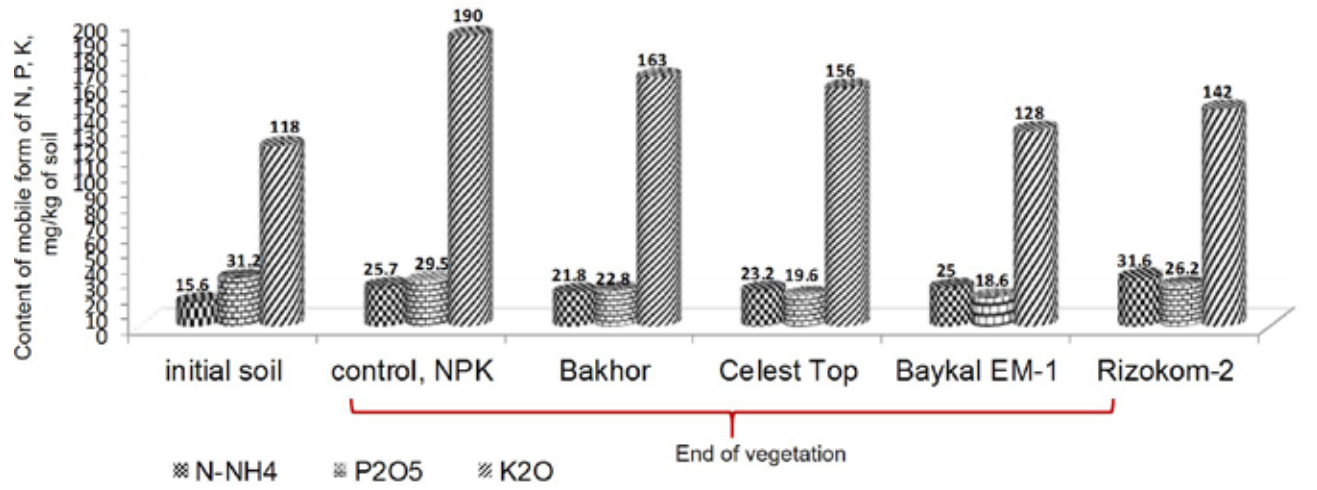

Figure 4. The effect of chemical fungicides and microbiological preparations on the content of mobile forms of nitrogen, phosphorus and potassium in the soil under wheat (mg / kg soil, arable horizon, 0–30 cm)

The content of mobile nitrogen in the soil increased by the end of the vegetation period by 6.2–7.6 mg/kg soil in variants with the use of chemical fungicides, by 9.4 mg/kg soil – in a variant using Baikal EM-1 and by 16 mg/kg of soil – in the

version using Rizokom-2 in comparison with the original soil and with control. The obtained data indicate that the use of microbiological preparations has a positive effect on the content of mobile nitrogen in the soil. The best option was the application of the biological product Rizokom-2.

The content of mobile phosphorus in the soil by the end of the growing season decreased by 6.7–9.9 mg/kg soil in variants with the use of chemical fungicides, by 10.9 mg/kg soil – in the variant with Baikal EM-1 and by 3.3 mg/kg soil – in the version with the use of Rizokom-2 in comparison with the control. The obtained data indicate that when using chemical fungicides and Baikal EM-1 by the end of vegetation in the soil, the content of mobile phosphorus is much reduced, using Rizokom-2 – the decrease is in significant, which is a positive moment.

The content of mobile potassium in the soil by the end of vegetation decreased by 27–34 mg / kg soil in variants with the use of chemical fungicides, by 62.0 mg / kg soil – in a variant using Baikal EM-1 and 48 mg / kg soil – in variant with application of Rizokom-2 in comparison with the control. The obtained data indicate that the use of chemical fungicides has a negative effect on the content of mobile potassium in the soil, while the use of microbiological preparations has a positive effect (Fig. 4).

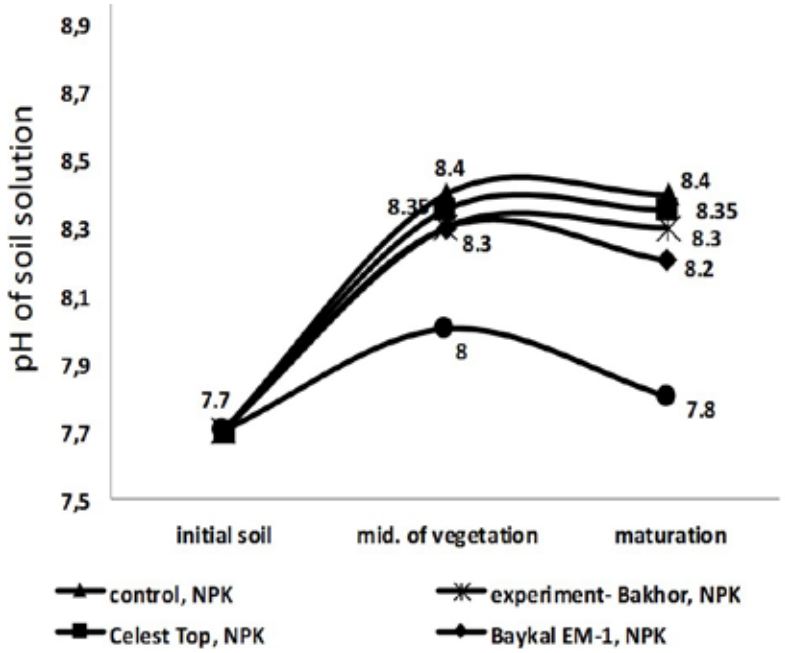

Figure 5. Influence of chemical fungicides and microbiological preparations on soil pH under wheat during vegetation of plants (arable horizon, m 0–30 cm)

A study of the pH of the soil revealed that during the vegetation of wheat the pH of the soil solution rises from 7.7 to 8.2–8.4 during the growing season, both in the control and in all experimental variants, with the exception of the variant with Rizokom-2, where soil pH rises only in the middle of vegetation, but decreases significantly by the end of vegetation to 7.8 and becomes at the same level as the initial value (Fig. 5).

Thus, on the basis of the results obtained to study the effect of chemical fungicides and microbiological preparations on soil bioagrocenosis – the microbial community and the agrochemical composition of soils under winter wheat during the growing season revealed a positive effect of the RIZOKOM-2 complex action on the pH of the soil solution, the balance of the soil microflora in the use of beneficial microorganisms and the balance of biogenic elements – nitrogen, phosphorus and potassium. The parameters of the amount of salts and the content of the dense residue decreased by the end of the vegetation period by 0.03%.

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EFFECT OF THE SOIL MOISTURE CHANGES ON THE GROWTH AND DEVELOPMENT OF DIFFERENT COTTON BIOTYPES

Abstract: The article presents data on the growth and development of introgressive lines obtained on the basis of interspecific hybridization and cotton varieties differing in tolerance to water deficiency, grown in three conditions for water availability. Some physiological processes taking place in the leaves (the total water content in the leaves, transpiration rate, water-holding capacity) in the samples studied were studied. The observed differences according to the obtained data are the result of the adaptability of the studied biotypes of varieties and introgressive lines of the cotton plant depending on the genotype.

Keywords: cotton, introgressive lines, cultivated varieties, water deficiency, total water content in leaves, transpiration rate, water-holding capacity.

Introduction

Cotton-growing, which is one of the main agricultural branches of the republic, is based mainly on artificial irrigation and requires regular irrigation with higher degree than other crops. For the cultivation of cotton on a hectare field in our country is spending more than twice the water, compared with some countries [4]. At present, in the cotton fields together with introduction of high-yielding varieties that meet world standards for quality, also creation of varieties with resistance to adverse environmental factors is important. The solution of these problems depends on the acceleration of breeding genetic work on the selection of genotypes adapted to different soil moisture conditions and work on selection of appropriate biotypes [1].

Materials and methods

As a material of the investigation were 5 introgressive lines L-384 (F_{12}[(*G.thurberi* x *G.raimondii*) × Tashkent-1]); L-483 (F_9[(*G.thurberi* x *G.raimondii*) × C-4880]); L-534 (F_9 [(Tashkent-6 × *G.raimondii*) × C-4880]); L-6 (F_{10} [(C-4880 × × *G.stocksii*) × C-4534]); L-8 (F_{10}[(*G.thurberi* × *G.anomalum*) × × C-4880]) corresponding to the medium-fibrous species *G.hirsutum* L. and different in the tolerance to the water deficiency varieties Tashkent-6 (control), Gulbakhor-2, Navbakhor- 2, AN-Bayut-2, Bukhara-6, Omad and a new variety Armugon-2. Planting was carried out on May 1–2, 2016 at the experimental station "Durmen" of the Institute. All samples were studied in the following three conditions of water supply: according to the scheme 0–1–0, i.e. single watering in the mass flowering phase (13.07.2016), soil moisture before irrigation 56.5%, 1100 m^3/ha water availability – conditions of the simulated drought; according to the scheme 0–2–1 at the phase of mass flowering and at the beginning of mass box formation (05.08.2016), as well as in the phase of opening the boxes (August 11, 2016); according to the scheme 1–3–1 during the budding phase (June 30, 2016) and the accumulation of the crop (July 14, August 05 and August 21, 2016), in the phase of opening the boxes (10.09.2016), respectively, with a soil moisture content of 70.7%; 75.2%; 72.3%; 75.8%; 70,5%, before watering and 5200 m^3/ha of water supply.

For the purpose of comparative study of resistance to water deficiency during the growing season, field studies were conducted to study a number of morpho-physiological indexes. The results of the studies were statistically processed using a single-factor ANOVA dispersion using the Fisher test [5].

The results of the research and their discussion

Over the previous years, individual selection according to the shape of the bush and resistance to water deficiency were carried out [3]. Seeds of individual selections with the best indicators were divided into three parts and studied in three water-provided conditions. Comparing the indicator "height of the main stem" in the version of the irrigation scheme 1–3–1, there are marked differences in comparison with other conditions of irrigation. For example, if the height of plants in the cotton plant variety Gulbakhor-2 under this irrigation scheme was 139.0 ± 4.4 cm, for the 0–1–0 irrigation scheme it was 100.0 ± 2.8 cm, and for the 0–2–1 was 102.6 ± 4.2 cm. In the introgressive line L-384, according to the variants, it was 143.7 ± 8.1, respectively; 93.6 ± 3.4; 109.4 ± 6.4. For L-8 lines this index had the smallest value (100.7 ± 2.9, 91.2 ± 1.0, 86.6 ± 4.7 cm) and no significant differences in the amount of branching were found in comparison with other samples. The reason for this is very short nodes (2.5–3.5 cm) between the fruiting branches, which are related to the conical, first type of branching. At the

L-534 line, the plant height for all variants averaged 106.4±6.7 cm and the plants had a generally conical shape with a second type of branching. The height of plants of variety Tashkent-6 averaged 97.8 ± 2.2 cm with a branched third type of branching.

Phenological observations on the number of leaves and leaf area showed that these indicators are dependent on the plant genotype. For example, in all variants of the experiment, the largest leaf area was observed in Bukhara-6 (an average of 106.8 ± ± 2.9 cm^2), the lowest in Tashkent-6 (average 81.6 ± 1.9 cm^2), the number of leaves 32.7 ± 4.2 pcs. The Armugon-2 variety and the L-6, L-8 lines had a relatively large number of leaves (45.8 ± ± 3.9 pieces) and the leaf area averaged 88.9 ± 2.5 cm^2.

In some varieties and lines, there were differences in the variants of the irrigation scheme. For example, in the AN-Bayaut-2 variety under the 1–3–1 irrigation scheme, the leaf area was 112.8 ± 1.0 cm^2 and in the 0–1–0 irrigation scheme it was 85.8 ± 2.3 cm^2, significant differences in the number of leaves.

It is known that the deviation from the norm of soil moisture negatively affects the physiological and biochemical processes taking place in plants [2].

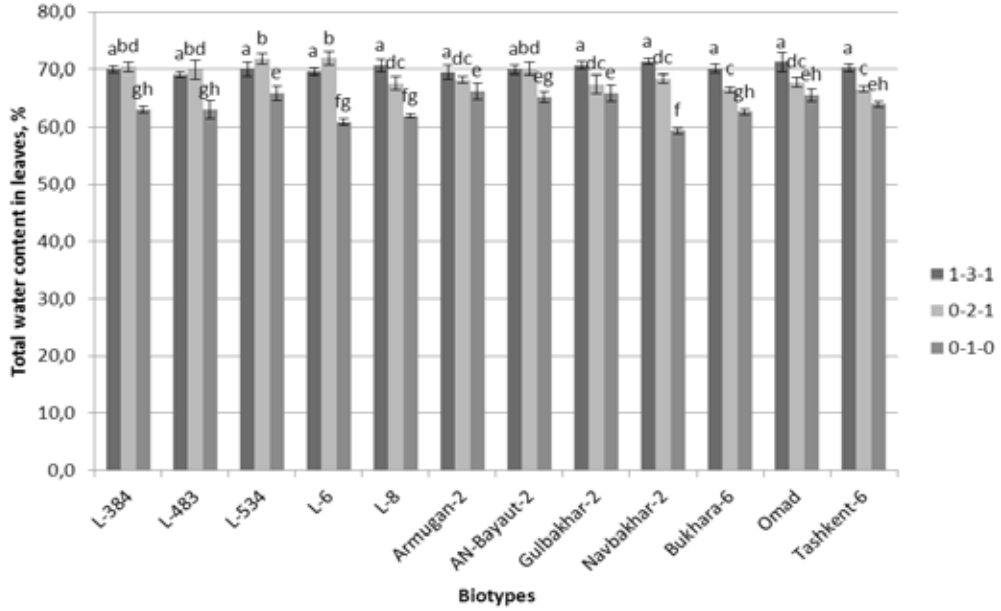

Figure 1. The total water content in the leaves of biotypes under different water availability (The letters indicate the degree of reliability of the differences between the samples (P < 0.05) in the Fisher PLSD test)

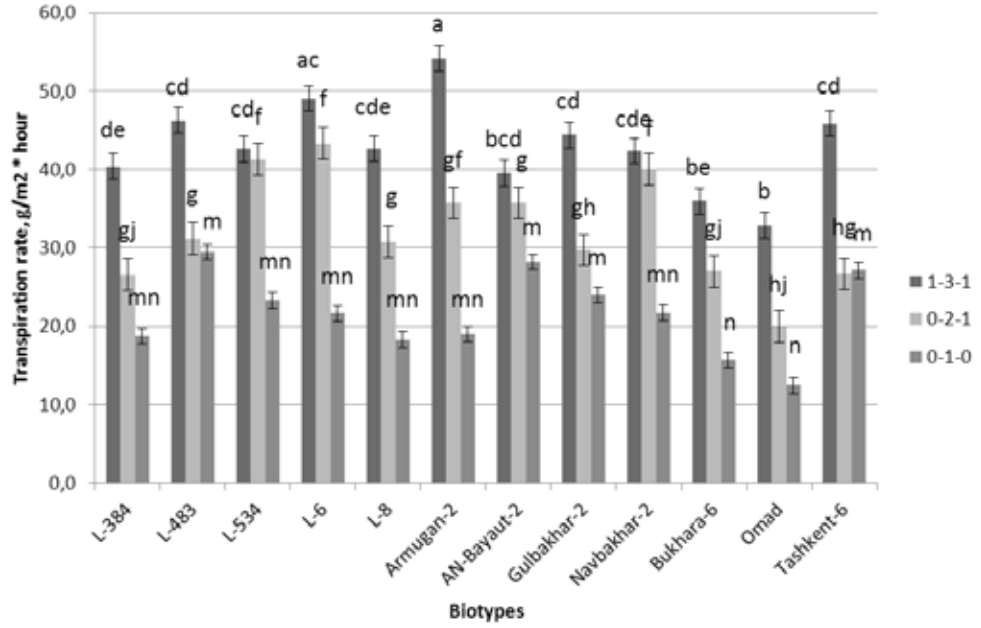

Figure 2. Transpiration rate in biotypes under different water availability (The letters indicate the degree of reliability of the differences between the samples (P < 0.05) in the Fisher PLSD test)

The trait "total water content in leaves" was high in all studied cotton varieties under the irrigation scheme 1–3–1 and in all introgressive lines under the 0–2–1 irrigation scheme. In the 0–1–0 irrigation scheme, all the samples studied showed low rates. The cotton plant variety Navbakhor-2 (59.4 ± 0.5%) and L-6 line (60.8 ± 0.5%) were especially different (Figure 1).

One of the main processes in the management of water balance in plants is transpiration. Analysis of the obtained data shows that with the variant of the irrigation scheme 1–3–1, the transpiration rate in all the samples studied was high, especially the Armugon-2 grade was significant (54.1 ± ± 5.2 g/m^2 x hour). With the 0–2–1 irrigation scheme, the highest transpiration rate index was observed at the L-6 line (43.3 ± 3.8 g/m^2 x hour), and the lowest index was observed in Omad (19.9 ± 2.3 g/m^2 x hour), and with the 0–1–0 irrigation scheme, this index was the smallest in all the samples studied, in Omad, Bukhara-6, Armugon-2 and L-384, L-8 lines were 12.4 ± 3.0; 15.7 ± 3.6; 19.0 ± 4.0; 18.7 ± 2.9; 18.3 ± 2.9 g/m^2 x hour (Fig. 2).

One of the important indicators in the water balance of plants is the trait "water-holding capacity" of leaves. The water retention capacity of cotton leaves depends on a number of factors, including soil moisture and biological properties of the studied biotypes. The water-holding capacity of the leaves of the studied cotton samples was studied under different water conditions, this feature shows the water flow due to evaporation within 2 hours of the initial water content in the leaves. A low index of this trait indicates a high water holding capacity and vice versa, high index – low water holding capacity of the leaves.

There was a difference in the water-holding capacity of leaves of different varieties and lines of cotton under different conditions of water availability. If this parameter in the cotton variety Armugon-2 under irrigation scheme 1–3–1 was 32.5 ± ± 1.2%, then under the irrigation scheme 0–1–0 it amounted to 11.5 ± 1.5%, i.e. The difference between them was 21%. In the Omad variety, these figures were 17.3 ± 1.2 and 8.3 ± 1.5%, respectively. In the AN-Bayaut-2 cultivar, slight differences in this trait were found from the variants of the experiment.

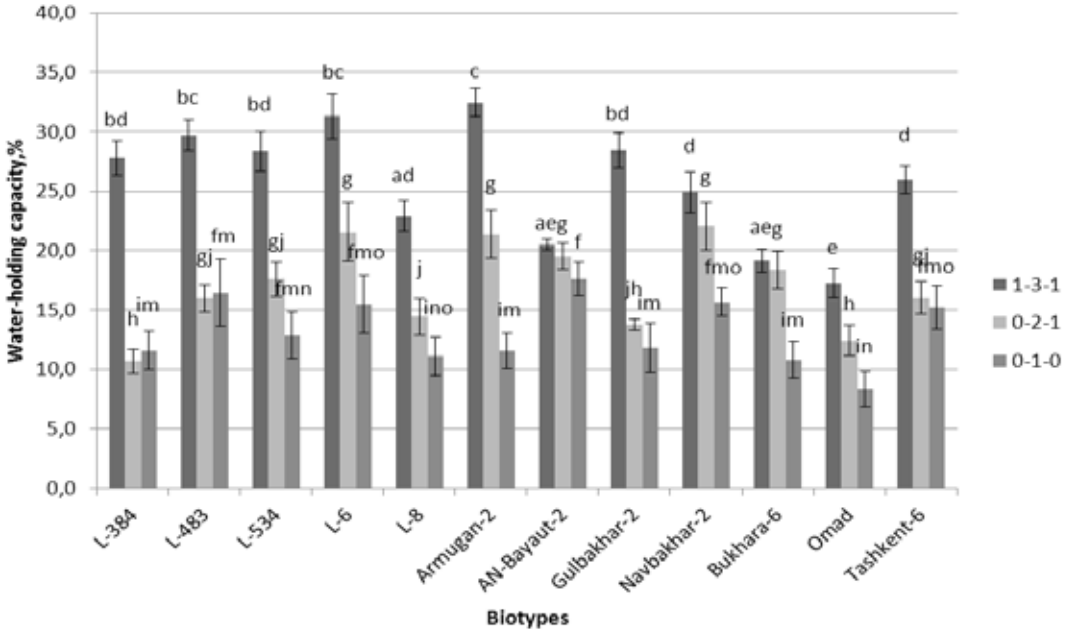

Figure 3. Water-holding capacity of leaves of biotypes under different conditions of water availability (Letters indicate the degree of reliability of differences between samples (P < 0.05) according to the Fisher PLSD test)

With the 0–1–0 irrigation scheme, the highest evaporation of water in this class was observed in comparison with other cotton samples. In the variant of the 1–3–1 irrigation scheme, all introgressive lines showed high indexes, while in the 0–1–0 irrigation scheme the L-8 and L-384 lines showed a high water-holding capacity (Fig. 3).

Thus, as a result of the studies carried out, it can be concluded that with increasing in the water deficiency in the soil, the total water content in the leaves of cotton decreases with a simultaneous decrease in the intensity of the transpiration process. On the other hand, the water retention capacity of the leaves increases. The observed differences are the result of the adaptability of the studied cotton samples depending on the genotype.

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TAXONOMICAL STRUCTURE OF DOGS' POPULATION ECTOPARASITES (*CANIS FAMILIARIS* DOM.) IN TASHKENT MEGAPOLIS, UZBEKISTAN

Abstract: Some peculiarities of the species diversity of dogs' ectoparasites under the conditions of the urban environment in Tashkent megapolis were studied. It was registered 17 species of ectoparasites belonging to the type of arthropods (Arthropoda) formingo two classes – Arachnida and Insecta. The Arachnida representatives are represented by 10 species belonging to the following families – Ixodidae (8 species), Sarcoptidae (1) and Demodecidae (1). The Insecta class is represented by 7 species that belong to the following 5 families – *Trichodectidae* (1), *Haematopidae* (1), Pulicidae (2), Culicidae (2) and Hippoboscidae (1). The total infection of the dog population was caused by ticks (65.6%) and insects (53.7%). This is an initial data characterize the degree of infection of the domestic dog with the ectoparasites in the megapolis under study.

Keywords: Ectoparasites, Arachnida, Insect, Megapolis, dog, Tashkent, Uzbekistan.

Introduction

The processes of urbanization, in some degree, happens in all regions of the planet. Large and small cities, megacities are formed all the time, leading to the formation of an urban ecosystem with peculiar abiotic and biotic factors. All these factors have a significant impact on the fauna, the inhabitants of the urban environment (Dremova [4]). In this respect, special attention should be paid to the study of the community of parasites of a domestic dog – a typical representative of the fauna of mammals in the urban environment in Tashkent megapolis.

Tashkent is the largest city in Central Asia. It is located in the north-eastern part of the Republic of Uzbekistan, right in the valley of the Chirchik river, at an altitude of 440–480 m above the sea level. The climate is continental. Modern Tashkent is a huge megapolis located on the territory of more than 30.0 thousand hectares, with a population of about 2.5 million people. A city ecosystem with all the components is formed here. These and other factors have a significant impact on the fauna, biology and ecology of species of invertebrates and vertebrates living in urban environments. In this context, we are interested in parasites representing medical-sanitary and veterinary importance in the metropolitan area under study.

According to the latest veterinary statistics, during 2018, about 25.000 domestic dogs kept in houses and apartments have been registered in Tashkent. According to known data of parasitologists, in Uzbekistan, more than 30 species of helminths have been registered on domestic dogs, some of which have adapted to parasitize in the animals and humans body (Sultanov and othres, 1975, Azimov and others, 2016).

Due to the increase in the number of dog populations in Tashkent megalopolis, the problem of its regulation proved to be relevant, as well as the study of the role of parasites in the development of invasive diseases of humans and productive animals.

The present study is devoted to the species and taxonomic diversity of ectoparasites of the domestic dog population in the studied megacity.

Materials and methods. The study material was collected from March 2016 to March 2018 in the territory of Tashkent, consisting of four zones: multi-storey buildings, private buildings, forest parks and urban inconveniences. The dogs were examined in all seasons of the year – winter, spring, summer and autumn. A total of 160 individuals of domestic dogs were examined. Collection of parasitic insects and arachnids was carried out on the basis of popular methods (Agrinsky [1]; Zolotarev [5]; Doszhanov [3]).

The study and species determination of collected ectoparasites were carried out in the laboratory of the General Parasitology under the Institute of Zoology of the Academy of Sciences of the Republic of Uzbekistan.

To determine the quantitative characteristics of dog ectoparasites, the intensity of infestation (II, spe), the extent of invasion were tested (EI %).

Results and discussion. At the time of examination of 160 individuals of domestic dogs – 129 (EI-80.6%) were infected with ectoparasites related to Arthropoda, two subtypes – Chelicerata (Class Arachnida) and Tracheata (Class Insecta).

We have established that the class of Arachnida on the domestic dog on Tashkent megapolis is represented by 10 species; 8 species of them belong to the Ixodidae family of the Parasitiformes, 2 species – Acariformes (one species of the Sarcotptidae and Demodecidae families Figure 1).

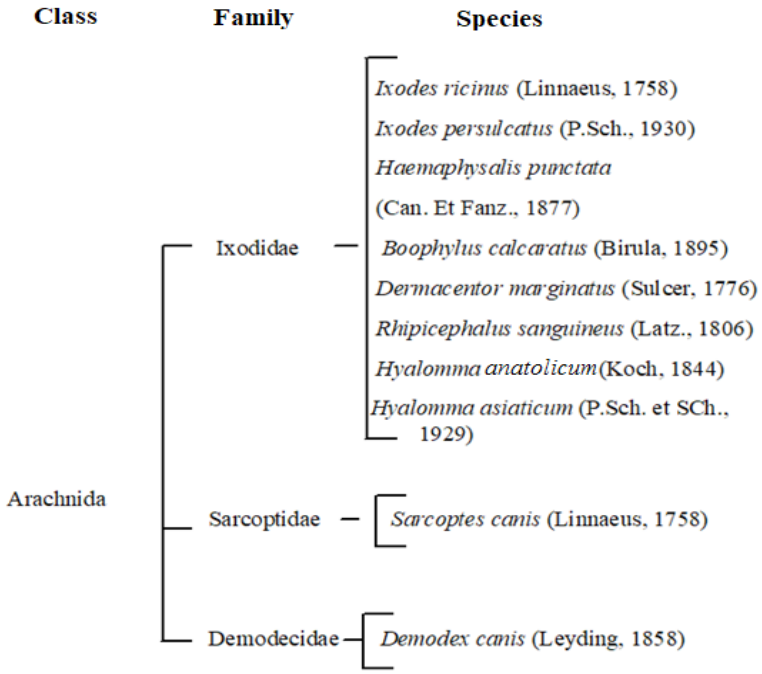

Figure 1. Species diversity of Arachnida – domestic dog ectoparasites of Tashkent megapolis

The total number of collected ticks was 2253 specimen. 105 (65.6%) out of 160 dogs were infected. The most numerous were the ticks of the Ixodidae class. In the animals studied, both monoinvasions and their associations were recorded. *Sarcoptes canis* and *Demodex canis* were found in 4 (3.8%) dog individuals in autumn and winter seasons.

The Insecta class is represented in the studied territory by four subclasses – Mallophaga, Anoplura, Siphonaptera, Diptera (Figure 2).

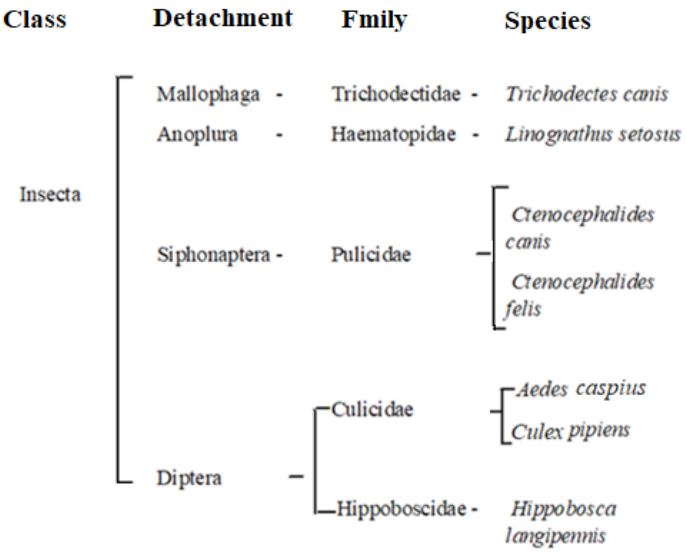

Figure 2. Species diversity of Insecta – the domestic dog ectoparasites in Tashkent megapolis

The total number of collected insects was 2743 specimen. 86 dogs out of the 160 individuals examined were infected with ectoparasites, which is 53.7% of an extent of invasion.

Species diversity of insects we noted is small. It consists of 7 typical species, which were registered mainly in associative form. Trichodectidae, lice and fleas were found, practically, in all seasons of the year, while diptera bloodsuckers were active in spring, summer and early autumn.

The data obtained by us show that the fauna of ectoparasites of a domestic dog is represented by 17 species, which consist of ticks: Ixodidae, Sarcoptidae, Demodecidae and insects: Trichodectidae, Haematopidae, Pulicidae, Culicidae, Hippoboscidae.

The distribution of the ectoparasite community is probably dependent on the specific ecological characteristics of the functional zones of the megalopolis. Together with a human, dog's ectoparasites – ticks, fleas, lice and bloodsucking Diptera, which can parasitize in humans penetrate in the urban environment.

The composition of the domestic dog's parasitocenosis of Tashkent megapolis is not constant in quantitative and qualitative relations. The species diversity of ectoparasites that make up the parasitocenosis of the animals under study is in a dynamic condition depending on the season of the year and their habitats in the megacity (Table 1).

Table 1.– Domestic dogs Ectoparasites of various functional zones in Tashkent megapolis

Family	Zones and number of species			
	Multi-storey buildings	Private buildings	Forest Parks	Urban inconveniences
Ixodidae	3	6	2	9
Sarcoptidae	–	1	–	1
Demodecidae	–	1	–	1
Trichodectidae	1	1	1	1
Haematopidae	1	1	1	1
Pulicidae	1	2	–	2
Culicidae	1	2	–	1
Hippoboscidae	–	1	–	1
In total	**7**	**15**	**4**	**17**

Characterizing the communities of the domestic dogs' ectoparasites in Tashkent megapolis, it should be noted that the number of species in different zones is different. The most number of species is recorded on dogs, kept in the areas of urban inconveniences (17 species) and private buildings (15). The number of species was the lowest in the forest-park zone (4). Thus, the formation of the dogs' parasitocenosis in urbanized areas, for example, in Tashkent megapolis, occurs through the following types of connections: topical, trophic and phoric, which corresponds to the well-known data (Vysotskaya [2]; Sklyar [6]).

The presented materials, which may have the nature of a preliminary communication, are becoming increasingly relevant due to the globalization of the anthropogenic impact on the environment and its components.

Conclusion

The conducted studies showed, that the populations of the domestic dogs in Tashkent megapolis are invaded by ectoparasites – blood-sucking mites of Arthropoda class and insects of Insecta class. Species diversity of ectoparasites consists of 17 species belonging to 8 families like – Ixodidae, Sarcoptidae, Demodecidae Trichodicidae, Haematopidae, Pulicidae, Culicidae и Hippoboscidae. The total infection of the urban population of dogs with ectoparasites was 65.7% in mites and 53.7% in insects with varying degrees of invasion intensity.

The distribution of the ectoparasite community is dependent on the peculiar ecological characteristics of the structure and functional features of the metropolitan zones of Tashkent. Together with a human, dog's ectoparasites – ticks, fleas, lice and bloodsucking Diptera, which can parasitize in humans penetrate in the urban environment. This explains the role of dog's ectoparasites in the occurrence of parasitic diseases not only of other domestic animals, but also of humans.

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COMPARATIVE CHARACTERISTICS OF BODY WEIGHT OF BEGINNER PUPILS (7–11 YEARS OLD) OF SOME SCHOOLS OF ANDIJAN REGION OF THE REPUBLIC OF UZBEKISTAN

Abstract: The indicators of physical development of children play an important role in monitoring their health. The purpose of this study is to describe the primary grade pupils (7–11 years of age) in Andijan region of the Republic of Uzbekistan on the basis of comparison of the body weight. The investigations were conducted in Andijan, Ulugnor district (school #17), Pakhtaabad district (school #26), Markhamat district (school #4), Andijan city (school #30) and Khanabad) are based on generally accepted anthropometric research methods in 2013–2018. Studies show that the increase in body weight in the 7–11 age range shows that children (7–11 years of age) in schools # 17, # 26, # 30, # 4 and # 5 minimal/their maximum values are – 20,4–27,4; 22.6–33.2; 23.4–35.8; 22.9–35.6 and 26.5–38.4 fluctuations were observed. This distinction could be explained by the fact that the surveyed schools are located in different geographical and climatic zones. That is, schools #17, #26, #30, #4– and #5 are located above the sea level–desert, steppes, foothills and foothills. Particularly, this distinction can be clearly observed in the values of weight (kg) of pupils (7–11 years) at schools # 17 and #5 in the desert area. The value of body weight in boys aged 7–11 in boys at schools #17, #26, #30, #4 and #5, located in desert, steppes, foothills and climatic zones of research 9–11 years, relatively high rates of growth (22.4%) were detected. Also, it was found that the rate of increase in body weight in girls aged 7–11 was significantly higher than that of boys and recorded 25.1% in the 9–11 age group. The achieved results show that a differential approach is needed to take into account the effects of factors affecting the climate–geographical situation in the development of anthropometric standarts/standarts for primary school pupils (7–11 years old), as well as in the development of a complex of medical/pedagogical correction and preventive measures of different characteristics.

Keywords: the body weight, primary school pupils, geographical/climatic zones.

Introduction

World Health Organization (*WHO*) stresses the importance of creating conditions for the physical, psycho-emotional development of children as a priority for the future of each society Especially physiometric/anthropometric researches for the continuous monitoring of the level of physical development and health of school-age children in the process of education have scientific practical importance

in the context of the development of a set of health promotion measures.

Moreover, analysing on the basis of camparing anthropometric indicators of organism of children living in different geographical areas is considered to be very important from the poit of view of learning the process of adjustment to climate geographical conditions of human organism [1, 17; 2, 3–22].

Materials and methods

The investigations were carried out in 2013–2018 in comprehensive school #17 located in Ulugnor district, in comprehensive school #26 located in Pakhtaobod district, in comprehensive school #4 located in Markhamat district, in comprehensive school #30 located in Andijan city and in comprehensive school #5 located in Khonobod town (Fig. 1).

Figure 1. The map location of comprehensive schools where invetigations were conducted

There are 740 comprehensive schools belonging to Public education department in the Andijan region of the Republic of Uzbekistan. The comprehensive school #17 where the investigation was conducted is located in the area of Mingchinor Village Citizens Coincil in Ulugnor district. Ulugnor district is located in the western part of Andijan region (coordinate of geographical location: 40°44' East latitude 72°46' North longitude). It was founded on 26/12/1973 and its area is 440 km^2, the climate is rapid continental/subtropic, in January average air temperature is –4 °C, in July + 24 … + 28 °C, average amount of annual atmospheric precipitations – 195–200 mm, population is 47.300 people (there are Uzbek, Kyrgyz, Tajik, Russian, Uygur, Tatar nations) (Ulugnor (district) // [Electronic resource]. URL: https://uz.wikipedia.org/w/index.php? title=Ulug nor_(tuman)&oldid=1929718 Application date: 04/08/2018; Ulugnor district // [Electronic resource].

The comprehensive school #26 where investigation was conducted is located in Madaniyat Village Citizens Council, Pakhtaobod ditrict, Andijan region. Pakhtaobod district is located on the north-east of Andijan region, its area is 26033 km^2, climate is medium, 3000 m above the sea-level, population consists of 165000 people (there are Uzbek, Kirgiz, Tajik, Russian, Uygur, Tatar nations) (Pahtaobod district // [Electronic resource]. URL: https://uz.wikipedia.org/w/index.php?title=Pakhtaobod _tumani&oldid=1991980 Application date: 04/08/2018).

The comprehensive school #30 in Navoiy Avenure, Eski shahar neighbordood, Andijan city.

The comprehensive school #5 in Kichik Nayman Village Citizens neighbordood, Markhamat district, Andijan region. Markhamat district is located in the southern part of the Andijan region (geographical coordinates: 40°30 East latidute' 72°20 North longiture), was founded on 29/09/1926 (center – Markhamat cit(y), the area is 320 km^2, north and North–the Eastern part is plain, the remainder of the foothill zone (1500 m above the sea level), and the southwestern part has the Alay Mountain Range, Ulughtog and Tuyamuyun hilly region (above sea level ~920 м), these geographical regions form the Oyim-Markhamat-Hojaabad mountain system; the northern part of the Moylisoy Hilly region; the climate is sharply continental; the average temperature in January is –2.9 °C, +26.1 °C in July, the average annual rainfall is 218 °C, 320 mm, population is 119.800 people (Uzbek, Kyrgyz, Russian, Tatar, Korean, Uygur, Kazakh, Ukrainian).

There are more than 28.000 pupils in over 40 secondary schools in Markhamat district (Markhamat district // [Electronic resource]. URL: https://uz.wikipedia.org/w/index.php? title=Markhama; t_tumani&oldid=1992006 Application date: 04/08/2018; Markhamat district // [Electronic resource]. URL: https://ru.wikipedia.org/w/index.php?title=Markhamat region&oldid=94179838 Application date: 04.08.2018 r.).

The comprehensive school #5 is loacated in Topolina Village Citizens Council in Khonobod town (coordinated geographical location: 40°48' East latitude. 73°00' North longitude.) located in eastern part of Andijan region. The climate of Khonobod town is subtropic, and consists of mountain ranges located in the area ~603 m above sea–level. The population of the town consists of 35181 people (there Uzbek, Kyrgyz nation representatives) (Khanabad//[Electronic resource]. URL: https://ru.wikipedia.org/w/index.php?title=Khanabad (Uzbekistan)&oldid=9416420 Application date: 04/08/20180).

Generally accepted anthropometric research methods were used in the investigation [3, 76–79; 4, 107]. In the investigations we carried out the record of body weight (kg) value as one of the essential indicators of phyical development of primary school–children [5, 59–61; 6, 27] (7–11–year old children). Medical scale of weighing the children's body weight was carrie out by (TU9441-004-00226425-2005) [7, 10–336; 8, 455–458; 9, 30], i.e. the body weight of the tested pupil determined by weighing with medical scale without clothes except his underwer (determination degree of measuring is equal ± 100 g).

Statistical analysis. Data were analyzed by OriginPro v. 8.5 SR1 (EULA, USA). The taken results were mathematically and statistically reworked by means of the following methods given by L. V. Denisova et al. (2008) [8, 455–458; 10, 5–312; 11, 7–127]. The results were given in $M \pm m$ form of results of experiments carried out in n times repeatability, and M expresses an average arithmetic value and m – value of mistake. Here, $\overline{x}_{aver.}$ means the sum of total elements towards its sum in statistic selection and in our experiment it was calculated by the following formula as (n) the ratio towards the number of experiments of obtained total sum $\left(\sum x\right)$ in experiments:

$$\overline{x}_{avr.} = \frac{\sum x}{n} \qquad (1)$$

The average squared deviation (σ) is calculated using the following formula, expressed as the square root of the dispersion value:

$$\sigma = \sqrt{\frac{\sum (x - \overline{x}_{ypm.})^2}{n}} \text{ or } \sigma = \sqrt{\sigma^2} \qquad (3)$$

Also, the results of the experimental results were calculated on the basis of Student t – scores and the $p < 0.05$ values were evaluated statistically as $p < 0.01$. The distinction reliability level between the two experimental groups was calculated according to the Student criterion [12, 675–678]:

$$t = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{m_1^2 + m_2^2}}$$

Results and Discussion

In the general education schools where experiments were conducted, the physical characteristics of primary school pupils were characterized by a comparative characteristic of the level of body weight (kg) (Tabl. 1).

Tabl 1.– The body weight (kg) of primary school pupils (7–11 years old) in some schools of Andijan region of the Republic of Uzbekistan ($M \pm m$)

Comprehensive school #17 located in Ulugnor district										
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***
Anthropometric indicator	**Boys (n = 85)**					**Girls (n = 79)**				
	7 years old (n = 16)	8 years old (n = 21)	9 years old (n = 16)	10 years old (n = 17)	11 years old (n = 12)	7 years old (n = 16)	8 years old (n = 12)	9 years old (n = 19)	10 years old (n = 18)	11 years old (n = 14)
Body weight (kg)	20.4 ± 0.2	22.7 ± 0.2	24 ± 0.3*	25.7 ± 0.5**	27.4 ± 0.4**	18.5 ± 0.2	22 ± 0.2	23.1 ± 0.5*	24.7 ± 0.4**	25.4 ± 0.4**
Comprehensive school #26 located in Pakhtaobod district										
Anthropometric indicator	Boys (n = 90)					Girls (n = 82)				
	7 years old (n = 16)	8 years old (n = 19)	9 years old (n = 11)	10 years old (n = 21)	11 years old (n = 23)	7 years old (n = 17)	8 years old (n = 16)	9 years old (n = 12)	10 years old (n = 24)	11 years old (n = 13)
Body weight (kg)	22.6 ± 0.1	24.5 ± 0.1	26.8 ± 0.2*	30.8 ± 0.4**	33.2 ± 0.3**	20.2 ± 0.1	22.8 ± 0.1	25.3 ± 0.4*	30.8 ± 0.3**	32.9 ± 0.3**
Comprehensive school #30 located in Markhamat district										

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Anthro-pometric indicator	Boys (n = 76)					Girls (n = 88)				
	7 years old (n = 14)	8 years old (n = 18)	9 years old (n = 12)	10 years old (n = 13)	11 years old (n = 19)	7 years old (n = 11)	8 years old (n = 22)	9 years old (n = 17)	10 years old (n = 23)	11 years old (n = 15)
Body weight (kg)	23.4 ± 0.2	25.6 ± 0.2*	27.7 ± 0.3**	32.9 ± 0.3**	35.8 ± 0.4**	22.4 ± 0.2	23.6 ± 0.2	26.4 ± 0.3*	32.8 ± 0.5**	34.4 ± 0.4**
Comprehensive school #4 located in Andijan city										
Anthro-pometric indicator	Boys (n = 82)					Girls (n = 78)				
	7 years old (n = 14)	8 years old (n = 12)	9 years old (n = 18)	10 years old (n = 20)	11 years old (n = 18)	7 years old (n = 16)	8 years old (n = 11)	9 years old (n = 17)	10 years old (n = 22)	11 years old (n = 12)
Body weight (kg)	22.9 ± 0.3	26.1 ± 0.3	27.3 ± 0.2**	31.7 ± 0.4**	35.6 ± 0.5**	23.2 ± 0.3	24.2 ± 0.3	25.9 ± 0.4*	33.1 ± 0.5**	34.6 ± 0.6**
Comprehensive school #5 located in Khonobod town										
Anthro-pometric indicator	Boys (n = 87)					Girls (n = 84)				
	7 years old (n = 19)	8 years old (n = 14)	9 years old (n = 24)	10 years old (n = 13)	11 years old (n = 17)	7 years old (n = 14)	8 years old (n = 17)	9 years old (n = 18)	10 years old (n = 16)	11 years old (n = 19)
Body weight (kg)	26.5 ± 0.3	27.4 ± 0.2*	33.6 ± 0.3**	37.5 ± 0.5**	38.4 ± 0.4**	25.3 ± 0.2	24.4 ± 0.2	29.4 ± 0.5*	35 ± 0.4**	35.7 ± 0.4**

Note: The degree of statistical reliability of the difference between the experimental group (7 years) relative to experimental groups (– $p < 0.05$; ** – $p < 0.01$)*

Thus, in comprehensive school #17, experiments show that the rate of growth of the body weight in boys, between ages 7–11 years old, makes 34.3% in total, in the 7–9 age group – 17.6%, and in the 9–11 age group this indicator is 14.2%. The rate of increase in body weight in girls aged 7–11 is 37.3%, it is 29.9% between the ages of 7–9 and 9.9% in the age group 9–11.

Also, in comprehensive school #26, the rate of growth of body weight in boys, in 7–11 age group, total 46.9%, between 18% of age 7–9 and the age range 9–11, this indicator is 23.8%. The rate of increase in body weight in girls aged 7–11 is 62.8%, especially in the 9–11 age group, and this figure is 30.1%. In comprehensive school #30, aggregate growth rate of boys in the 7–11 year age group is 52.9%, 18.4% in the age group 7–9 and 29.2% was calculated. The percentage of body weight in girls between the ages of 7 and 11 is 53.6%, 7–11 years – 17.9% and 30.3% in the 9–11 age group.

At next comprehensive school #4, the rate of growth of body weight in boys is 55.4% in the 7–11 age group, 19.2% in the 7–9 age group and 30.4% in the 9–11 age group was calculated. The rate of increase in body weight in girls aged 7–11 ranges from 49.1% in the range of 7–11 years to 11.6% in the range 9–11 years and it is 33.5%.

Also, in primary school #5, the rate of growth of body weight in boys aged 7–11 is 44.9% among boys aged 7–11, 26.8% in the age of 7–9, and 14–11 age group, and 3%. The rate of increase in body weight in girls aged 7–11 was 41.1% in the range of 7 to 9 years and 16.2% between the ages of 7–9 and 21.4% in the 9–11 age group.

Based on the results of the experiments obtained, it can be seen that in primary school pupils the percentage of body weight (kg) in the age range 7–11 increases with linearity (Fig. 2 A, B).

In particular, the minimum/maximal values of body weight (kg) of pupils of elementary grades (7–11 years) in general secondary schools #17, #26, #30, #4, and #5 – respectively 20,4–27.4; 22.6–33.2; 23.4–35.8; 22.9–35.6 and 26.5–38.4 fluctuations.

In this view, legitimate differences can be attributed to the fact that the schools surveyed are located in different geographical and climatic zones. In this sequence, as shown in the mapping scheme of the Andijan region, general secondary schools #17, #26, #30, #4, and #5 are located at this altitude above sea level–desert (300 m above sea level) (at a height of ~400 m above sea level), Hill (at a height of ~400–600 m above sea level) and in Foothills (at a height of 1000 m above sea level). Particularly, this distinction can be clearly observed in secondary school #17 and general secondary school #17, located in the desert area (7–11 years), in the body weight (kg) figures (Fig. 2).

The results of these experiments are generally in line with the available literature data. In particular, the morpho–functional growth and developmental processes in the human body during the childhood/adolescence are highly intensive,

which, in turn, is highly responsive to the effects of climate–geographical, ecological and social factors [13, 4]. In addition, the research shows that the value of physical development and training indicators of elementary schoolchildren is directly related to climatic–geographical conditions (environmental factors), activity, nutritional ration and regime [14, 3–19.].

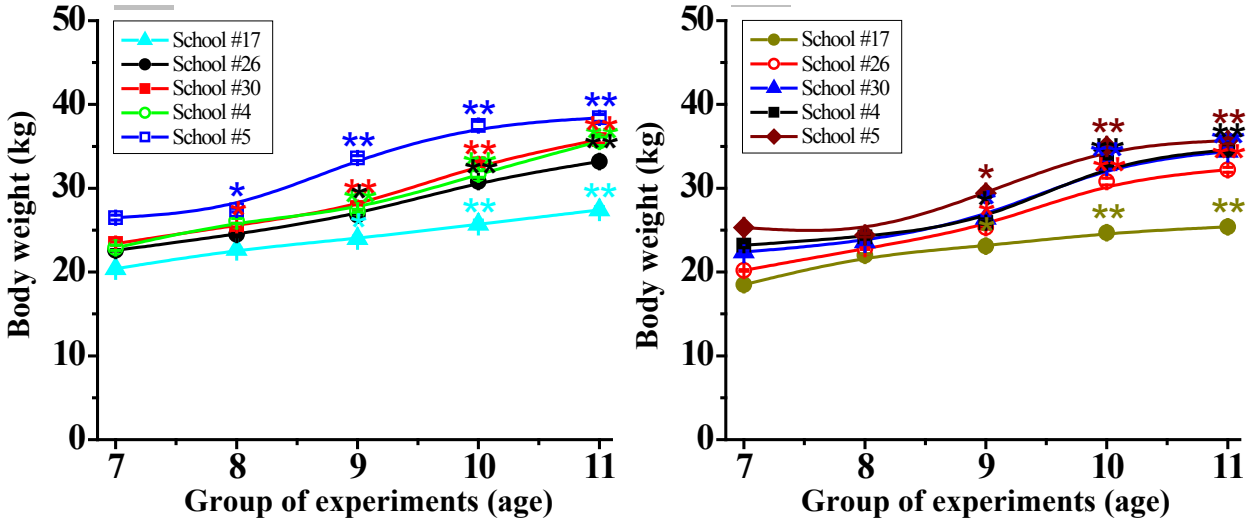

Figure 2. Dynamics of variation in body weight (kg) values of primary school pupils in age range 7–11 years in secondary schools. A. Among boys. Б. Among girls. * – $p < 0.05$, ** – $p < 0.01$

In some restrictions, the differences between the anthropometric parameters of the human organism in the climatic zones (altitude elevation) [15, 17–19; 16, 90–92], were identified that the body weight (kg) 2.2–2.6 times, the length of the neck (cm) 1.42–1.45 times higher than the normal average values in adult mountainous areas (7–17 years) are higher than 3000 m above sea level [16, 90–92].

Also, the study analyzes the dynamics of anthropometric indicators in the children aged 7 to 12 in the lowland (Kyrgyz Republic). Specifically, it was found that children of 7–12 years of age in the low mountain region had relatively high body weight, height, and cervical spine values compared to the high mountain area [2, 3–22].

It should be noted that in our studies, the highest levels of body weight in primary school pupils (7–11 years) compared to other climatic and geographical areas analyzed in the mountaineering zone (1000 m above sea level) – is a mountain area of the foothill zone may be associated with the specific adaptation mechanism of the child's organism.

Also, it can be seen from the analysis of the results above that it is observed that the values of body weight (kg) in girls in primary school pupils (7–11 years) are significantly lower in the corresponding age range of boys. This can be explained by the gender–specific characteristics of anthropometric parameters in the human body. In particular, some researchers have identified anatomical anthropometric parameters (body weight, height, chest circumference) of the person in physiological age, gender, ethnicity, and age [17, 918–920].

In its turn, it is important to monitor the quality of life of children and adolescents taking into account climatic–geographical, demographic characteristics, implementation of complex diagnostics and the development of medical/social programs that envisage a healthy lifestyle [18, 3–22.].

Based on the above–mentioned numerical data analysis, it was noted that the overall rate of increase in the body weight (kg) of elementary school pupils and the growth rates in the age range of 7–9 years and 9–11 in general secondary schools (Fig. 3).

It was also noted that the rate of increase in body weight in boys between the ages of 7 and 11 was uniformly higher than the desert zone, the adjacent zone and the hilly zone, and then a significant decrease in the area of the foothills. The characteristic of this law is observed in the 9–11 age range of boys' growth in body weight, and in the age group 7–9, almost close to each other (Fig. 3 A).

In these general schools, the rate of growth of body weight in girls at the age of 7–11 is minimal – 37.3, maximal – 62.8, and average 48.8%. The value of this indicator is 7–9 years minimum – 11.6% and maximum – 29.9%, average – 20.7%, 9–11 years – 9.9% and maximal – 33.5 and the average value – 25.1%.

On the contrary, it was noted that the rates of increase in body weight in girls at the age of 7–11 will gradually increase in the transition from the desert zone to the adjacent area and then gradually decline in the foothill zone. It also found that the rate of increase in body weight in girls at the age of 7–11 was found to be relatively high in the 9–11 age group (Fig. 3 A).

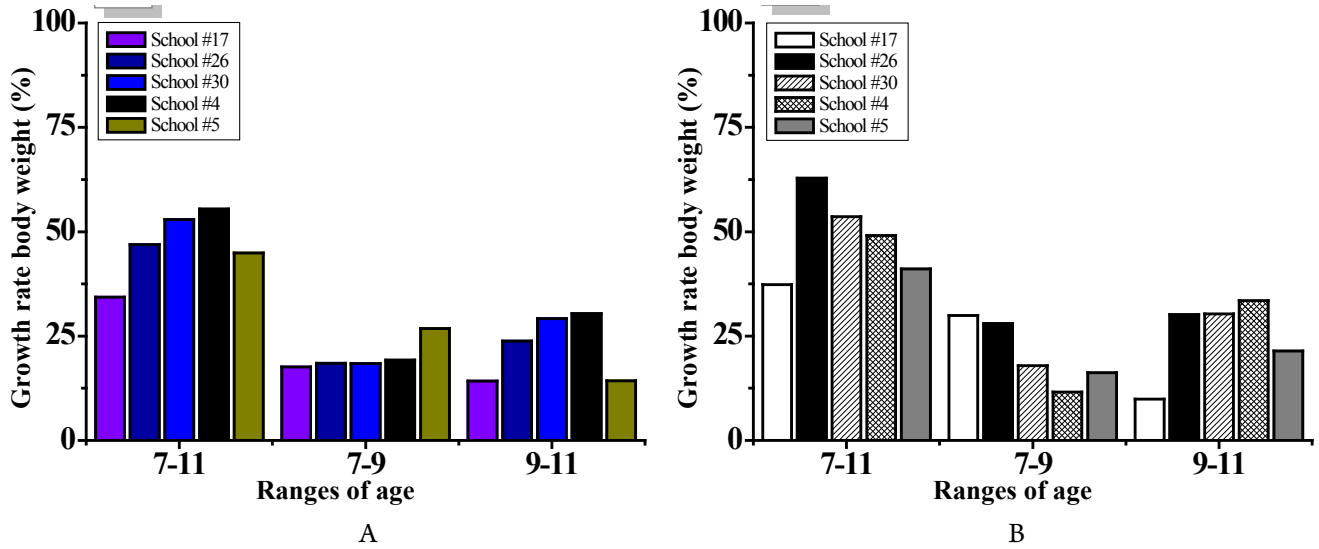

Figure 3. The rate of increase in the body weight (kg) index among primary school pupils at the age range 7–11 in the surveyed secondary schools. A. Among boys. Б. Among girls. In particular, the overall growth rate of body weight in boys aged 7–11 of elementary grades of comprehensive schools # 17, # 26, #30, #4 and #5 is minimal – 34.3% and maximum – 55.4%, average – 46.8%. The value of this indicator is 7–9 years minimum – 17.6% and maximal – 26.8%, average – 20.1%, minimum 9–11 years – 14.2% and maximal – 30.4 and the average value – 22.4%

The results are generally in line with the current literature data. Specifically, the research showed that the infant mortality rate increased by 1.2 times in females and by 1.3 times in females in the mean age of children in the middle–aged region of the Kyrgyz Republic (7–12 years of age), as well as in children The intensive growth of weight was 9–12 years, and in girls it was 9, 11–12 years old.

The proportional identification of indicators of physical development has been shown to allow estimates of the rate of deviation of children in the normal course of development [19; 3–21].

Conclusion

Thus, based on the obtained data, it is possible to conclude that in the steppe, steppes, foothills and mountain climatic zones, where the researches are conducted – secondary schools #17, #26, #30, #4 and #5 it was found that in the age group of 7–11 years old boys the percentage of body weight in primary school classes is relatively high (22.4%) at the age of 9–11 years. Also, the rate of growth of body weight in girls aged 7–11 is significantly higher than that of boys and makes up 25.1% in the 9–11 age group.

The results of the research are based on the differentiated approach to the impact of climate–geographical factors on the development of a standardized/normative anthropometric indicators (7–11 years), as well as in the development of a complex of medical/pedagogical correction and preventive measures of different characteristics.

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PRESERVING OF SAMPLES OF POMIGRANATE SORTS IN *IN VITRO* CONDITIONS

Abstract: The article presents the results of the slowdown in the growth of pomegranate varieties in *in vitro* conditions through increasing the concentration of sucrose in nutrient media. Increasing the concentration of sucrose from 30 g/l slows down the growth process of pomegranates. It was revealed that with the introduction of sucrose in the amount of 70 g/l into the nutrient medium, is possible to directly transplant the plants for 7 months while maintaining the viability of the plants. The reduction of sucrose in the nutrient medium from 70.0 g/l to 60.0 g/l remained from 7.1 to 42.85% of the plants. At concentrations of sucrose 70–90 g/l, clear inhibition of growth processes after storage for 5 months was noted, but the plants maintained their viability. In order to increase the duration of non-transportable storage of pomegranate plants in culture, it is necessary to combine the use of elevated concentrations of sucrose and cultivation of plants at a lower positive temperature for up to 1–2 years. It is noted that an increased concentration of sucrose (4–5%) in nutrient medium retards cell growth without causing a toxic effect, and therefore can be used to maintain cultures in a state of rest for a long period of time. Studies have established slowdown in growth process and the possibility of increasing the duration of direct cultivation to create a collection of pomegranate *in vitro*.

Keywords: pomegranate, sucrose, concentration, in vitro collection.

Introduction

Biotechnological methods are widely used in the world for the long-term preservation of plant collections used in the future for breeding purposes, the production of healthy planting material and for the preservation of the gene pool and plant biodiversity. One of the methodological approaches to the deposition of plants – is the content of biological objects in a slow metabolism. It is known that various organic substances with high osmotic activity are added to nutrient media to slow down the growth and preserve the invitational plant material. The researchers note that an increased concentration of sucrose (4–5%) in the nutrient medium retards cell growth without causing a toxic effect, and therefore can be used to keep cultures at rest for a long period of time. The goal of our study is to identify the effect of sucrose concentrations on the growth processes of pomegranate mericloning for long-term non-storage of plants in vitro collection.

Conservation of plant collections is particularly important for future use, both for breeding purposes, the production of a healthy planting material, and for the preservation of the gene pool and plant biodiversity as a whole. And biotechnological methods are widely used for long-term preservation of plant collections.

At the same time, special attention is paid to slowing down the growth and development of plants. One of the conditions for slowing down growth is the use of osmotic [1, 60–62].

To slow down the growth and preserve the invitational plant material, various organic substances with high osmotic activity are added to the nutrient media: glucose, sucrose [2, 733–736] or sorbitol [3, 145–146]. Sucrose has inhibiting properties of plant development under *in vitro* conditions. The inhibitory effect of sucrose is based on a change in the osmotic pressure of the fluid in the direction of exosmos.

While studying the growth and development of flax [4, 64–66], winter wheat [5, 68], potatoes [6, 46; 7, 8–10; 8, 15–16], poplar [9, 28–30], strawberries [10, 75], grapes [11, 9–12] *in vitro* conditions, it was proved that the addition of sucrose in the redistribution of 4–5% in the nutrient medium, retards the growth of plant cells. Therefore, for the storage of biotechnological plant collections, sucrose is used as a retarding agent for the growth and development of plants [12, 202; 13, 65–66].

The purpose of this research is to determine the concentration of sucrose, affecting the growth and development of pomegranate for long-term direct storage *in vitro* conditions.

Materials and methods

As objects of the research, we have selected plants of 5 varieties of *Punicagranatum L*. In this research, both general biotechnological methods were used [14, 125] equally as methods developed in the laboratory of biotechnology and virology of plants of the NBS-NNC [15, 190–192]. Sterilization of plant material and its introduction to an isolated culture was carried out in laminar boxes.

The conditions of sterilization of original plant material were determined experimentally for each studied culture. At the same time it needs to be taken into account the origin of the explants as well. The concentrations and exposures of the sterilizing reagent are also tested. As sterilizing agents for the release of endogenous or exogenous infections, 1–2% solutions of sodium hypochlorite NaClO, 70% ethyl alcohol – C_2H_5OH, 0.08% solution of silver nitrate $AgNO_3$ were used, that freed isolated explants from exogenous and endogenous infections. For cultivation of pomegranates, *in vitro* were used mineral base of Murasige-Skooga nutrient media [16, 477–482].

Samples of pomegranate varieties were deposited after recovery by using the culture method of apical meristems with a relative explants size of 0.1–0.2 mm. In order to increase the regenerative capacity of the meristem during micro multiplication of obtained plants, there were used cloned micro-multiplication of scheme and technology [12, 202–203].

Estimated plant viability at a frequency of once a month in the number of leaf and shoot tissue necrosis:

– visual death of plant – 0 points;
– necrosis of more than 50% of tissues plants – 1 point;
– necrosis of less than 50% of tissues – 2 points;
– plants without necrosis – 3 points.

In order to find the optimal condition for slowing the growth of pomegranate varieties Qizil anor, Qozoqi anor, Qaiym anor, Oq dona (tuya tish), Achchiq dona were studied in terms of the influence of sucrose at concentrations of 10–90 g/l. The content of sucrose was in the amount of 60–70 g/l in a nutrient medium.

Result and discussion

Discussions of the results of data on the state of growth and development of pomegranate plants of the Qozoqi anor variety at various concentrations of sucrose under *in vitro* conditions are given in the (table 1).

Table 1. – Viability of test-tube plants of grapes at various concentrations of sucrose, Qozoqi anor variety, 2017–2018.

Sucrose g/l	Retention,%	Roots			Height, sm	Leaf quantity, pc	Growth rate. sm per day	Polarity coefficient
		Quantity, pc	Length, sm	Resogenous zone, см				
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Recording after 25 days of cultivation								
10.0	100	4.6	1.8	8.3	1.9	2.5	0.08	4.4
20.0	96.4	4.1	2.2	9.0	1.8	2.3	0.07	5.0
30.0	100	4.8	2.6	11.0	2.2	2.5	0.09	5.0
40.0	96.4	4.0	2.8	11.2	1.8	2.3	0.07	6.2
50.0	96.4	4.0	2.9	11.2	2.2	2.3	0.09	5.1
60.0	82.1	3.7	3.0	11.1	1.8	2.2	0.07	6.2
Recording after 45 days of cultivation								
10.0	100	5.0	2.8	14.0	4.0	5.6	0.09	3.5
20.0	96.4	4.9	2.9	14.2	4.0	5.7	0.09	3.6
30.0	100	4.9	3.7	18.1	5.0	6.8	0.1	3.6
40.0	96.4	4.7	4.0	18.8	4.6	6.4	0.1	4.1
50.0	96.4	4.6	3.8	17.5	4.8	6.3	0.1	3.6
60.0	82.1	4.4	4.1	18.0	4.7	6.4	0.1	3.8

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Recording after 65 days of cultivation								
10.0	100	5.1	3.0	15.3	6.2	8.5	0.09	2.5
20.0	96.4	5.5	3.3	18.2	6.2	8.7	0.09	2.9
30.0	100	5.1	4.3	21.9	7.6	10.0	0.11	2.9
40.0	96.4	5.3	4.4	23.3	7.4	9.5	0.11	3.1
50.0	96.4	5.1	4.3	21.9	7.8	9.4	0.12	2.8
60.0	82.1	4.5	4.8	21.6	7.2	9.3	0.11	3.0
Recording after 85 days of cultivation								
10.0	100	5.3	2.2	11.7	8.4	10.3	0.11	1.4
20.0	96.4	4.1	3.1	13.0	8.4	10.6	0.11	1.5
30.0	100	4.4	4.3	18.9	9.8	12.0	0.12	1.9
40.0	92.8	4.2	3.6	15.8	9.4	11.8	0.12	1.7
50.0	92.8	4.0	3.8	15.2	10.0	11.7	0.13	1.5
60.0	78.6	3.7	4.1	15.6	8.7	11.4	0.11	1.8

It should be noted the high survival rate of micro cuttings and the safety of plants in the experiment. Only at the maximum concentration of sucrose the deterioration of the development of micro-cuttings was noted. During the entire cultivation period, the optimal development of plants occurred at a sucrose concentration of 30 g/l. At the minimum (10 g/l) and maximum (60.0 g/l) concentrations, root formation deteriorated, the length of the rhizogenic zone, the growth rate, and the decrease in the foliage of the shoots decreased. In general, the slowdown of growth processes was not significant; based on this, part of the plants were transferred to a culture room with a low temperature to extend the plant storage period.

Plants, that were transferred in the culture room with a lower temperature were maintained for 6 months (Table 2). In versions with minimal sucrose concentrations in surviving plants, the viability was 2 points. When the concentration of sucrose is 40 g/l, pomegranate plants are characterized by satisfactory viability – 1.6 points and shoot aging in single plants. With increased sucrose concentrations of 50–60 g/l, the viability and the number of surviving plants decreased, but green leaves still existed, shoots matured.

Table 2. – The condition of plants after storage for 6 months in the cultural room with a low temperature, variety of pomegranate sort of Qozoqi anor, 2018

Sucrose, g/l	**Kept, pc.%**	**Height, см**	**Leaves, pc**			**Retention**	**Band, pc**		
			Green	**Yellow**	**Dried**		**Green**	**Dry**	**Yielded**
10	3/100	14.0	14.6	3.4	–	2.0	3	–	–
20	3/100	15.3	20.3	–	1.6	2.0	3	–	–
30	2/66.7	10.3	4.0	–	5.5	1.0	1	1	–
40	6/100	14.5	9.4	5.3	6.0	1.6	1	2	3
50	3/50	10.0	5.3	–	8.0	1.0	–	1	2
60	6/66.6	9.8	3.6	–	11.5	1.0	1	3	2

The presence of plants for 3 months at a temperature of 25–27 °C on a nutrient medium with a high content of sucrose, followed by transfer to conditions of low temperature ensured their safety without a decrease in viability for 9 months. Single plants remained in a satisfactory condition, their cultivation continued. Similar results were obtained in experiments on the study elevated concentrations of sucrose (4–6%) on varieties of pomegranate Qayim anori, Achchiq dona.

Table 3. – Viability of test-tube plants of grapes at various concentrations of sucrose, Oq dona (Tuya tish) sort, 2012–2013

Sucrose g/l	**Kept,%**	**Roots**			**Heght, sm**	**Leaf quantity, pc**	**Growth rate. Cm per day**	**Polarity coefficient**
		Quantity, pc	**Length, sm**	**Resogenous zone, sm**				
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Recording after 30 days of cultivation								
10.0	100	5.7	3.3	19.2	3.6	2.3	0.12	5.3

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
50.0	100	4.9	3.5	17.1	2.6	1.8	0.09	6.5
60.0	96.5	4.5	3.1	14.1	2.1	1.5	0.07	6.9
70.0	100	4.1	3.0	12.3	2.4	1.3	0.09	5.1
80.0	96.5	3.0	2.7	8.1	2.0	1.3	0.07	4.0
90.0	100	3.2	2.0	6.5	1.8	2.0	0.06	4.0
Recording after 60 days of cultivation								
10.0	100	5.5	3.4	18.7	7.0	4.7	0.11	2.7
50.0	82.2	4.8	3.9	18.8	4.7	4.5	0.08	4.1
60.0	92.9	4.7	3.8	18.0	4.3	3.5	0.07	4.2
70.0	89.3	4.2	3.9	16.4	4.1	3.5	0.06	4.0
80.0	71.6	3.0	3.5	11.0	2.9	2.5	0.05	3.8
90.0	71.4	3.5	2.5	9.0	2.9	2.3	0.05	3.1
Recording after 90 days of cultivation								
10.0	100	5.8	3.6	20.8	10.5	6.6	0.11	2.0
50.0	82.1	5.2	4.5	22.8	7.2	6.5	0.08	3.1
60.0	67.9	5.0	4.4	21.5	6.6	6.2	0.07	3.3
70.0	85.7	5.0	4.9	24.5	6.3	5.8	0.07	3.8
80.0	39.3	5.0	4.8	24.0	4.7	4.2	0.05	5.1
90.0	25.0	5.4	4.1	21.8	3.8	3.4	0.04	5.0

In setting the experiment on the Oq dona variety (tuya tish), higher concentrations of sucrose were included in the study: 50, 60, 70, 80, 90 g/l. From the analysis of the data given in table. 3, it follows that the optimal development of plants occurs when the sucrose content in the nutrient medium is 10.0 g/l. At elevated concentrations of sucrose, the decrease in the safety of plants and the intensity of growth processes was observed. Reducing the growth rate of plants and the intensity of growth processes are in this situation a positive phenomenon, since they ensure the minimization of growth for the deposit of plants in the collection.

Observations on the state of plants in the collection (Table 4) showed that when they were stored for 200 days, the plants dry out, the number of green, yellowed plants and the number of dry leaves decrease, and the plants' vitality decreases. At elevated concentrations of sucrose, a decrease in the intensity of growth processes is most pronounced and is expressed primarily in the slowing down of plant growth. When cultivated for 220 days, this process is aggravated and the drying of plants and the decrease in their viability at sucrose concentrations above 70.0 g/l were observed. It should be noted that in this experiment the maturation of plants occurred. At a concentration of 50 g/l-9 plants, at a concentration of 60 g/l – 3 plants, 70 g/l – 6 plants and 90 g/l –1 plant matured.

Table 4. – Indices of plant viability in direct cultivation on a nutrient medium with various concentrations of sucrose, Oq dona (Tuya Tish) grape variety, 2018.

Sucrose g/l	**Kept,%**	**Plant height, см**	**Leaves, quantity**			**Survivability, rates**
			Green	**Yellow**	**Dry**	
1	*2*	*3*	*4*	*5*	*6*	*7*
Cultivation during 214 days (07.11.13.)						
10.0	26/92.8	15.9	7.8	2.7	3.4	1.8
50.0	20/71.4	11.3	5.9	2.9	4.0	1.8
60.0	12/42.8	11.0	7.7	3.0	2.5	1.8
70.0	11/39.2	100	5.6	2.5	5.3	1.5
80.0	8/28.5	5.0	3.1	2.0	4.5	1.4
90.0	2/7.1	5.5	3.0	2.5	5.0	1.4
Cultivation during 260 days (23.12.13.)						
10.0	26/92.8	–	3.5	6.0	4.4	1.0
50.0	19/67.8	–	4.5	3.8	4.5	1.1
60.0	12/42.8	–	4.1	5.0	4.1	1.2

1	*2*	*3*	*4*	*5*	*6*	*7*
70.0	8/28.5	–	4.0	4.8	4.6	1.2
80.0	6/21.0	–	2.1	2.3	4.9	1.0
90.0	2/7.1	–	2.0	3.0	5.5	1.0

The storage period of Oq dona variety (tuya tish) on a nutrient medium with different sucrose contents was 7 months. The greatest number of plants was preserved at a sucrose content of 10 g/l – 9 pieces, 4 plants each were preserved at concentrations of 50 and 60 g/l, individual plants were preserved at high concentrations of sucrose – 70–90 g/l.

With the introduction of sucrose in the amount of 70 g/l into the nutrient medium, the possibility of direct cultivation of plants of the pomegranate varieties Bedona, Ulfi, Qayim anor, Pushti Gulosha (clone 2–3) and Qoraqayin was established in 9 months. At the same time, their aging occurs and viable plants remain in storage.

Thus, for most of the studied varieties, the possibility of direct storage of plants up to 90 and even 240 days on a nutrient medium with a sucrose content of 60.0 g/l has been proved.

Cultivation of pomegranate plants continued under standard conditions for 240 days. During this period, 8 plants from a variant with a sucrose concentration of 5.0 g/l.4 plants from a variant with a concentration of 20.0 g/l, and 7 pomegranate plants from a variant with a concentration of 60.0 g/l were preserved viable. The results of our research on the use of elevated concentrations for long-term storage of pomegranate plants have been confirmed, moreover, the possibility of using for these purposes lower concentrations of sucrose has been revealed.

Conclusion

With an increase in sucrose concentration in nutrient media above 30 g/l, the growth processes of granate plants slow down: root formation, root length and rhizogenic zone length, plant growth and leafiness of plants decrease: Installed opportunity of introduction into the composition of the nutrient medium sucrose in the amount of 70 g/l possible direct cultivation of plants for 7 months with preserved viability of plants. A decrease in the sucrose content in the nutrient medium from 70.0 g/l to 60.0 g/l increases the depositing time up to 360 days.

From storage, from 7.1 to 42.85% of plants remained, depending on the variety and condition of the plants before putting them for storage. At sucrose concentrations of 70–90 g/l, a clear inhibition of growth processes after storage for 5 months was noted, but the plants maintained their viability. However, when deposited for 8–10 months in these variants of the experiment, a sharp decrease in viability and intensive drying of the plants was observed. It is not possible to recommend these concentrations of sucrose for the deposition of *in vitro* pomegranate. In order to increase the duration of non-transportable storage of pomegranate plants in culture, it is necessary to combine the use of elevated concentrations of sucrose and cultivation of plants at a low positive temperature for up to 1–2 years.

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Section 2. Geography

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COMPARATIVE ANALYSIS OF THE PROTECTED NATURAL TERRITORIES OF THE REPUBLIC OF UZBEKISTAN AND THE INTERNATIONAL UNION OF NATURE PROTECTION

Abstract: The article presents a general classification of protected natural territories of the Republic of Uzbekistan by IUNP categories. Each of the categories of these territories is described in detail, taking into account the peculiarities of their regime and status, which are located on them by environmental protection institutions. It was proposed to use the IUNP category system to improve the national classification and its adaptation to international standards in the process of revising the legislation on protected areas of Uzbekistan.

Keywords: protected natural areas, categories, classification, reserves, parks, legislation, IUNP, WWF.

The process of creating a representative network of specially protected natural territories (hereinafter referred to as PNT) is inevitably associated with the creation of new and changing existing protected areas. At the same time, the issue of choosing a category of protected areas is important. The priority of environmental tasks, the protection regime, the possible profile and zoning of the created PNT depend on it [6]. The Republic of Uzbekistan is interested in improving the system of protected natural territories (hereinafter – PNT) with the experience of advanced states in general, in particular, in Germany, Austria, Great Britain, the USA, Russia and other states. In these countries over the past two or three decades, environmental protection legislation has been well tested. It can be argued that these states today have advanced experience in supporting the integrity and conservation of wildlife diversity and ensuring that people use natural resources on a sustainable and reasonable basis.

According to LA Yudanova, in world practice there is a large variety of forms of special natural territories. And the most urgent task in this matter is their classification [9]. Therefore, PNT classifications are developed by researchers, ecologists, geographers, lawyers and other scientists. Existing PNT classifications are divided into various categories based on genesis, content, purpose and mode, legal status, function, as well as their meaning. In domestic and foreign literature on the protection of natural territories, many attempts have been made to create a unified classification of protected areas. For example, V. A. Borisov, N. F. Reimers, F. R. Shtilmark, R. F. Dasmann, S. Editor, K. Bishop, N. Dudley, A. Fillips, S. Stolton, E. Kreuzberg-Mukhina, E. Bykova, A. S. Krotik, T. V. Kovaleva, N. A. Sobolev and other scientists were engaged in the classification of the protected areas. Such classifications are of paramount importance for science, since they allow for a comparative assessment by categories of the International Union for Conservation of Nature (hereinafter – IUNP). The main purpose of the classification is the appropriate choice of protected areas to ensure the region's environmental safety and sustainability. This classification, which differs from the domestic one, is used below in the characterization of the world system of protected areas. When familiarizing with it, one should keep in mind the significant difference in the functions implemented by each category of protected areas. Among these functions, an important place attracts attention is the applied aspects: tourism and recreation, sustainable use of natural resources, maintenance of environmental services [3].

The positive aspects of the IUNP PNT definition system were expressed by foreign scientists K. Bishop (2006) who indicated that the IUNP definition system played an important role as a mechanism for unifying PNT national names. When considering the types of classification of protected areas, it is clear that all of them are quite similar to each other, but each has its own specific capabilities.

At the same time, most states have their own specific categories of protected areas, the idea of which was formed gradually, absorbing the national traditions and experience of other countries. Due to the extremely large diversity of protected

areas, classifications that would cover all the categories known in the world have not yet been created [8].

The standard consolidation of the notion "protected natural territories" was implemented in the law of the Republic of Uzbekistan "On protected natural territories" dated December 3, 2004 No. 710-II. The adopted PNT state laws provide general, legal, environmental, economic, and organizational bases for their protection.

From the preamble of this law, it follows that the PNT are plots of land and (or) water space (water area) that have priority environmental, scientific, cultural, aesthetic, recreational and sanitary and recreational value, fully or partially, permanently or temporarily removed from economic exploitation [four].

Uzbekistan has a developed PNT system consisting of 7 categories. Each category has its own special protection mode. When considering the types of classification of the PNT, it is clear that all of them are quite similar to each other, but each has its own specific capabilities. The law provides for the possibility of creating various categories of protected areas in line with international practice, these are state nature reserves; complex (landscape) reserves; natural parks; state monuments of nature; areas for the preservation, reproduction and restoration of individual natural objects and complexes; protected landscapes and territories for the management of individual natural resources. And also, the legislation provides for the creation of state biosphere reserves, national parks, interstate and other protected natural areas [4].

In our opinion, the domestic category and classification of PNT should coincide with the IUNP classification generally accepted in world practice. This allows us to compare examples of solving problems with the establishment of a mode of economic activity within PNT in foreign countries with how this is solved in the Republic of Uzbekistan. Therefore, it is necessary to conduct a comparative analysis of the classification of the categories of protected areas with the IUNP classification. The categories of protected areas according to the Law of the Republic of Uzbekistan "On Protected Natural Territories" (2004) correspond to the classification of categories of management of the protected areas, adopted in 1994 by the IUNP World Commission on Protected Areas (Table 1).

It should be noted that there is no consensus in science and practice on the ratio of the categories of protected areas to the classification of IUNP with the domestic classification. For example, according to A. S. Krotika, dendrological parks and botanical gardens belong to category II, and state natural reserves to category IV. In turn, T. V. Kovaleva assigns dendrological parks and botanical gardens to the V category, and reserves of federal significance to the III and IV categories, regional to the IV and V N. A. Sobolev natural parks equates to the V category, and natural monuments to category III and IV [7]. Sometimes it turns out that many OPT with one or another (international, republican, regional and local) status fall into two or three categories of classification at once, which causes confusion.

Table 1.– Geoecological classification of protected areas

№	PNT groups		Types of PNT	IUNP PNT categories
	By function	By purpose of use		
I	Conservation and reference	Standards, protected in strict mode	State nature reserves	Ia
			Interstate reserves	Ia
		Managed Reserves	State Biosphere Reserves	Ib
			Complex (landscape) reserves	Ib
II	Resource conserving and stable use	Multipurpose using	National parks	II
			Natural parks	II
		Relative reserve	State Monuments of Nature	III
III	Environment and preserving	Restoring	Reserves	IV
			Natural nurseries	IV
		Supportive and preserving	Water protection zones	V
			Coastal stripes	V
			Zones of sanitary protection of water objects	V
			Surface and groundwater formation zones	V
IV	Resource Saving and managers	Combined use	Protected forests	VI
			Resort Natural Territories	VI
			Recreation areas	VI
			Fishery zones	VI

In accordance with the IUNP classification, state and interstate reserves belong to the Ia – category of protected areas, for which the most complete and strict nature conservation regime is provided. Comprehensive protection of biodiversity is carried out mainly in the areas of nature reserves. At the same time, state biosphere reserves and complex (landscape) reserves can be equated to Ib. categories. Therefore, these protected areas are designed to preserve the natural state of natural objects and complexes of particular ecological value.

The IUNP World Convention on the Pollution of Natural Resources Park categorizes natural parks in category V, created specifically for nature conservation and recreational use. In the overwhelming majority of countries, the name "national park" is used to denote category II protected area [1]. According to the laws of Uzbekistan, the regime provided for state reserves is established in the protected areas of natural parks. Therefore, in terms of content and, above all, natural and ecological value, natural parks are closer to national parks, according to category II of the IUNP.

According to the IUNP classification, nature monuments belong to the third category of protected areas. Monument of nature is one of the most popular concepts related to the protection of natural objects, widely used not only in science, but also in everyday life. K. Bishop (2006) concludes that natural monuments, especially those of sacral significance. And in our opinion, sacred landscapes also belong to category III, which sacredness is associated not only with long-standing religious, mythical or historical traditions, but also has real events that are not so remote in time from today.

In the adopted state laws, the scientific substantiation of the territorial organization of reserves is less developed than it is in relation to other categories of protected areas. Therefore, this circumstance also makes it difficult to unambiguously relate the reserves to one of the IUNP classification categories [2]. Napremer, according to Sergey V. Lupachev (2013), reserves belong to the Ia, IV, V and VI categories of IUNP. But, in general, the majority of reserves correspond to category IV of the protected areas, in which the conservation of habitats and species is carried out through active management. One of the most effective forms of nature conservation and biodiversity conservation are nurseries for the breeding of rare species that correspond to category IV of the IUNP. On their territory, any activity that threatens the conservation, reproduction and restoration of plants and animals for which the nursery is intended is prohibited.

By geoecological functions and objectives, protected forests, resort natural areas, recreational and fisheries zones are dominated by VI – the IUNP category. In recent years, Uzbekistan has witnessed a significant increase in the number and area of the PNT VI categories. The total area of the 6th category of IUNP is 7933.747 ha, or 75.4% of the total area of protected areas. This category is based on the concept of "territory of combined use". But, in order to determine the status of these protected areas, it is necessary to conduct an assessment of the effectiveness of managing public institutions as required by IUNP.

The above materials allow us to draw the following conclusions: The system of the IHR PNT categories can be considered a good tool that was used to promote the idea of creating an efficient and representative system of protected areas in the world. In the process of revising the legislation on protected areas of Uzbekistan, it was proposed to use the IUNP category system to improve the national classification and its adaptation to international standards. In 2014, a number of regulatory and legal documents were adopted, in particular: Amendments and additions were made to the Law of the Republic of Uzbekistan "On Protected Natural Territories" providing for the inclusion of biosphere reserves in the list of protected areas, defining the legal basis for organizing work and carrying out activities in these territories.

According to the provision of the Convention on Biological Diversity, activities directly aimed at the preservation of geographical diversity are mainly carried out in the protected areas of I–IV category IUNP. Thus, sustainable conservation of geographical (landscape, biological, soil, geological) diversity or its individual components is provided in the protected areas, corresponding to categories I–IV of the IUNP. Among them, in Uzbekistan only nature reserves, natural parks and a natural nursery are legal entities, have a staff, funding and carry out on their territory appropriate management aimed at the preservation of biodiversity.

While improving the organizational and legal aspects of the protected area, there is a need for a thorough analysis of the environmental, economic and social functions of each category identified in the IUNP classification. In this approach, prerequisites are created that make it possible to simultaneously improve the legislative and regulatory frameworks and the effective functioning of the protected area. This will bring together our legislative bases of nature protection in international standards.

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THE INFLUENCE OF THE ZONE OF RECREATION ON THE TEMPERATURE IN THE CITY

Abstract: Green plantings of the city have a significant impact on the climate in the city, especially on the summer air temperature. It was revealed that with an increase in the share of the area of recreational zones in the city, their influence on the average air temperature becomes more significant due to the nonlinear relationship. The example of Tashkent shows the intra-annual change in greening in areas of the city obtained from images from space (NDVI index).

Keywords: NDVI, Recreation, Green parks, temperature.

The air temperature in Tashkent for more than 130 years is measured at a standard weather station site located on the territory of Uzhydromet. Average long-term monthly temperatures (normal) are given in the table below.

Table 1.

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
T °C	0.925	8.3	15.6	20.2	25.7	27.8	25.8	25.8	20.3	13.6	8.1	3.6	14.4

Over the past half century, there has been an increase in the average annual temperature due to climate change. It is known that an increase in the average annual temperature, for example, by 1 °C, is a consequence of an increase in the winter temperature by 1.5 °C and a summer one by 0.5 °C [4]. Green areas of the city have a significant impact on the formation of micro-and bioclimate. The degree of their influence is determined by the size, shape, breed composition, density of gardening. This effect is most significant in the summer months. On the territory of Tashkent there are several dozens of parks, a large number of public gardens and gardens belonging to the areas of common green parks. Their recreational significance for recreation and recovery is difficult to overestimate. Since the mid of 70th of the last century, micro- and bioclimatic observations were carried out in Tashkent, which made it possible to evaluate the ameliorative efficiency of green parks, squares and gardens. It has been established that in parks and gardens under the canopy of trees the air temperature is 1.5–2.0 °C lower than in open areas. The greatest decrease in temperature is observed in parks and squares of large sizes: on average, during the daytime period it is 4.3–4.7 °C. In parks, occupying a smaller area, this figure is 2.5–3.0 °C [1–3]. In a large square, the average temperature reduction per day is 3.0 °C, in small squares it is up to 2.5 °C. Such a decrease in temperature, denoted by the letter d, is especially important for a hot summer. It can be shown that the average temperature for a large area, for example, for the whole area of a city, can be lowered with an increase in the total area ofrecreational areas (parks, forest parks, and green areas):

$$Ts = To - Ud \quad (1)$$

Where *Ts* is the average temperature, *To* is the temperature of the area outside the recreational zones (open areas), *d* is the amount of decrease in air temperature in the recreational (park) zone compared to the open areas, *U* is the fraction of the area of the recreational zones. In the absence of recreational zones *Ts* = *To*, and when the contour is fully occupied by the park zone *Ts* =

$To - d$. It follows that the average air temperature within a given contour of the studied area also depends on the fraction of the area of the recreation zones U and on the type of the recreation zone (value d), which itself depends on the size of the zone U, that is, $d(U)$. If on this basis it is assumed that small parks correspond to $U \approx 0.1$, medium $U \approx 0.2$ and for large zones $U \approx 0.3 \div 0.5$, then the logarithmic dependence with the coefficient of determination will be an acceptable expression for this connection $R_2 = 0.9$ (Fig. 1).

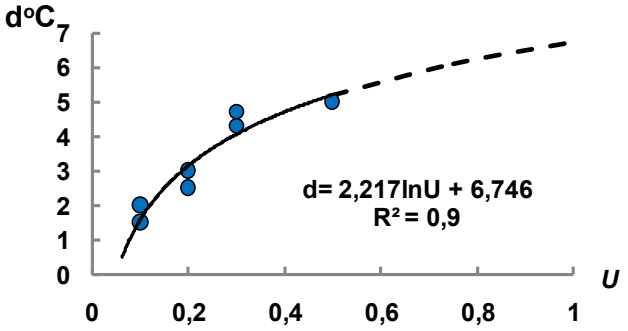

Figure 1. Extrapolation at U → 1 shows that a decrease in the average air temperature is possible by almost 7 °C

As a result, the general formula for estimating the reduction of the average air temperature over an area is as follows:

$$Ts = To - U^* d(U) = To - U^*(2.217\, LnU + 6.746). \quad (2)$$

Figure 2 shows calculated values of the average air temperature, depending on the fraction of the area occupied by the recreational zone, when the temperature at the open surface is 40 and 41 °C (summer). As we see, while the share of the area occupied by recreational zones does not exceed ~ 15%, there is practically no significant decrease in temperature. With the increase in the share of the area of recreational zones, their effect on average temperature becomes more significant due to nonlinear relationship.

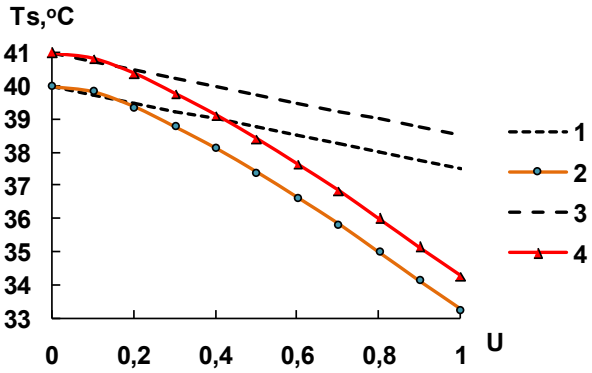

Figure 2. Decrease in average air temperature depending on the share of the area occupied by recreational zones, at summer temperatures of 40 °C and 41 °C; 1 and 3 – calculation by the formula (1) 2 and – calculation by the formula (2) taking into account the influence of the increase in the size of recreational zones

As it is shown in the figure that bringing the share of the area of recreational zones to 50% of the total area reduces the average air temperature over the total area by more than 2.6 °C. At the same time, within the limits of the recreational zone itself, a decrease in temperature is possible by ~ 5 °C. Introducing a reasonable values of U, can be specified for specific territories.

In this research the share of the area of greenery in the districts of the city have been estimated. For this purpose, we used multi-spectral images from the Landsat and Sentinel satellites for the years of 2017–18.

The shapes of Tashkent and its 11 districts is shown on the images (Fig. 3–5).

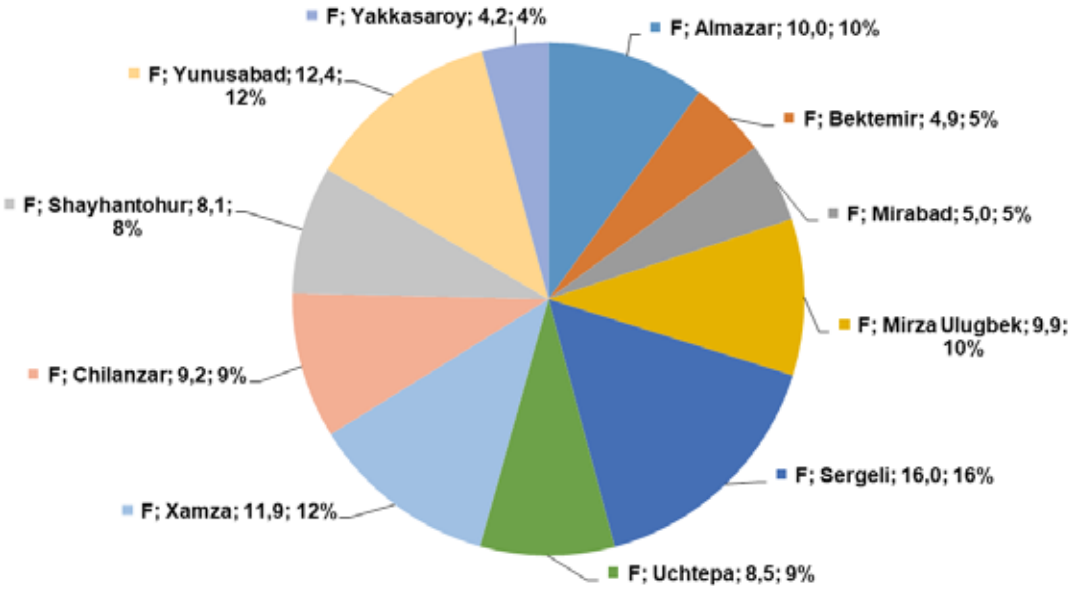

Figure 3. Distribution of the area by districts in% within the area of Tashkent $F = 335$ km²

On the territory of each district, areas covered with greenery were estimated using the well-known vegetation index equation $NDVI = (Nir - Red) / (Nir + Red)$. Then the relative area of green areas were calculated: Areas in% (Fig. 4 and 5).

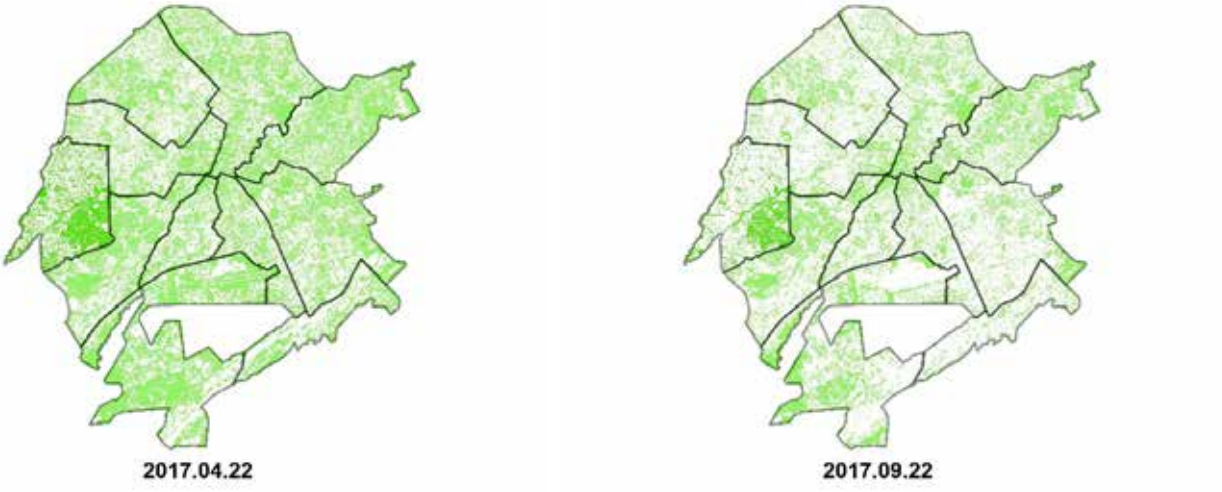

Figure 4. Tashkent. Green area according to NDVI index

The information of Figures 3–5 perfectly reflects the intra-annual dynamics of greening the city: the rapid growth of greenery in spring, a rather long period (April-August) of the stability of greenery and the relatively smooth extinction of green cover in the autumn period. In general, for the area of the city, the maximum greening in the spring-summer period varies from ~ 51% to ~ 41%, while the minimum falls at the end of November-beginning of December ~ 3%. The Almazar district (10% of the city's area) is characterized by elevated values of the relative green area in spring and summer (~ 51–38%), and the Bektemir area (~ 5% of the city's area) by lower values of the relative green area (41–21%).

Green areas have a significant impact on the humidity regime of parks and squares as well. The average daily values of water vapor elasticity and relative air humidity in parks are 2.4–5.0 hPa and 10–17% higher than in open, illuminated streets and squares. In the squares and parks, a microclimate is formed, which is characterized by lower air temperatures, where the thermal state of the person is much better; here the minimum thermal load. At present, stationary spraying systems are widely used both for irrigation and for mitigating the microclimate of greened recreation areas. Their use allows to further reduce the temperature and increase the humidity. The combination of tree plantations with the use of spraying installations should be recognized as quite an effective means of improving the environment of a person being outdoors in a hot climate.

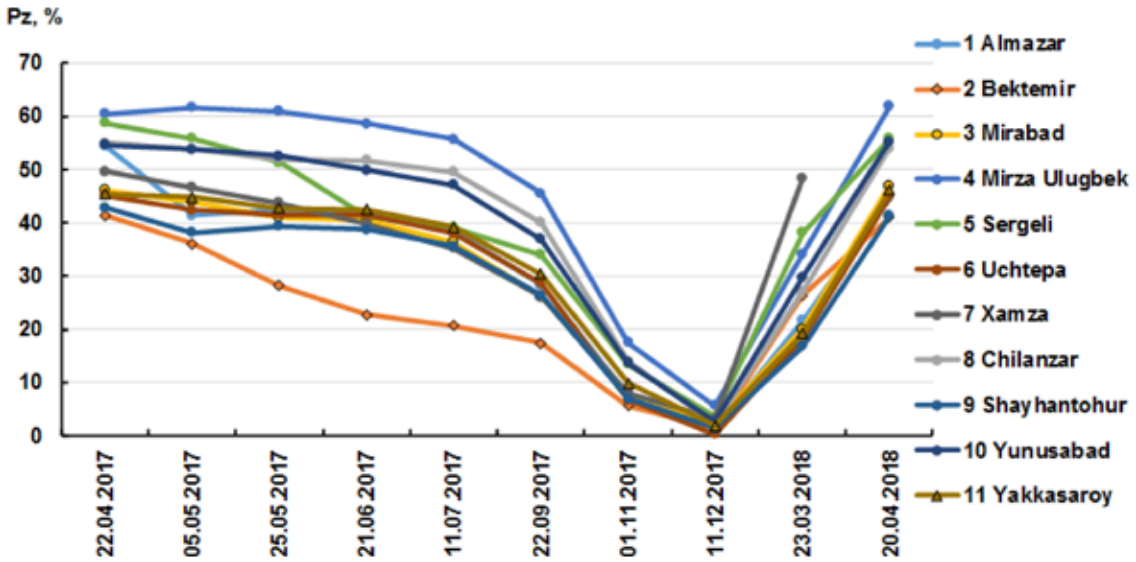

Figure 5. Intra-annual change in the areas of green zones (by NDVI index) in% by districts

Greened trees with wide leafs gives good shading, increases the comfort of living:

- Increases the absorption of carbon dioxide CO_2 and the release of oxygen O_2;
- Significantly reduced various types of pollution: noise, light, dust;
- The effect of direct solar radiation decreases, and gusts of wind are significantly reduced;
- Relative humidity increases, which is only a boon in the conditions of recreation areas of Tashkent;
- Natural regulation of the groundwater level is increasing.

Thus, the placement of park areas and zones are advisable in areas of relative lowering of the terrain, as this contributes to a more rapid removal of heavy rainfall from asphalt and other coatings and the absorption of water into the soil. Special techniques for reducing the temperature in parks include the optimal set of tree types that provide three-tier protection:

The lower tier (up to 3–4 meters) – juniper, thuja, spruce and other ornamental forests;

Middle tier (4–10 m) – oak, ailanthus, gladia, acacia, etc.;

Upper tier (more than 10 m) – pine, plane tree, pyramidal poplar, etc.

The most important factor in justifying the need to expand the areas of recreational areas in the city is to take care of the health of the population, especially children.

In 2018, the Ministry of Justice in Uzbekistan revealed serious shortcomings with the improvement and greening of cities. Main problems: – limited source of funding for improvement works; – not determined the actual area in need of improvement; – a large burden on the improvement workers; – outdated equipment and lack of monitoring of the implementation and results of work; – lack of public-private partnership and public control. " In this regard, the Ministry of Justice has developed a draft regulatory legal act "On additional measures to improve the efficiency of work on the improvement of human settlements" [5].

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FLASH FLOODS CAUSED BY THE BREAKTHROUGH OF HIGH-MOUNTAIN LAKES ON THE TERRITORY OF UZBEKISTAN

Abstract: The article provides the result of analysis of the spatial and temporal distribution of flash floods caused by the breakthrough of high mountain lakes on the territory of Uzbekistan.

Keywords: high mountain lakes, flash floods, dangerous hydrometeorological phenomena.

In the current conditions of active use of the foothill and mountainous areas of Uzbekistan, the problem of the threat of breakthrough of high-mountains lakes of various genesis is becoming more urgent and still little studied. Analysis of the research showed that in mountainous areas are ubiquitous modern exogenous processes lead to the formation of debris flows, landslides, mudslides, avalanches and mountain lakes breakthrough.

Among the dangerous hydrometeorological phenomena, especially the destructive forces are flash floods formed as a result, of the breakthrough of lakes, as well as intra-glacial and intra-moraine reservoirs.

Flash floods of breakthrough genesis occur much less frequently than rain mudflows, in percentage terms they constitute only 2% of the total recorded number of flash floods over the territory of Uzbekistan, but breakthrough flash floods are the most catastrophic (Figure 1).

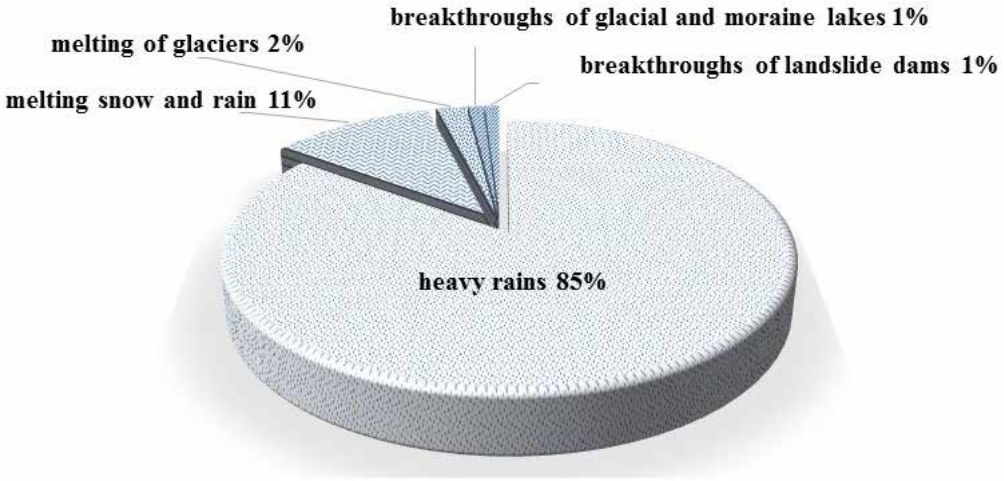

Figure 1. Distribution of flash floods by genesis in the territory of Uzbekistan

The mountainous regions of Uzbekistan cover the lower western spurs of the Gissar-Alai and Tien Shan, as well as the greater part of the Fergana Valley. These mountain areas are the most inhabited within the region. A case of the flash floods in the developed areas is accompanied by considerable damage. Big cities of Uzbekistan – Namangan, Andijan, Fergana, as well as settlements, irrigation canals, railroads and highways, irrigated lands are the most endangered of flash floods.

680 lakes have been identified on the territory of the Republic of Uzbekistan and transboundary territories in the course of research. The breakthrough of these lakes threatens the national economy of Uzbekistan. The majority of lakes are located in the territory of neighboring countries, in the basins of rivers flowing to the territory of Uzbekistan. Such transboundary basins are conditionally assigned to the regions of Uzbekistan to which they carry water, and pose a potential threat if high-mountain lakes break through.

A total, have been identified of 20 river basins, on which there are high-mountainous break-through lakes (Figure 2).

The most concentration of lakes is in the altitude range from 3000 to 4000 m a.s.l, and the largest total volume of lakes at altitudes from 1500 to 2500 m a.s.l. This is explained by the fact that at altitudes up to 2500 m a.s.l. there are large rock-dammed lakes, for example, the largest lake in the surveyed area Sarychelek (493 million m^3) is located at an elevation of 1859 m a.s.l.

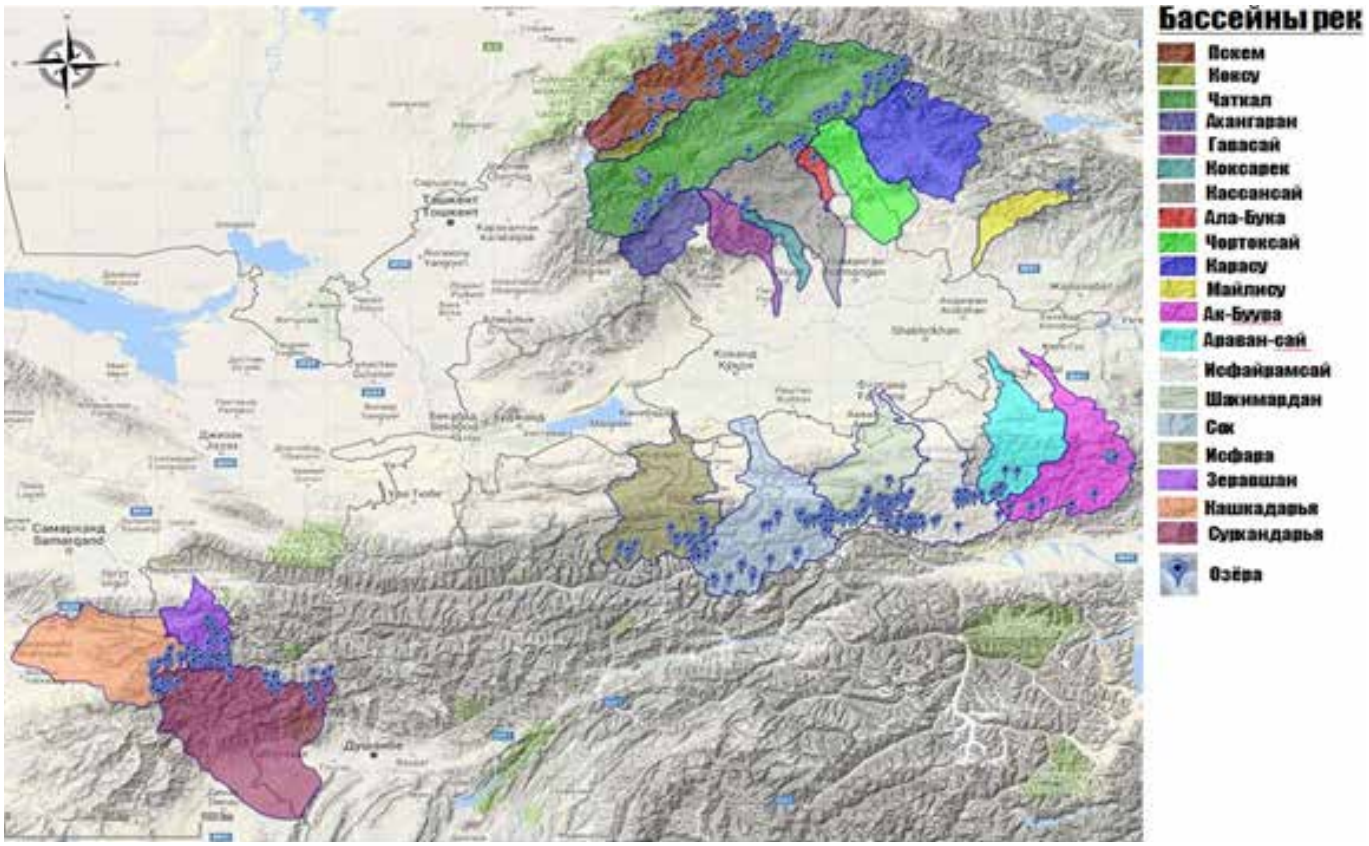

Figure 2. Scheme of the location of river basins with break-through lakes

In the altitude range from 3000 m a.s.l. and above there is a large number of glacial and moraine lakes. Which is because at these heights there are powerful geological faults, tectonic depressions, negative forms of relief are associated with the manifestation of activity of modern and ancient glaciation, favorable for the formation of a large number of very small lakes (Figure 3).

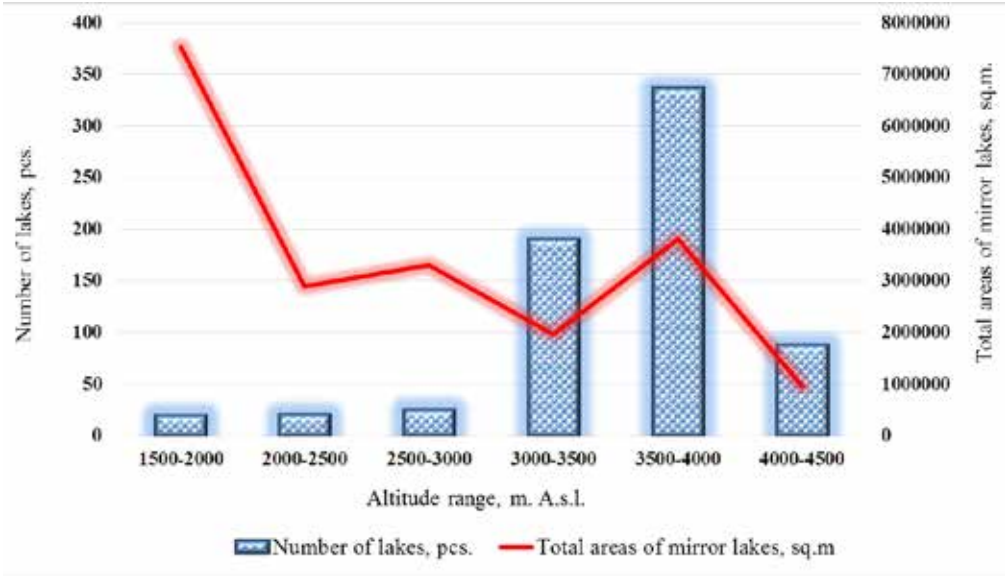

Figure 3. Distribution of the number and total volume of lakes on high-altitude zones

Rockdammed lakes caused by landslides of rocks can exist for tens, hundreds and thousands of years, although they may break through. The ice dams, however powerful they were, are short-lived. The ice is melting, cracking, some of its blocks emerge, and the destruction of such a dam is a matter of time [1].

With the reduction of glaciation, which is observed not only in our region but also around the world, the site of retreating glaciers formed shafts terminal moraines and "dead" ice. Between these ramparts in summertime, with intensive melting of seasonal snow and ice, melt water accumulates, forming temporary lakes. These lakes are very variable, their number and size undergo strong changes from year to year. Such lakes can break through the destruction of ice or moraine dams, which leads to floods or mudflows, sometimes catastrophic. This happened many times in the headwaters of the rivers flowing into the Fergana valley from the northern slopes of the Alai and Turkestan ranges.

The flash flood of 1998 on the Shakhimardan River was formed as a result of the breakthrough of three moraine lakes formed on the terminal moraine and "dead" ice, below the Archabashi glacier (on the territory of Kyrgyzstan), in the upper reaches of the same river – one of the Shakhimardan river flowing to the north from the Alay Range in Fergana Valley [2; 3].

The approximate total volume of water in the erupted lakes was 40,000 m^3. The upper lake, the largest, broke through the moraine-ice dams, splashed into the lower lake, which in turn broke and caused flooding. The maximum breakthrough rate was approximately 50–70 m^3/s.

When the flood spread down the valley, it seized the ground due to the intensive erosion of the riverbed and the banks, resulting in the formation of a mudflow that, when moving down the river, was replenished by the melt water of the remaining tributaries of the Shakhimardan River. Of the spreading of the flood, the water flow in the area of the city of Shakhimardan was equal to 150–200 m^3/s. As a result, of the catastrophe, more than a hundred people were perished and huge damage was done to the national economy of Uzbekistan.

The intensive melting of extremely large winter snow reserves contributed to the formation of flash flood in early July. By the time the flash flood passed the soils were well "ripened" – saturated water.

In the case of the breakthrough of glacial and moraine lakes, it is almost impossible to predict the time of the beginning of the flood. The only thing that can be done is to identify areas where such floods are possible, and to determine the periods when their occurrence is most likely. Typically, this summer is a hot time, when moraine and glacial lakes are overflowing with water. The time of possible descent of glacial mudslides – the mudflows period – corresponds to the period of maximum intensity of ablation and runoff from glacial basins.

On the basis of a comprehensive study and generalization of the available information on the breakthroughs of the high-mountain lakes of Central Asia, the features of seasonal risk of the threat of mudflows of breakthrough genesis are established. It was revealed that the most number of mudflows of rain genesis occur in May, and breakthrough mudflows are activated in July and in August (Figure 4).

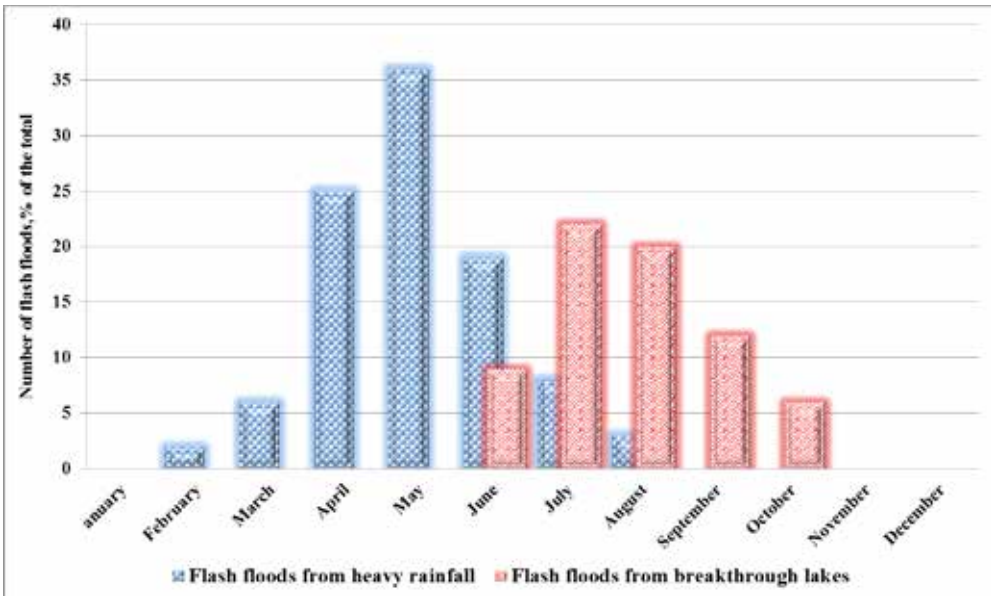

Figure 4. Intra-annual distribution of mudflows of different genesis,%

In recent years, there has been a steady trend of global warming. According to climatologists, the warming, the maximum of which is forecasted for 2020–2040, will primarily affect mountainous and foothill areas [4; 5].

Expert estimates of the response of small lakes in the glacial zone indicate an increasing danger of breakthroughs in lakes with unstable dams. This is due, first of all, to the possibility of the appearance of new lakes in the preglacial zone due to the

reduction and retreat of the ends of the glaciers as a result of warming. When the glaciers recede, a glacial-moraine complex forms on the lower edge of the glaciers, including dead ice fields, pond lakes, accumulative bodies of moraines and fluvioglacial deposits. This complex is continuously changing, that is, it is in an unstable state, which favors the occurrence of mudflows. The mudflows at the ends of modern glaciers originate mainly due to the breakthrough of the preglacial lakes or the breakthroughs of moraine and firn-ice masses. The highest activity of glacial mudflows is characteristic of the stages of the retreat of glaciers. The current degradation of glaciation, associated with global warming, maintains this level of high activity.

The increase in summer temperatures will lead to an increase in the intensity of snowmelt, an increase in the maximum flow of water supplying the lakes of watercourses, which will affect the existing equilibrium of the water regime of lakes and the capacity of dams, existing lagoon lakes.

Humanity cannot change or stop the development of dangerous phenomena, so the ability to reduce their destructive effects is the creation and development of systems that allow us to constantly monitor the state of the hydrometeorological environment, predict the occurrence of a dangerous phenomenon and warn the public about the impending danger.

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THE STATE OF GEOGRAPHICAL AND TOPONOMIC ASPECTS OF THE WORLD COUNTRIES' NAMES

Abstract: This article describes the state of geographical and toponomic aspects of the world countries' names and its development trends.

Keywords: geography, toponomic research, the etymology, transcription, transliteration, scientific classification, lexical-semantic, the ancient times.

It is well known that toponomics is a special science between geography, history and linguistics, and is closely associated with them, using the methods of research of these sciences. As the theoretical basis of each science improves and develops, it defines its object, object, and functions, and naturally, the science is integrated into the process of integration and differentiation. At the same time, the interdisciplinary connection is also expanding.

Toponomics is closely linked with natural geographical sciences, since it is evident in the classification of geographic locations, their natural geographical study, the principles of toponomic research, methods of naming natural objects, and more.

The countries in the world have their own name, and various factors have served as the basis for their name. Problems such as countries' name and their etymology have been studied relatively by toponomist scientists. This situation determines the relevance of the selected topic.

The emergence of geographical science as a science is largely related to the practical need of science. The scientists of the eighteenth and nineteenth centuries studied the names of geographical objects in the process of studying, descriptive, descriptive objects. The emergence of geographical names, their origin, formation, meaning, and scientific study of the history of their nomination, in particular, their classification began in the mid-18th century.

During the 20th century, toponomic research has developed rapidly in foreign countries. A. Dose (France) for the study of geographical names of different regions of the world; G. Krae, M. Fesmer (Germany); E. Euall, A. Smith, A. Rum, S. Mettyuz (UK); A. Profouz, V. Shmilauer (Czech Republic); V. Tashitsky, Yu. Stashevsky (Poland); V. Georgiev (Bulgaria); L. Kish (Hungary); G. Dragu (Romania); M. Olson (Sweden); J. Stuart, N. Holmer (USA); J. Armstrong (Canada); The services of scientists such as A. Kordozu (Brazil) are great.

In Russia it is worth noting that B. F. Dobrinin (1885–1951) is a scientific country science school. According to Russian scientist E. Murzayev, any topographic research should begin with studying geographical terms, because toponomic terms are a universal key to the identification of the etymology of most geographical names. Based on this, the British Geographic La Dadli Stamp (1975) published a book in English entitled "Glossary of Public Geographical Languages" in English. In this book, G. W. Alman, E. Kant, U. Olson of Scandinavian geographical terms; In German, K. Troll, K. A. Ziinxuber, G. Bosh, T. H. Elkinz; RW countries in the West African region. Experts like Garrison – Cherch are proud of their work.

Arabian geographers, Greek and old Roman historians, and Central Asian scientists have been mentioned in the works since the ancient times to the middle ages and to the eighteenth century. Although Yaquw Hamâwi completed his work in 1224, the book Mujam al-Budhon ("Glossary of Globes") was written in Arabic, but in the form of a dictionary about the countries of the Mediterranean, Arabic and Academia, the legendary India and China (Chin) and Muslim countries in North Africa is explained.

In recent years in Uzbekistan, A. Hazratkulov (2006), R. Mahamadaliev (2012), Q. Rajabov and B. Kandov (2015) and K. We can see Gadaev's books (2012). However, these books do not include country studies or the etymology of some countries.

The services of Russian scientists are great in forming the toponymy as a science. In this area A. Dulzon, A. Matveev, A. Popov, A. Superanskaya, V. Toropov, S. Tolstov, E. Pospelov, O. Trubachev, V. Juchkevich, R. The works of scientists such as Ageeva are known and popular.

Later on, a group of geographers of the Moscow State University named after M. Sc. Prof. A. Gorkin has prepared the book "World Countries" (Encyclopedia) (2013). It's L. Aksyonova, T. Galkina, G. Gladkevich, V. Strelskiy, S. Takhov's articles about the world were translated into Uzbek by A. Mufiev in scientifically-popular language.

In 2003, English explorer Clive Gifford saw the globe on the World Countries and Continents' Book of Illustrations. This book was translated into Russian in 2004. This is one of the most pressing topics on the basis of the above-mentioned books, from the point of view of the natural geographical aspects of the names of countries and the analysis of topography. At the same time, the classification, transcription and transliteration of countries' names are also important.

One of the toponymists in Uzbekistan, Suyun Karayev, once said: "There are more than 200 countries around the world. Creating a transcript of geographical names for each of them is not an easy task, except for the neighboring Turkic-speaking countries, so many countries have yet to use the Russian-language transcript to write their local names in Uzbek" Referring to this scientific classification, the Russian toponymist writes: "As any state or territory has complex, multi-layered and variable toponymy systems, it is difficult and even impossible to create classification of single geographical names, which meets all the requirements."

We have found the lexical-semantic classification of the names of the world's according to H. Hasanov's method, first of all, to sort out the toponyms and then to formulate according to the rules of the language. Well-known Belarusian toponymist V. A. Juchkevich believes that the ideal classification of ideal formulas must meet three basic requirements: what and what objects are known, how it is called, in which languages and what means of the language, what is the name? The answer is that the toponymy is an integral science. Because the first question-geography, the second question-linguistics, will have to answer the third question-toponymy itself. Obviously, the classification problem is practical, particularly in regional toponimic investigations. Because any research work requires systematization of the data collected, that is, the classification. Therefore, the creation of a single and universal scientific classification is the future of the future.

The natural geographical aspect of the name of the world states necessitates research on the basis of internal "laws" in a specific natural geography. These are: 1) Territory; 2) Periodicity; 3) Integrity and; 4) Systemicity. The toponymic analysis of the country names is closely related to linguistics, that is, linguistics.

Here is a clear fact. Kalimantan Island is located in Brunei. Country is located on the island. In 1984, the country gained independence from the point of view of its periodicity and called it Brunei. Q: What is the meaning of the term "brunei" and how did it come about? In a lexical-semantic analysis, we can clearly state that the former name of Kalimantan Island appears as a transformed form of the island of Borneo. It is somewhat inappropriate and unusual to say that the local population is ethnographic as "brunei" – "black eye", "black hair".

Conclusion of books about world countries in Uzbekistan: The names of countries do not have sufficient grounds. It is therefore desirable to publish scientific books in a monographical manner. The "mirror" of the names of world countries – this is certainly a political map of the world. Thus, in contrast to geographical and linguistic views, in contrast to the geographical and linguistic views, the political card of the modern world of writing, reflection and diversity of names, in cooperation with cartographers, has developed a new abbreviated form of an English-language coding card and the implementation of the educational process requires life itself.

Who can use this country as we research the names of countries around the world? It is natural that such a question arises. The answer is: Teachers and students of Uzbekistan state world languages university, Tashkent State Institute of Oriental Studies. Teachers and students of the department of geography, as well as people around the world, and so on.We think that articles from the National Encyclopedia of Uzbekistan on world countries should include the country's toponymy (name and etymology of capital cities).

We have considered the geographical and toponymic aspects of the names of the world countries inadequate.

Academician V. V. Bartold wrote in his day: "Every researcher determines something that is unclear, and every new interpretation increases the number of errors. Whoever has more correctly understood, who has made many mistakes, should be left to the future without any problems."

We can say that the name of each world has a certain amount of information, and it often reflects a real event. The name of the countries cannot provide the required toponymic information even if it is morphologically and semantically transparent. Therefore, it is appropriate to examine itself as a whole among its own names.

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GRADUAL STUDY OF GEOGRAPHIC FEATURES OF ETHNO-ECOLOGICAL CULTURE

Abstract: The article focuses on methods and approaches to gradual study of geographical aspects of ethno–ecological culture, one of the new directions of geography.

Keywords: ethno-ecology, ethno-ecological culture, ethno-ecological landscape, ethno-geography, agrarian ethnology, geoecology.

Today, due to the rapid development of humanitarian geography, the unifying the areas of natural and social sciences around the only problem is intensifying. One of these issues is the ecological problems of the planet. Although the impact of the anthropogenic factor on the occurrence of these problems is high, in some cases it is recognized that these problems have ethnological roots. One of these situations is forgetting traditional use of nature and conservation skills, which has been applied for centuries by native people. Studying cultural heritage like skills, traditions and enriching them with innovative ideas is becoming one of the most important tasks. Methodological bases of studying geographical aspects of ethno--ecological research in this direction are being created [1; 2; 3; 4; 5; 6; 7; 8].

The following concept developed by Yu. I. Gladky is very important in defining the right direction of these researches from the methodological point of view. According to him, geographical wing of the ethno-ecology studies – not all the relationships of the ethnos with the ecological environment, but only their conscious contact with environment. In this approach, the object of research in biological, sociological and geographical directions of ethno-ecology is clearly outlined.

First of all, any ethnos is a collection of living things, and its way of life is reflected in the unconscious, blind relationships with the forces of nature. Research in this direction is a research object of biological sciences, including bioecology. Secondly, ethnos is also a separate team of social beings. In this regard, it is also a research object of social research, including social ecology. Third, ethnos is the group of particular creatures of nature, and their conscious function, lifestyle [5].

Geographical direction of ethno-ecological researches focuses on studying the conscious relationship between ethnos and environment. The ethno-ecological culture and its components are analyzed as object of ethno-ecological research.

Of course, the study of such a complex object requires a strong methodological basis and correctness of inter-agency communication. At the initial stage of the research, apart from the geographical characteristics of the object, biological and social aspects are also studied by providing interagency communication. At the next stages of the study, research will be geography-oriented. During the research, it is proposed to study science and scientific direction in three deepening stages.

In the first stage, the basic concepts of the general methodological aspects of the study will be studied. At this stage, the geographical, ecological and biological aspects of ethno–ecological culture and its components are studied in the field of ethnology, culture and philosophy in social sciences.

The second stage outlines the general (both natural and social) aspects of the research object and examines the directions that provide a systematic approach to it. In this context, the study of ethnographic, geoecological and ethno-cultural aspects of the object is one of the main tasks. They will be informed about them taking into account the interdisciplinary nature and novelty of these scientific directions.

Ethno-geography – formed in the field of ethnology and geography, and influenced by antique scientists and F. Rattsel, L. D. Sinitsky, L. S. Berg. The scientist V. G. Bogaraz-Tan, the person to use this term first, opened the main directions of the field [9]. During the Soviet era, there was long stagnation in this scientific direction due to the struggle against the idea of anthropogeography.

The most clear definition and functions of ethno-geography for these studies were given by I. Saharov, who wrote that this scientific direction analyzes the nature and distribution of ethnic communities, and analyzes the differentiation of ethnic zoning. It uses information on ethnology, ethno-demography and population geography as an information base [10]. The main focus is on the nature of the population's life patterns (transient, nomadic), the form of population, population density and others. In the study of changes in the "landscape-ethno-economic" system, it is analyzed in close contact with its historical geography and ethnic cartography departments [11].

The modern ethnography focuses on the mapping of the ethnic distribution of ethnos, their migrations on the ethnic composition of the population. Particular attention is paid to studying the impact of geographical factors on the formation of the material and spiritual culture of peoples and their mapping on smaller regions. Works of M. Murodov, U. Koraboev [12; 13] were used to study the role of geographical factors in the formation of the culture of the Uzbek people.

Geoecology – although K. Troll's definition was used as a synonym for landscape, it has more than hundred interpretations, 5 of which given by A. I. Jirov [14] correspond to the essence of ethno–geographic research. According to him, geoecology studies population and anthropogenic impact, explores the properties of objects or subjects that are vivid or temporarily hidden, geotopologic and ecologically significant features and explores the nature of the ecological relationships that arise in geo-ecological space. Its object of research is geo–system or ecosystem and the subject of research is studied the laws and principles of the geo–ecosystem.

In Uzbekistan research in this direction was carried out by A. Rafigov [15], A. Nigmatov [16], Yu. A. Ahmadaliev [11], Sharipov [17]. Concepts of geo-ecological research include concepts such as geoecological environment, anthropogenic pressure, ecological relations and interactions, ecological landscape, ethno-eco-landscape balance, sustainable development.

Ethno-culturalism: although there are more than 400 definitions of culture, it is still unclear, especially in western and eastern terms. The term culture in the West is derived from the Latin word *cultura*, which was initially used as a synonym for the term "civilization" (civil), and later translated as the process of cultivation of agricultural crops and pets. The term culture in the East is close to the meaning *educated/trained human being* and closely related to the Arabic word "madiniy" which means *city dweller*.

In both cases it defines all achievements that have been gained by people in the society.

Culture is a phenomenon biologically not relevant to the society, and is a result of people's lifestyle. Ethno–culture is a set of imagined patterns that are intended to preserve certain characteristics of a particular ethnos. Among the issues examined in the scientific direction of ethno–culture, the focus is on the "traditional folk culture" of the interconnected formation of the spiritual heritage, which has become a tradition, handed from generation to generation. It is a factor that has emerged from the historical and spiritual needs of culture, which has been developed as a result of their mental and creative activity, through the millennium experiments, trials, mistakes, and helps to mature the nation and solve environmental problems arose as a result of industry.

Ethnoculture, as well as general culture, can be used to describe and respond to some of the ecological problems in the context of ecological information, and to find ways to remedy them. It is analysed integrating the most common types of natural-geographical factors (nature use, agriculture, etc.) of ethno-ecological culture and ecological culture.

At the third stage, territorial aspects of ethno–ecological culture are studied. The first aspect of this phase covers the use of natural resources and aspects that are directly linked to the natural geographical basis of environment conservation. These scientific directions include agrarian ethnology, ethnomethereology, ethnobotany, etnozoology. The next disciplines include ethnoecology, ethnoecotoponomy and ethnopedagogics, which are related to social sciences.

It is desirable to use the style of "chamomile" model developed by V. Kalutskov [6], taking into account inter-nature character of ethno-culture. This model is characterised by the following: firstly, object research has a complexity, unity, uniformity, and secondly, the above-mentioned situations direct the researcher to consider the relationship with the landscape. Thirdly, in separate studies, such as – natural environment is studied by geographer, linguistic system – philologist, folklore – folk researcher. In the whole study of the cultural landscape, the researcher focuses not only on the isolated components of the ethno-culture but also on the study of internal (structural) links between them.

Studying the components of the ethnolandscape is a complex task, with particular attention to the ethno–ecological aspects of each component. The following aspects of these components are ecologically important to us.

Natural environment – when a combination of natural conditions and resources meets the formation of a certain type of traditional farm, a particular economic-cultural type is formed at the zonal level. Partial preservation of traditional forms of farming (e g, farming, livestock, households) allows preserving other components of ethno-ecological culture, and on the contrary, the destruction of traditional farming leads to the destruction of all ethno–ecological culture and tragic consequences.

Ethnos – it may be studied ethnologically, socially and confession. Any cultural landscape has its own community that is a component of the landscape and considers itself as a mother landscape (like a feeding landscape).

Residential area – forms the cultural landscape in the vicinity of the population through its territorial location. The community is learned as a method of self-organization.

The language in the etymological landscape creates a global image for the community itself, incorporates the natural and cultural characteristics of the ethno-cultural landscape through the local geographical terms and toponym system.

The spiritual component of the ethno–cultural landscape incorporates the creed of religious beliefs or other types of folk art. In addition to the linguistic and spiritual components of the ethno-landscape, it also functions as a description, storage, retranslation of other components.

This methodological approach allows us to disclose the role of each component in the formation of the ethno-ecological culture necessary for our research. Comparative, analytical, cartographic and landscape-toponym methods have been applied for each component to be explored in terms of research, and summed up for final suggestions and recommendations.

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MEDICAL AND GEOGRAPHICAL ASPECTS OF THE USE OF RECREATIONAL RESOURCES

Abstract: The article highlights the sources of recreational resources, scientific and methodological issues of their study, medical geographic analysis of recreational resources. It contains some historical information on recreation geography, sanatorium and resort facilities in Uzbekistan, as well as information on the Ammonxona Sanitary Center and its bolomological significance in Surkhandarya Region.

Keywords: Recreational resources, sanatoriums, spa resorts, mineralization level, recreational infrastructure, hepatitis, medical landscaping, human ecology, biogeochemical elements, bolneological complexes.

As you know, health geography plays an important role in the geography of medical geography. This is closely linked to such areas as recreation and spa. The word recreational is Polish "recreation" – recreation, Latin "recratio" means rehabilitation. Hence, long-term recreational activities are appropriate for tourism, and tourism geography is part of the traditional recreational geography. Recreation geography is directly related to the health, rehabilitation and recreation of people (sanatorium, spa, boarding house, etc.). At the same time, one of the main objectives of the recreational geography is to develop and demonstrate the development of various diseases in the treatment and recreation of people, and ways to effectively use regional recreation systems [1]. Recreation geography is an important branch of social geography, which explores areas that promote the recovery, strengthening, and development of human health, and the development of science began in the second half of the 20th century. In the creation and development of his theoretical foundations, Pereobrajensky VS, Mironenko N. S., Vedenin Yu.A., Tverdoxlebova I. T., Zorina I. V., Gerasimov I. P., Shoshin A. A., Avtsin A. P., Lebedov A. D. and others' services are great [2]. With regards to the use of recreational potential and environmental protection, Rodoman B.B, Zabelinoy N.M, Chijovoy V.P, Drozdova A. V., Ryashchenko S. V., Kalihman T.P, Kulakova T. I., Shagjiev K. Sh., Tuloxonov A. K., Imethsenov A. A. as well as scientists.

As you know, recreation is an important aspect of tourism, a process of restoring the physical, mental, intellectual, and power of people. Research on recreational and recreational activities is one of the youngest trends in modern science. In the second half of the 20th century, more precisely, in 1963–1975, the team of specialists of the Geographical Institute of the Russian Academy of Sciences (V. Preobrajensky, Yu. A. Vedenin, I. V. Zorin, V. N. Lexonov, L.I Mukhina, L. Filippovich et.al.), the monograph "Theoretical Foundations of Recreational Geography" was prepared, and this manual served as a basis for further researches [3].

It is important to use the healing properties of mineral water, healing mud and climate for the treatment of colds and dystrophic diseases, especially for those suffering from diseases in the recreational area, in terms of climatic conditions, characteristics of the flora and fauna, the aesthetic characteristics of the area. One of the most important areas of medicine that studies these factors, ie mineral waters, mud, climatic and prophylactic uses, is curetology. While the health and science of the resort is closer to medicine, the study of the territorial aspects of recreational resources is one of the leading places in the geographical science system.

N. S. Mironenko sets out a group of economic geographical factors for the formation and development of recreational areas:

- Recreation resources are an important basis for determining the interrelationship between the formation and specialization of recreational areas and their interaction with other regions;
- determines the geographical location of the population in the choice of the recreational area and the provision of food and labor resources;
- Location of the population;
- The level of development of recreational infrastructure;

• Describe the relationship between recreation services and other economic sectors.

• Grouping and studying these factors in the same order are important for geographers and economists dealing with regional issues.

According to their characteristics, more than 60 percent of the existing resorts are in the seaside, more than 20 percent in mountains and foothills, and about 15 percent in forest areas. As can be seen from this, the most common type of resort is the sea front. The climate of the sea allows us to avoid many diseases. It has a positive effect on the health of people suffering from diseases of the blood, lymph nodes, heart, vascular and respiratory tract. Natural water is used as a major treatment factor in the Balneological Resort. They are recommended for bathing and drinking. Mineral water helps many treatments. Among those who come to the balneal resorts are people with nervous system, heart, vascular, gastrointestinal and basal diseases. In the medical and geographical surveys, balneal resorts have shown that they are effective in treating multiple diseases. They give results equivalent to the effects of simple drugs. However, no harmful effects can be detected. Another type of resort is mud treatment. It is used for the treatment of bone marrow pathology, nervous system injury, as well as genetic and some other diseases. Today, due to modern methods of treatment of mud and advanced technologies, high medical results are achieved. This is increasing the interest of tourists to mud resorts.

Climate resorts are as diverse as the climate itself. Unique climatic factors (such as temperature, atmospheric pressure, sun rays, etc.) are valuable sources of healing, such as forests, plains, mountains, sea, climate, and climate. They are widely used for therapeutic and prophylactic purposes. Due to the combination of these factors, specialization of resorts is established. It is important to note, however, that when selecting resorts, it is important to take into account the disturbing disorder groups and species, as well as the specific individual characteristics of the human body.

It is recommended that those who suffer from upper respiratory tract diseases (bronchial asthma, nervous system disorder), mountain resorts begin with anemia and tuberculosis, depending on the characteristics of the continental climate characteristic for forests. In particular, relaxation of hypertension and cardiac and vascular diseases in mountain-resort resorts causes health-related inconveniences [4].

Today there are 183 sanatorium-resort establishments in Uzbekistan, which are distributed unevenly in regions. When analyzing the dynamics of their number over the past four years, we can see that they are growing in almost all regions of the country (Table). By the number of sanatorium-and-spa establishments, Ferghana is distinguished by Tashkent region and Tashkent city. These indicators also apply to the number of children's sanatoriums.

Table 1. – Activities of sanatorium and resort institutions by region

№	Regions	Number of sanatorium and resort institutions, units			
		2013	2014	2015	2016
1.	Republic of Uzbekistan	154	167	170	183
2.	Republic of Karakalpakstan	11	10	10	10
3.	Andijan	10	9	8	10
4.	Bukhara	3	3	3	3
5.	Jizzakh	8	4	5	11
6.	Navoi	5	6	6	6
7.	Namangan	13	14	13	16
8.	Samarkand	13	13	18	21
9.	Syrdarya	2	2	1	1
10.	Surkhandarya	12	9	10	9
11.	Tashkent	23	23	24	25
12.	Fergana	26	43	40	39
13.	Khorezm	5	4	4	4
14.	Kashkadarya	13	13	13	11
15.	Tashkent City	10	14	15	17

The table is based on data from the Statistics Committee of the Republic of Uzbekistan.

It is known that in many diseases, the main sources of healing are spring waters. At present, he is the only provider of medicinal herbs in a large number of sanatorium and spa establishments in the territory of Uzbekistan. In particular, the Amanxona recreational complex is located in the Baysun district of Surkhandarya Province and is surrounded by moun-

tains. This country is also famous not only for its nature, its rich history and traditions, but also its clear water.

It is not surprising that Yunesko is acknowledged as "one of the cornerstones of humankind". There are many places of pilgrimage in the boy, some of whom have used them to restore their health.

"Omonxona" is a balneologically important plant that destroys health and is the most important feature of the liver deterioration. According to the laboratory tests, the mineral content of "Amanxona" mineral content is slightly fibrous (M-2.0–3.12 g/l), sulfate calcium-sodium-magnesium, weak alkaline (pH-7.2–7.7) cold (temperature –18 °C). The water content is also slightly less copper (0.003–0.16), fluorine (0.45–0.65), zinc (0.007–0.036), myshyac (0.0057–0.002), iron (2.0–9.3), strontium (0.72–12), selenium (0.003–0.05), and bromine (0.22–0.50).

Scientists at the N. Semashko Research Institute under the Ministry of Health of the Republic of Uzbekistan believe that Omonxona water plays a crucial role in the treatment of chronic hepatitis and cholecystitis, gallbladder infections, gastritis, duodenitis, colitis, pancreatitis and diabetes.

In general, as we have already mentioned above, the development of mountain tourism, tourism, tourism, tourism, recreational tourism, tourism, tourism, infrastructure, and infrastructure of these recreational recreational systems and centers, day is one of the most important tasks facing geography of recreation.

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FACILITIES OF PLAIN LANDSCAPES OF UZBEKISTAN AND SUSTAINABLE DEVELOPMENT

Abstract: The article describes the historical and geographical stages of the geological age of the occurrence, formation and sustainable development of Uzbekistan's landscape and a special place in the history of landscape development. Dynamic development of the landscape in the period is detailed in the example of the Zarafshan Ditch and the Kashkadarya Basin.

Keywords: Ore Landscape, History of Development, Geographical and Archaeological Periods, ancient settlements, Neolithic and Bronze Periods, Geoecological Situation, Protection, Mapping, Forecasting.

Anthropogenic landscape landscapes, which have a special place in the present-day geosystems and are an integral part of them, are a specific historical category. The occurrence, formation and development of the archeological landscape are part of a certain geological era and play a special role in the history of the landscape sphere. In order to know the history of formation and formation of anthropogenic landscape lands in any region, its development should be based on palaeogeographic, historical-genetic and archaeological methods. By studying the history of the formation of anthropogenic landscapes and their age, F. N. Milkov [1, 11–27], V. Jekulin [2, 6–7], A. A. Abdulqosimov [3, 16–21] and others engaged in. At the same time, all the geosystems emphasized that the morphological structure of the anthropogenic landscape landscapes of each region is a historical category.

According to the zonal stratification characteristics of anthropogenic landscapes, they began to form at different times and formed. According to F. Milkov and V. Jekulin, the origin of anthropogenic landscapes in the central and northernmost plains of the Eastern European plains suggests that neolithic origin began in Neolithic, and later in the northern foothill zone, in Mesopotamia and even in the Middle Ages, in Mesolithic and even Neolithic.

A. A. Abdulqosimov has analyzed the history of formation and formation of anthropogenic landscape landscapes in Central Asia and Uzbekistan, explaining that they were formed and developed under the influence of human activity in various geographical and archeological epochs. Based on these historical genetic and archeological methods, A. A. Abdulkosimov defined the following major historical and geographical centers of anthropogenic landscape landscapes in Central Asia and Uzbekistan: South-West Turkmenistan, Southern Turkmenistan, South-East Turkmenistan, Southern Uzbekistan, Khorezm, Ferghana, South Kyzylkum and Samarkand Historical and Geographical Centers. Each of these centers differs from one another at the time of their appearance and formation. The Samarkand Historical and Geographical Center, which is one of the largest centers of nine anthropogenic oocynal landscapes, is based on the origin and formation of the above mentioned Zaporozhny shrubs.

The first impact of the ancient people on the first natural wildlife landscapes in the Zarafshan ditty began from the mid-Pleistocene 100–40 thousand years ago, or from the Middle Paleolithic period of archaeologists. The most ancient people of Zarafshon were the oldest people on the slopes of Omanqoton on the northern slope of the Zarafshan mountain range and near the ancient Kuchumbulak waterfall in the Narpay district, located in the plains of the prolific plain. According to Archeologists, Neanderthal type ancient people lived in medieval paleolithic sites. They affected the nature of the surrounding habitat, including the animal world. This is evidence of paleozoological materials found in middle paleolithic basins. For example, ancient people living in the cave of Omanqota were engaged in hunting and were found in the cultural layers of the archaeological excavations conducted by the bones of animals such as arches, deer, horseradish, brown beard, rabbit, Nearly 10,000 stone weapon and various stone materials found in Middle Paleolithic. In the cave of Ammanu found work tools of diorite, quartz and lightning stones – cutting blades, pens, and pillars. Hence, ancient people have also used the rocks forming the basis of natural landscapes.

In the upper Pleistocene, the ancient people gradually abandoned the caves in the mountains and began to come to the central parts of the Zarafshan ridge, to the upper terraces of the Zarfshon River, to the delta of the large rocks. More than 40–12 thousand years ago, the people of the Great Paleolithic era settled around the gardens in the central part of present-day Samarkand. This location is studied in detail by archaeologists, and it is called the ancient city of Samarkand. Older people living in the High Paleolithic eras were occu-

pied with open-air dwellings, engaged in tree cutting, hunting, fishing, and hunting. The impact of the economic activity of people in this period covered the valleys and delta landscapes of the rivers. About 7500 hunting and labor weapons, found in the Samarkand settlement, are made of solid rocks such as green silicon, diorite, amphibolite gneiss, extracted from the Choponta hill by A. Askarov and DN Lew [4, 21–30]. The Upper Paleolithic men were engaged in hunting Przewalsky horse, wild beasts, various herbs, Pleistocene cattle, and influenced the nature of the wildlife around Samarkand.

Tribes living in the valleys of the Zarafshan River and in the delta of the big rocks begin to engage in irrigated agriculture during the Bronze Age. From the first half of the Bronze Age to the Greater Holocene, a variety of anthropogenic landscapes are formed that are associated with the development of the personality society. Agriculture plays a major role in agriculture in that era. During the Bronze Age, people were digging the ground and digging the canals to sow crops along with wheat, barley, and tares. Thus, natural landscapes in the terraces of the Zarafshan ditch and the delta of the large sediments were changed as a result of the economic activity of people, and instead of anthropogenic oak landscapes. Gradually the development of irrigated agriculture enabled the expansion of the irrigated landscape landscape and the formation of the city's selector landscapes.

It should be noted that during the Bronze Age the influence of man on natural landscapes has changed from quantity to quality change. In areas where irrigated farming is concerned, natural plants are replaced by cultivated crops – agrolandshaft, irrigated soils are formed by agro-rehydration deposits, and anthropogenic breakdowns occur in irrigated erosion areas. However, the anthropogenic landscapes, especially those of the ooche landscape, were local (local) in the first half of the upper Holocene. The primitive people of the Bronze Age were also engaged in the art of their time and culture. 20 km south of the city of Samarkand, depicting the wildlife hunting scenes of the primeval hunters on the rocky cliffs of the Ellisoy Valley of the Mount Karatepa and the Karagaskasoy valley of Mount Ho'bdin. More than 50 photos have been found. In the rock are pictures of animals, various animals, including goats, camels and other animals. Archeologists say that these pictures are of bronze and iron age.

The second half of the top golocene corresponds to the iron age of archaeologists. During this period, the state of iron control over the material culture of the population and the weapons of mass destruction, the process of formation of the class society and the great states began. From the millennium BC, ie, in the culture of the population, the development of the forces of production will accelerate, the technique will grow, and human nature will begin to widerly exploit it by studying the laws of nature. At the same time, a new phase of human impact on the landscape complexes of the Zarafshan ridge begins. During this period a number of urban selector landscapes were erected in the valley of the Zarafshan ditch, on the shores of the northern slopes of the Zarafshan ridge and in the north of the Yangirabot castle of the Khatirchi district. These are cities such as Afrosiyob, Kofirqal, Chldhortepa, Kuldortepa, Ishtixon, Rabinzhon, Dabusiya, Kushani, Hojaqurgan. At present, these ancient cities are anthropogenic hills that have been devastated and ruined, and that the madphoids are in the form of landscaped landscapes [5, 9–13].

In the Zarafshan Dynasty, the formation of a class society and state led to the expansion of urban and rural landscapes and the creation of large cultural centers such as Sughd and Afrosiab. At the beginning of the Iron Age, people engaged in the production of minerals, other than farming and animal husbandry. They built salt from silver, iron, and salt lakes in the surrounding mountains. As a result, there are also technogenic anthropogenic landscapes of local significance.

Hence, in some parts of the Zarafshan River, high gravitates have been intensively shaped by various types and types of anthropogenic landscapes, including arid landscapes, urban and rural seliph landscapes, on the alluvial plains of the Zarafshan River, overlain terraces, and plains proluvial plains. In particular, the area of the oceanic landscapes went down the valley of the Zarafshan River compared to the mountainous plateau. The new era of development of urban and rural landscapes, in particular the role of the present-day era, is enormous. By that time, people were armed with powerful technical equipment, acquired atomic energy, mastered spacecraft, built large reservoirs and major canals, and opened unprotected and ravenous terrain.

Occurrence and formation of the oasis landscapes in the Kashkadarya basin began shortly after the Samarkand and Khorezm landscape landscapes. According to Archeologists, the population at the beginning of the Eneolithic period, at the beginning of the 4th-3th millennium BC, had been cultivated by irrigated agriculture, along with the cattle breeding, along the rivers and streams, and the agrolandshaft and smaller settlements. During the Bronze Age, the Bactrian region of Kashkadarya became a part of the cultivated culture, creating its wheat, barley, oats, cotton and hinges on the loose and abundant lands, creating and forming simple elements of the landscape landscape, and gradually expanding their area. During the Iron Age, irrigation facilities are being built, irrigated agriculture develops, agrolandish and rural selector landscapes are built, and the landscape areas of the oceanic landscape become widespread. Due to the increase in the number of settlements such as Karshi, Shakhrisabz, Kitab, Dehkanabad and Nishan in the Kashkadarya basin, the landscaping of rural

and urban selector lands, the area of agrolandish shores are expanding and the landscape landscapes are steadily developing.

As a result, the landscape of the anthropogenic oasis developed steadily, extending from the eastern part of the Zarafshan stony to the western part of the storm. At the earliest possible stage, the fullest use and transformation of various natural landscape complexes of the inhabitants of Zarafshan bog, the most urgent problems such as forecasting of negative and positive changes in regional and local natural conditions under the influence of geo-ecological, nature protection and anthropogenic factors, is coming. This, in turn, requires a comprehensive study of the oasis landscapes, a thorough study of emerging geo-ecological situations, serious attention to their protection, and mapping in various sizes.

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TRENDS AND VARIABILITY OF AIR TEMPERATURE AND PRECIPITATION FROM 1961 TO 2016 IN THE KYZYLKUM DESERT

Abstract: Comprehensive analysis of variability of the temperature and precipitation regime in Kyzylkum desert in the course of two last climatic periods made it possible to reveal peculiar features of these variations for separate half years and a year as a whole, and to evaluate their significance, as well. It is shown that the change of climatic conditions within homogeneous landscape can occur in asynchronous way. It is foreseen that increase of the air temperature variability in the warm half-year can be considered as a feature of bifurcation period — i.e., change from warming to cooling in the nearest feature.

Keywords: climatic period, warming, air temperature, precipitation, trend, Kyzylkum desert, bifurcation.

Introduction

In the **Fifth Assessment Report** of IPCC it is emphasized that «Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen» [2]. Spatial-and-temporal distribution of temperature and precipitation, their tendencies and variability related to climate change caused by the global warming and anthropogenic activities have raised significant attention, especially in arid and semi-arid regions where the climatic indices are very important environment factors. In the aggregate, these factors can have substantial impact on ecological systems and on life activity of population in regional scale, in a whole. That is why, the studies of the temperature and precipitation regime and of their tendencies and variability in one of the arid region of Uzbekistan have rather significant scientific and practical importance.

Study area. From the point of view of distinguishing homogeneous climatic zones, Uzbekistan is subdivided to 14 regions considering their physical-and-geographic conditions.

Figure 1. Schematic map of the study area and location of meteorological stations

Variations of meteorological conditions in these regions are regarded as homogeneous. That is why, for each of these regions the most representative meteorological stations are determined as the data of these stations observations characterize the regime of meteorological quantities for the whole region. The study area covers non-irrigated territory of Kyzylkum desert of Uzbekistan. According to this zoning Kyzylkum desert includes 4 climatic regions, 3 of which are referred to as non-irrigated: Northern, Central and Southern Kyzylkum (Figure 1).

Materials and methods. Akbaytal (Northern Kyzylkum), **Tamdi** (Central Kyzylkum) and Ayakagitma (Southern Kyzylkum) are representative meteorological stations for the investigated climatic regions. Investigations of the regimes of the air temperature and precipitation and of their tendencies and variability are performed on the base of the data of these stations observations in the period of 1961–2016. For the processing of data series of observations of the air temperature and precipitation the methods for statistic and comparative analyses are applied. Analysis of the trend changes and of variability of air temperature and precipitation is made on the base of non-parametric statistic test of Mann-Kendall [1, 3–5; 7; 8]:

$$Q = \frac{\sigma}{\sqrt{\frac{1}{18}\left[n(n-2)(2n+5) - \sum_i x_i (x_i - 2)(2x_i + 5)\right]}}, \quad (1)$$

where n is record length, σ is standard deviation, x_i is the number of identical data values (for each value).

The confidence levels of the trend variations according to the values of non-parametric statistical test of Mann-Kendall are given in (Table 1).

Table 1. Confidence levels CL and error probabilities *a* for the Mann-Kendall nonparametric statistical test

Q	CL	*a*	Q	CL	*a*
> 1	> 68.3%	< 0.317	> 1.282	> 80%	< 0.2
> 1.5	> 86.6%	< 0.134	> 1.645	> 90%	< 0.1
> 2	> 95.4%	< 0.046	> 1.960	> 95%	< 0.05
> 3	> 99.7%	< 0.003	> 2.576	> 99%	< 0.01
> 4	> 99.999%	< 0.00001	> 3.290	> 99.9%	< 0.001

Results and discussion. For the purposes of statistical and comparative analyses the time series of the air temperature and precipitation were divided into two periods – 1961–1990 and 1991–2016. It is known that the first time period is taken as the base climate period and is used for assessment of the scale of climate change.

Table 2. – Mean monthly, half-year and yearly values of the air temperature and precipitation during 1961–1990 (1) and 1991–2016 (2); Air temperature (°C)

Station	Period	Month												CHY	WHY	Year
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Akbaytal	1	–6.0	–4.2	3.9	13.9	21.2	27.0	29.7	26.7	20.0	10.7	3.4	–2.8	1.4	22.6	12.0
	2	–5.0	–2.5	5.6	14.7	21.9	27.8	29.6	27.8	20.7	12.2	3.4	–2.8	2.2	23.3	12.8
Tamdi	1	–2.5	–0.5	6.7	15.6	22.5	28.5	31.0	28.3	21.7	12.9	6.0	0.4	4.3	24.2	14.2
	2	–1.3	0.9	8.2	16.3	23.0	29.1	30.9	29.2	22.3	14.1	6.0	0.2	5.1	24.8	14.9
Ayakagitma	1	–1.7	0.8	7.6	16.0	23.0	28.8	31.4	28.8	22.0	13.1	6.0	0.6	4.9	24.5	14.7
	2	–1.0	1.3	8.3	16.0	23.1	29.2	31.1	29.3	22.2	13.6	5.8	0.4	5.1	24.7	14.9

Precipitation (mm)

Station	Period	Month												CHY	WHY	Year
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Akbaytal	1	9.6	11.9	17.3	21.9	11.8	3.5	3.8	1.7	2.2	6.8	11.4	16.7	88.8	29.8	118.6
	2	12.8	12.8	17.9	18.5	19.8	7.8	2.0	1.9	0.7	4.8	14.5	8.6	85.1	37.0	122.0
Tamdi	1	12.7	16.4	21.5	23.0	13.1	2.6	2.9	0.5	1.2	5.4	10.0	16.6	100.2	25.7	125.9
	2	10.3	15.6	16.9	14.9	12.9	4.5	1.9	2.7	0.4	4.3	13.7	13.1	84.5	26.7	111.2
Ayakagitma	1	14.2	15.2	27.8	26.7	13.3	1.8	2.8	0.1	1.0	7.4	11.4	18.2	113.5	26.4	139.9
	2	15.6	22.1	24.7	16.3	12.3	3.1	2.1	1.4	0.5	5.4	17.8	13.4	109.8	24.8	134.5

Note: CHY – cold half-year, WHY – warm half-year.

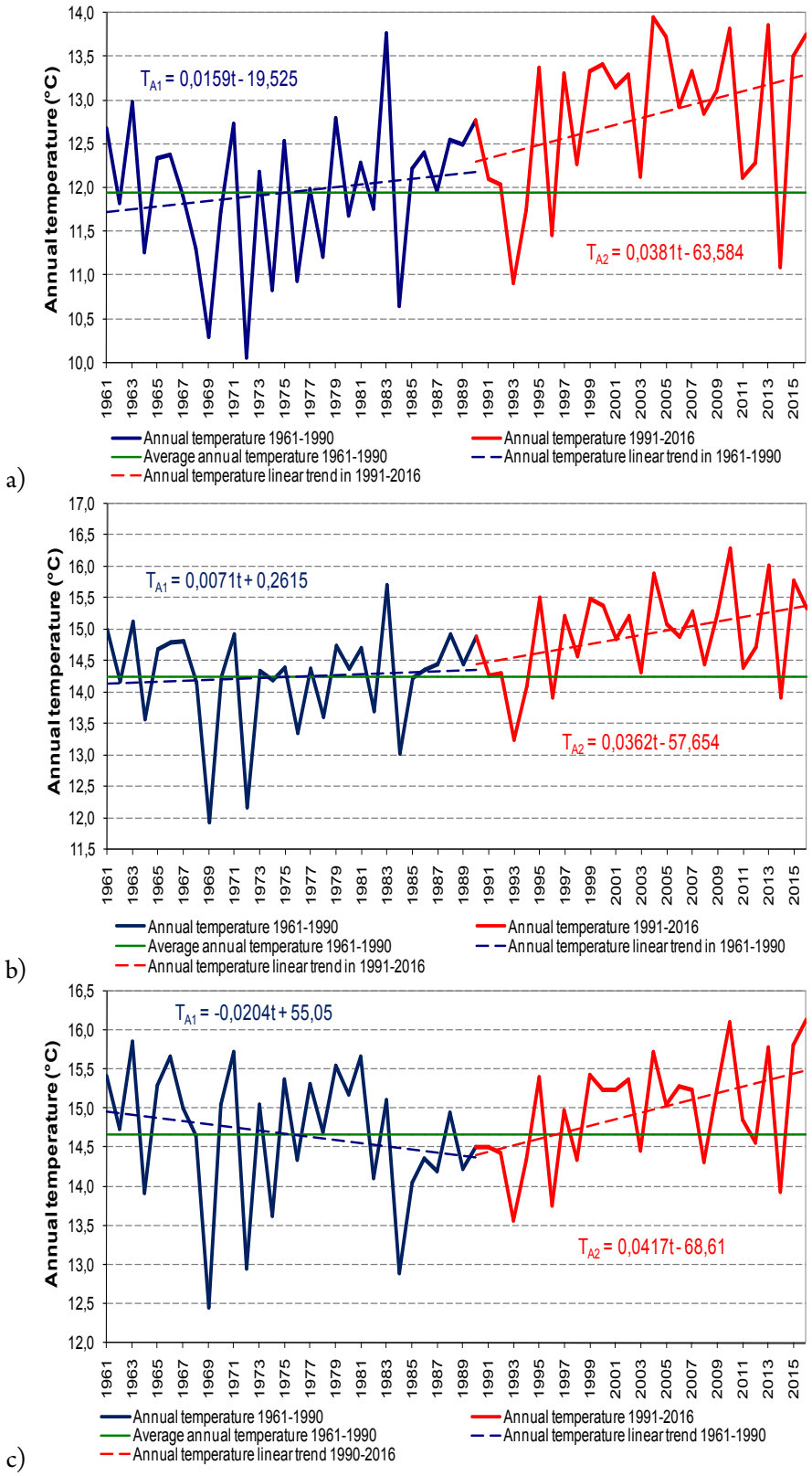


Figure 2. Annual changes of temperature from 1961 to 2016 in the Kyzylkum desert. (a) Akbaytal; (b) Tamdi; (c) Ayakagitma

The comparison of the mean monthly values of the air temperature in the above mentioned periods shows that their change within the studied climatic regions was uneven (Table 2). In all climatic regions the highest increase of the mean

monthly temperature was observed from January to March and in October. With this, in the regions of the Northern and Central Kyzylkum the value of accretion was 1 °C and more. Finally, the records show that that considering half-years and annual values, the increase of the mean annual air temperature was 0.8, 0.7 and 0.8 °C in the Northern Kyzylkum, 0.8, 0.6 and 0.7 °C in the Central Kyzylkum and 0.2, 0.2 and 0.2 °C in the Southern Kyzylkum, respectively. Uneven change is also observed in the value of precipitation amount. In the Northern Kyzylkum the annual precipitation amount increased (+3.4 mm), while in two other regions it decreased (–14.7 and –5.4 mm, respectively). As it shown in Table 2, the decrease of precipitation amount took place during the cold half-year in all studied climatic regions. Insignificant increase of precipitation amount in the Northern Kyzylkum was determined with the increase of this value in the warm half year.

Thus, the increase of the mean annual air temperature was observed, mainly, during the months of the cold half-year. For the analysis of this circumstance and for determination of tendencies of the air temperature variations the graphs of the interannual variation of the mean half-year and annual values of the air temperature (Figure 2) and annual precipitation amount were constructed (Figure 3).

Figure 2 shows that during the base (1961–1990) period in the regions of Northern (a) and Central Kyzylkum (b) insignificant decrease tendency was observed, while in the Southern Kyzylkum (c) the decrease of the mean annual temperature was observed. Currently, in these climatic regions the constant increase of the air temperature is observed. On the base of derived linear regression equations and using non-parametric statistic test of Mann-Kendall the characteristics of tendencies of variations of the mean half-year and annual air temperature values (Table 3) and of annual precipitation amounts (Table 4) were obtained. As the data of Table 3 show, during 1961–1990 the confidence levels of the trend variations are rather low (0.0 and <68.3%) with the exclusion of the warm half-year for the Northern Kyzylkum (>86.6%). During 1991–2016 the statistic test the value of Q for all climatic regions is 1.00 and higher during the warm half-year and regarding the annual values. Respectively, the confidence levels of the trend variations, especially during the warm half-year for the Central and Southern Kyzylkum are >80.0 and >90.0%, respectively. It is just this circumstance, that the annual confidence levels of the trend variations of temperature in all three climatic regions are within the range of >68.3 — >80.0%.

Thus, though the increase of the mean annual air temperature was determined by the increase during the cold half-year, the rate of the increase of the mean annual air temperature in the warm half-year were more significant in the occurred variations of the mean annual air temperature.

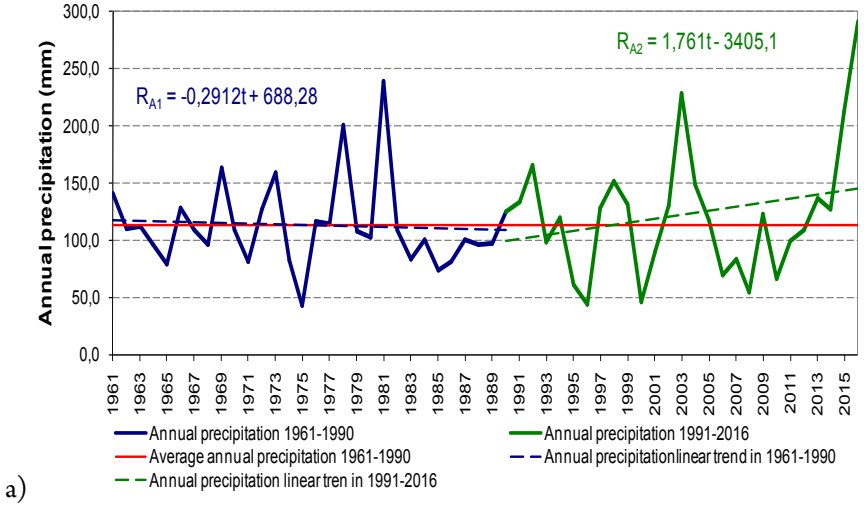
Table 3. Characteristics of the tendencies of the variations of air temperature in Kyzylkum desert in 1961–1990

Station	Season	Trend equation	Trend accretion, ΔT (°C)	σ	Q	CL (%)
Akbaytal	Annual	$T_{A1} = 0.0159t - 19.525$	0.5	0.84	0.55	< 68.3
	Cold half-year	$T_{C1} = 0.0008t - 0.1368$	0.0	1.51	0.02	0.0
	Warm half-year	$T_{W1} = 0.0311t - 38.914$	0.9	0.59	1.53	> 86.6
Tamdi	Annual	$T_{A1} = 0.0071t + 0.2615$	0.2	0.82	0.25	< 68.3
	Cold half-year	$T_{C1} = 0.0012t + 1.8892$	0.0	1.46	0.00	0.0
	Warm half-year	$T_{W1} = 0.0129t - 1.3662$	0.4	0.50	0.74	< 68.3
Ayakagitma	Annual	$T_{A1} = -0.0204t + 55.05$	–0.6	0.87	0.68	< 68.3
	Cold half-year	$T_{C1} = -0.0315t + 67.111$	–0.9	1.56	0.59	< 68.3
	Warm half-year	$T_{W1} = -0.0094t + 43$	–0.3	0.54	0.50	< 68.3

1991–2016

Station	Season	Trend equation	Trend accretion, ΔT (°C)	σ	Q	CL (%)
1	***2***	***3***	***4***	***5***	***6***	***7***
Akbaytal	Annual	$T_{A2} = 0.0381t - 63.584$	1.0	0.89	1.07	> 68.3
	Cold half-year	$T_{C2} = 0.0321t - 61.959$	0.8	1.63	0.46	< 68.3
	Warm half-year	$T_{W2} = 0.0442t - 65.208$	0.8	0.80	1.00	< 68.3
Tamdi	Annual	$T_{A2} = 0.0362t - 57.654$	0.9	0.74	1.23	> 68.3
	Cold half-year	$T_{C2} = 0.0286t - 52.292$	0.7	1.33	0.54	< 68.3
	Warm half-year	$T_{W2} = 0.0438t - 63.016$	1.1	0.80	1.37	> 80.0

1	*2*	*3*	*4*	*5*	*6*	*7*
Ayakagitma	Annual	$T_{A2} = 0.0417t - 68.61$	1.0	0.70	1.49	>80.0
	Cold half-year	$T_{C2} = 0.0335t - 61.915$	0.8	1.24	0.67	<68.3
	Warm half-year	$T_{W2} = 0.05t - 75.305$	1.3	0.68	1.85	>90.0



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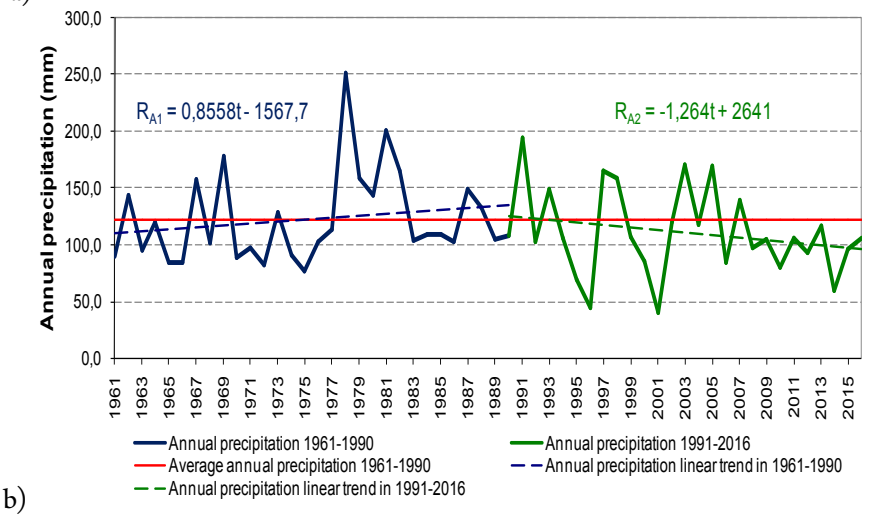

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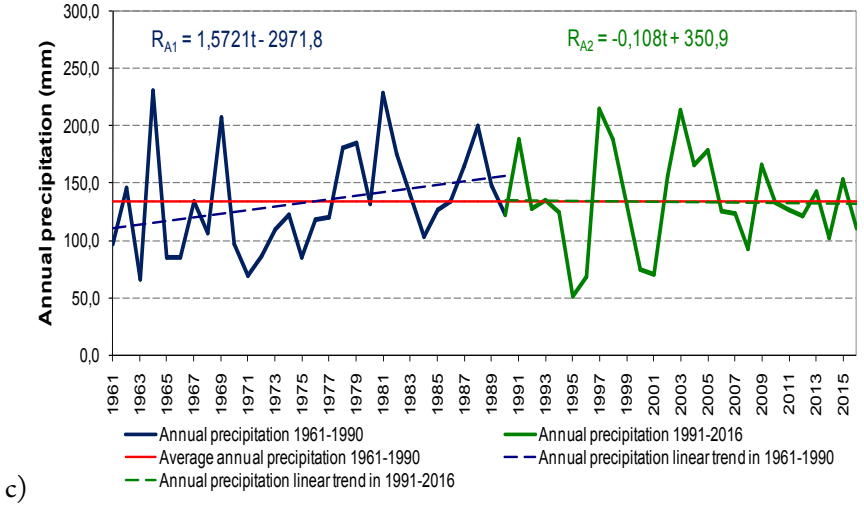

c)

Figure 3. Annual changes of precipitation from 1961 to 2016 in the Kyzylkum desert. (a) Akbaital; (b) Tamdy; (c) Ayakagitma

The intrannual variations of precipitation amount in the studied climatic regions were of different character. The Northern Kyzylkym region was characterized with insignificant decrease of precipitation amount in the period of 1961–1990 and with precipitation increase in the period of 1991–2016 (Figure 3a). The Central and Southern Kyzylkum regions were characterized with the inverse tendency (Figure 3 b, c).

Characteristics of the tendencies of precipitation variations both in the period of 1961–1990, and in the period of 1991–2016 are of rather low confidence levels (Table 4). With this, clearly expressed negative gradient of the trend accretion from the north to the south is traced. The reason of this circumstance is that during the movement of moisture laden air masses over the territory of Kyzylkum desert from the north to the south the warming of the air takes place from the underlying surface. In the result of this the air masses are not in saturation conditions more. As it was shown above, during the last decades the process of constant warming takes place, which undoubtedly, intensifies the negative gradient of precipitation from the north to the south.

Table 4. Characteristics of the tendencies of the variations of precipitation in Kyzylkum desert

Station	Period	Trend equation	Trend accretion, ΔR (mm)	σ	Q	CL (%)
Akbaital	1961–1990	$R_{A1} = -0.2912t + 688.28$	–8.4	38.30	0.22	< 68.3
	1991–2016	$R_{A2} = 1.761t - 3405.1$	44.0	57.30	0.77	< 68.3
Tamdy	1961–1990	$R_{A1} = 0.8558t - 1567.7$	24.8	39.66	0.63	< 68.3
	1991–2016	$R_{A2} = -1.264t + 2641$	–31.6	39.18	0.81	< 68.3
Ayakagitma	1961–1990	$R_{A1} = 1.5721t - 2971.8$	45.6	45.41	1.00	< 68.3
	1991–2016	$R_{A2} = -0.108t + 350.9$	–2.7	42.70	0.06	0.0

Conclusions. Analysis of the change of the regime of the air temperature and atmospheric precipitation in Kyzylkum desert during two last climatic periods gives the ground to make the following conclusions. First, in the first climatic period the insignificant warming was observed only in the northern and central parts of the region and only in the warm half-year. In the southern part of the desert the whole-year decrease of the air temperature was observed. Annual precipitation amount in the northern part of the desert also changed in asynchronous way over the whole territory. In the first period insignificant decrease of precipitation was observed in the northern part of the desert, while significant increase of precipitation was observed over its other parts. During the second period the inverse situation was observed: significant precipitation increase in the northern part and its decrease in the other parts of the desert. Thus, the proceeding of climatic changes, even within comparatively homogeneous landscape is rather complicated both temporally, and spatially, and also regarding the values of meteorological parameters.

Second, the increase of "σ" by the air temperature In the warm half-year on the whole territory can be regarded as the feature of bifurcation period [6], for which the deepening of the process instability is typical. In this cased the change from the warming to cooling in the nearest future is meant.

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GEOSTRUCTURAL PARADIGM IN PHYSICAL GEOGRAPHY AND ITS ROLE IN EXPLORATION OF LANDSCAPE STRATIFICATION

Abstract: This scientific paper narrates the geo-structural paradigm of physical geography and its exploration of landscape stratification.

Keywords: paradigm, geocysm, geocomponent, geomagnetic, landscape, stratification.

Introduction

Scientific knowledge consists of many different ideas and methods that are grouped into specific concepts and methods. As a result they are united by a common theory and methodology. Never the less, sometime in spite of the serious differences existing in the theory and methodology, it is possible to combine similar logic – philosophical foundations and methodological guidelines. The American scientist T. Kun (1977) proposed the concept of "paradigm" for the "unity of the theories" of similar generalities. T. Kun understood the paradigm, the scientific theory, which in the course of a certain period, served as a model for the scientific community to set and solve a scientific problem. According to the scientists idea, the paradigm shift leads to scientific revolutions – the paradigm ensures the unity of the scientific community

The scientific community consists of scientists who acknowledge a certain paradigm. The notion of paradigm is not limited to the theory of science alone, but also the methods of collection of evidence. Their classification the conclusions of individual and shared scientific goals, in the methodology of all knowledge.

Discussion parts of the paper. V. N. Solntsev (1978) analyzes the theoretical physical geographic scientific ideas of the XXIII *"International Geographical Congress"* and writes for the first time that there are four physical geographical paradigms in the field of physical geography. These include the following paradigms: 1) Geocomponent; 2) Geomechanical; 3) Ecological; 4) Geostriction. In the geostrategic paradigm, we wanted to focus primarily on the geo-system concept because it focuses on the structure of the geo-structure. Based on the words of Chavez (1978): "Geosystem covers all hierarchical lines of natural geographical units – elemental units from geographical shell to fase".

The systemic essence of the object is a particular emphasis on the concept of geo-system the nature of their order in the universal system. Since the emergence of a geostrategic paradigm relates to the doctrine of geothisie, recognition of this doctrine is a timeframe or V. B. Sochava (1978) states: "Recognizing the doctrine of the geo-system that forms the basis of modern geo-geography should not cause doubts and doubts as to satisfy the further development of our science".

The structure of the structure is not only the subject of geography but also the basic concept of all subjects. Structure is an in dispensable attribute of all objects and systems in real-life situations. Attribute is an integral part of this object and can't exist without this object. That's why many geographers have addressed a geostrategic paradigm, meaning that the category of structures serves as a basic concept to understand the system's sustainable nature in space and time. In other words, it is physical that the landscape structure of the object that forms the system is structural.

Landscape survey on V. N. Noltsnev's (1981) methodology consists of three stages: substructure, choreostructural and chrono-structural. Structural concept has long been used in the field of physical geography and its role in the geo-strategic paradigm is of particular importance. V. N. Soltsnev analyzes the definitions of many structures in the field of physical geography and concludes: "The structure is either a substructure of the object or a feature of the object of space allocation". In other words the idea of a structure is based on an object idea. In addition the geostrategic paradigm the information about the geo-system (object) is derived from the "structure", whereas the "structure" is derived from the "interaction". In short the geo-system's own structure is based on the interaction of the elements that constitute the object.

At first glance it is necessary to study the original landscape structure in two waysfirstly, as a result of the actual material structures available. As a result of the existence and interaction of the components of the material structur econstitutes the basis of the set of geocomponents of the landscape and secondly, as a result of the interaction of the landscape system with the structure of the surrounding systemthat is the environment of being together.

The first approach involves researching the content of the landscape.

The second approach is to investigate the environment of the landscape. Only after substructural structural development can the structural landscape be fully accessible. From

the description of the structure it is clear that the structure is a stable order of properties in the interaction.

Spatial structure – the order of the lens system, the stability of the chosen period of time. The timing structure is the stability of the sequential exchange of the cosmic state over time. The concept of space and time structures varies depending on the duration of timethat is the stability of the properties at that time. However the analysis of the time structure is based on the study of a set of spatial structures. Consequence coronatudinal research is the most necessary and independent stage of systematic study of the landscape structure. Choreographic research consists of three main stageselementary (simple), analytical and synthetic.

Simple coronary learning is based on the separation of the ordinary units of the landscape structure and the study of their internal structure. The scale of the study, which is the smallest unit of the horizontal system, is the "elemental" landscape or faction study. From the experience of horizontal research, even in large scale (1:10000 and small) topographical maps, it is impossible to study every single faint that is a group of phans as objects in these studies. Thus the scale of elemental choreostructure is relative and depends on the size of the landscape system.

Different types of space landscape structures that have been added together in the analitical choreostructural research are separated. The combined landscape is studied as a set of structured connections. That is complex landscape structures are formed as a result of the interaction between "elemental" landscapes and form certain forms of landscape structure.V.N.Soltsnev (1981) divides three landscape structures into the complex landscape structure: fragment – flat, linear and high area. According to these three landscape structures V. N. Solntsev (1978) divides three types of analytical and chorostrochemical research: a fragmentary structure a study of a linear structure a study of a high level structure.

The synthetic horizontal research identifies a specific type of three above mentioned landscape structures in each specific area and to make a clear conclusion about the structure based on the obtained knowledge the landscape structureis V. N. Solntsev (1981). In other words, is a "closing" landscape structure is the spatial order of this landscape system is the most common type of landscape structure in the area surveyed for a certain period of time. For example, if there is a whole landscape structure in certain parts of the mountain system (mainly in the high mountains). The other parts of the structure are linear (basin) structures while others have a high definition landscape structure. We know that the landscape structure, which is spread over the river or collector basin, belongs to the linear landscape structure. The third type of systematic study of the horizontal structure this is a chronological study. Conscious of the need for physical geographical, including landscape architecture of landscape processes. From this perspective, the occurrence of a continuous unitary state for any type and size of the landscape structureit is possible to determine the interval between the age and evolution of each age.

As a result of which it is possible to study the present state of the landscape structure, the historical period and evolutionary development. In connection with this, the following types of chronological research are provided: current, historical and evolutionary. When it comes to the evolution of the horizontal structure we understand the form of development, consisting of quantitative changes that will continue uninterrupted and lead to quality changes. For example, if we study the landscape structure of the present delta of the Amudarya river its historic era until 1961 from 1961 to the present we must pay close attention to the evolution of qualitative changes in the future landscape structure.

Conclusion. The main types of landscape structures mentioned above (simple, fragmented, linear, high – local, etc.) are different from each other by the historical period, the present state and the evolutionary development. Alternatively, the landscape structures mentioned above may be local, regional or global. That is geostrategic paradigm, taking into account the hierarchical units of different sizes of the geo-system, is based on the study of the structure of the system. In the internal structure, based on the teachings of the geo-system. Because the structure is the attribute of each object, we will only gain knowledge of the system only after the geo-structure structure is investigated on a geostructorial paradigm. In short, the main purpose of a geostrategic paradigm is to prove that the structure of the object is a system that has its own structure.

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THE NATURAL LAKES AT THE TIANSHAN MOUNTAINS COVERED IN CHIMGAN-CHARVAK RECREATION ZONE

Abstract: The article provides general information on natural lakes and their geographical location in the Western Tien Shan.

Keywords: Western Tien Shan, Iksnochkul, Badakul, Shaurkul, Lake Urungo, Pskom, Chimgan Mountain, Beldersay, Hora Chotok, Badaksoy.

The peoples of the world loves to travel from time to time. The reason is known to all. The atmosphere of the country, watching the miraculous objects of nature and enjoying the beauty of the world, enjoying the diversity of people, observing their customs, acquaintance with the cultural and architectural monuments of the country of travel and the people of science, on the one hand, on the other hand, the culture of the tourist increases, and the spiritual worldview is enriched.

In Uzbekistan, there are many attractions that attract the attention of world tourists. One of them is the Western Tien Shan, the other one is the "Uzbek doorman".

The beautiful nature of the Tien Shan mountains attract tourists with its fresh air and green landscapes and it gives a special impetus. Especially, it is pleasant to spend a vacation on the Charvak reservoir, also Chimgan ridge perfect places to spend time at Tien Shan highlands. These mountains, located in the zone of Chimyon-Charvak, have become so amusing for thousands of our compatriots and foreign guests, with so many cirrors, wonderful and beautiful views. Recreational tourists will be able to find interesting information about the unique natural areas, highlands and wonderful lakes of the country.

Of course, in the spring, watching the scenery of magnificent mountains rising on snow and skiing, gives us a lot of joy, just like that fishing, swimming in natural and artificial water, makes you feel better and gives you joy in the summer time.

The nature of the Chimgan-Charvak zone is impeccable and attractive for tourists visiting our country.

There are four Lakes surrounded by mountains which encompasses in the resort-recreation zone of Chimgan-Charvak. Of course is attracts foreigners with its natural and modest climate, and it is diverse flora and fauna. It is also proof of unique nature which has medicinal waters. There are many beautiful places on our planet, but there are some of them that look more charming in the winter. If you visit these places in the winter, you feel that you are in a fairy tale. For this reason, many visitors compares our house is like a Paradise, and they wish to stay there longer then they planned.

Nature has surprised man for centuries, with its extraordinary variety and appearance. I want to tell you about the beautiful lakes that is getting famous and for last couple yeas. Below you will see the wonders that nature gave to us.

Lake Urungoch

Lake Urangoch is a unique natural reservoir located in the Ugam-Chatkal national park and forming the Urungo stream.

The head of Urungokhsai is filled with snow water. A large southern lake begins in the southern part of the lake. As water is nephrite, Urungoch is translated into Uighur as "bright jade", and the local population uses "Bright Emerald Stone". Lake Urungoch separates into two lakes which is located in the same valley. When translated from modern Uighur it also means "Bright or white jade".

With its unique nature and temperate this place is attracting international tourists and the number of tourist are increasing year by year. Lake Urungoch is located in the upper reaches of Pskoma at an altitude of 1500–1550 meters above the sea level, in the upper part of Urengogsai Mountain in the Ugam mountain range 160–165 km from Tashkent city.

The appearance of Lake Urungoch led to large volumes of rock movements due to seismic activity. As a result 1,510 cubic meters of water were formed by the increase in snowfall from the mountains, as a result Lake Urungoch appeared naturally. The length of the lake is 660 meters, its width is 182 meters, the depth is 12.6 meters, and some of middle points 21.4 meters. Water moves under a stone and forms the lower "Small Lake Urungoch". The length of the lake is 320 meters, its width is 62 meters, its depth is 4 meters, and its surface is about 10 meters. The water of Urungokhsoy was thrown out of the rocks and droppes into the river Pskom. During the seasons, the lake water does not lose its clarity, and the water level does not fall during the year. The lake does not contain lakes because of the presence of copper in the lake and cold water.

These lakes are distinguished not only by pure fresh water, the unique nature of the landscape, but also by diverse flora and fauna. By the decision of the Major of Bostanlyk district on February 12, 2015, No. 173, the State Nature Reserve was awarded.

Ihnochkol

"Ihnochkol" is located 175–177 km from Tashkent. In order to visit the lake there, first of all need visit the village of Pskom, which locates close to the lake, crossing the bridge to the left bank of the river Pskom on the pedestrian or final road on Lake Enoch. Since the lake does not pass through Iksnokhsoy, you can go along the highway. There are three lakes in the bag, all three are different. The difference in the lakes is that they are characterized by a high water level and sea level. Passage through the slope leads to the first lake. The bottom of Lake Ixnoch is at an altitude of 2460 meters above sea level, the length is 505 meters, the width is 178 meters, depth is between10 and 21 meters. The formation of the lake led to a large amount of sedimentation due to migration of rocks and an increase in snowfall resulting from the mountains, which resulted in an increase of 900 m3 of water. The lower lake and the large lake are above 250–270 meters.

An altitude of Lake Ekhnoch is in the middle of 2508 meters above sea level and has a length of 1525 meters, a width of 216 meters, a depth is about 14.5 meters with a depth of 46.5 meters. The seismic location of rocks, such as a lake under a lake, was formed as a result of migration. Early spring 800 m3 of water is collected due to melting snow, and in some cases can cause flooding.

The biggest Lake Ikhnach is located at an altitude of 1.5 km from the lake in the middle one, at an altitude of 2724 m above sea level. The length of the lake is 150 meters, its width is 20 meters, its depth is about 2 meters, and its width is 6 meters. The difference between a lake and a lake in the upper lake is that there is a lake in the lake, because of which the snow sets in. As a result of melting snow, the water level in the lake grows, as a result the water in the lake flows into the lower lake, because Exozhts Lake is in high mountains temperature effects snow sthat is why melting seasons came too late, and in some places permanent glaciers are formed. Therefore, summer is short-term, and because of its high temperature cold weather prevails. The spring season begins on the lake within a month, beginning in June. July is warmer and falls in mid-August. Lake Ekhnoch not only attracts people with its huge waters, the unique nature of its beauty, and it is clear like a brilliant, person who once came to the place will return with a unique impression that will last forever.

Shaurkul

Lake Shaurkul is located 275 km from the city of Tashkent, surrounded by Pskoms rocky, mountains after crossing to the metiostation Oyga, so till the lake you can go by walking or by horse, therefore you will be enjoy by seeing such a beauty of Pskom, while on the way to Shaurkul, watching the unique beauty of nature, fresh air, waterfalls flowing from the mountains, flora and fauna, will complement the unrepeatable view of nature and definitely takes an attention of nature lovers and tourists who visits. In summer you will be surprised by watching mountain glaciers from hundred kilometers.

The appearance of Shaurkol led to the formation of a huge dam, associated with the migration of large mountain slopes. Shaurkol is located at an altitude of 2725 meters above sea level, the lake has a length of 1464 meters, its width is 273 meters, its width is 414 meters, its depth is between 9.7 and 17.4 meters, and the reservoir is 3, 89 m3 respectively.

As a result the lake level rises in July-August of the melting of glacial snow and the glacial perennial, and overflows the dam. From October to June, the lake level is covered with glaciers. The sides of the lake are surrounded by high mountains, and on the left bank you can reach the small path. Due to the strong coldness of the water, no living water is found. Since the Shaurkol level is surrounded by eternal glaciers, in summer is short-lived, at night sky drops to zero, and small flakes are frozen. During the daytime there is a constant breeze, a temperature does not rise from + 18 ° + 20 °C, and season will be rainy.

Lake Bodak

Lake Bodak is located 170 km from Tashkent, at an altitude of 1700 meters above sea level, on the left bank of the river Pskom, in Bodaksoe. The river Pskom crosses up to 8 km on the way to Lake Bodaksoy. It created Lake Bodak, which led to the formation of a dam through the migration of rocks and the subsequent increase in aquatic life due to the melting of large glaciers. Lake Bodak has a water volume of 4200 m3, its length is 1130 meters, its width is 274 meters, its depth is between 13.5 and 23 meters, depends on winter season.

Lake Bodak is a tributary of the Pskom River, derived from the Turkic words "Badak" or "Baidak", which means "Broad". Bodaxoy means "big", "wide" – soy. Bodok (Badok) is also one of the oldest generations of the Uzbek nation.

Lacustrine glacial melts, and in June-August the water in the lake grows, October and November the water levels decreases, the main reason for the reduction of water in the lake is that water is discharged into the ground due to the fact, that there are no large spheres of rock and there is no soil mixture lefts. In 1970s and 1980s geological exploration was carried out in Bodaksoy.

Lake Bodak is distinguished not only by its sources of pure spring water, but also by the diversity and historical places of its flora and fauna, which are unique in their unique nature.

Thus, it should be noted that the nature of the Western Tien-Shan attracts tourists with its highlands, national forests which is tremendous views of Alps.

As we have already noted, the variety of lakes surrounded by mountains, the size of flora and fauna, height above the sea level and the massive tides and pastures of Ugam, the Pskom Mountains, creates different climates.

What is closely connected with the lakes in the western Tian Shan Mountains magnificent color. These lakes, which are differen one touthe second one and they are completely different from each, gives an amaze with their own unique color, all of humanity.

Therefore, if you visit miracle of nature, (Urungo, Ihno, Badakh, Shaurkol,) you will never regret your trip.

Section 3. Study of art

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STAGE INTERPRETATION OF A WORLD CLASSIC PLAY IN THE MODERN UZBEK THEATRE

Abstract: The present article deals with a scenic interpretation of William Shakespeare`s "Hamlet" in the years of Independence. The article analyses historical experience and traditions of the Uzbek theatre and the ways of staging of the classic.

Keywords: theatre, play, director, classic play, tragedy, psychological feeling, tradition, experience.

It is a difficult process to express today`s urgent questions in staging world classic plays. This work requires great experience and skills from a director. In the scenic interpretation of the world classic examples in the modern Uzbek theatre the directing researches, such as, deeply studying of a character`s inner world, revealing characters` features through actors` real and natural performance, reaching the right use of each equipment of decoration, creating a deep psychological play that narrates a person`s fate could find its image in addressing W. Shakespeare`s heritage. In 2003 a well known actor of the Uzbek Academic Drama Theatre Turghun Azizov put Shakespeare`s "Hamlet" on the stage.

For the first time in 1935 "Hamlet" was staged at the Uzbek theatre by the director M. Uygur. In the guise of the main character the director embodied a hero who fought against meanness and falsity in the society. The strength, attention and skills of all theatre components were aimed at creating of a play based on the stage realism. Leaning on M. Uygur`s experience T. Azizov in his researches at the play drew his attention to reach reality and naturalness; he emphasized the idea that crimes, like murdering, betrayal, immorality would bring to destroy and tragedy of the society; he made a conclusion that all those features would spiritually and morally relate to the present time. "The director`s intend was to see in his Hamlet an image of a firm and explicit person who keeps human values in fighting against the evils of the society" [1, 29]. As a result of this great truth about main moral notions of humanity, like justice, conscience, honesty and others find reality on the stage.

The director interpreted the play in a heroic philosophical tragic genre. The heroism of Hamlet is not only in defining his father`s murderer and fighting against him and his companions, but his intended to establish justice by clearing the society from traitors. As a result, in the interpretation in which moral approaches were stressed the director could achieve the play not to be socialized, and the volume of the play could extend much wider. The play was staged without romantic pathos; it was rich with psychological experience of the main hero. T. Azizov tried to create in Hamlet an image of a modern hero embodying nowadays quick development changes. So the image of the protagonist was created as a perfect person having very strict, sharp features, being very quick at solving problems and making decisions; at the same time being much too sensible he considered everything before any actions. He didn`t have any nobility as a prince; in the image of Hamlet we could see just an ordinary rebel opposing spiritual recession in the society. Thus T. Azizov "makes a person who got into whirlpool of slyness and wickedness close to us" [4].

T. Azizov together with the artist B. Ismailov could create a tiny compact decoration. In the middle of the stage there was a small stage in triangle shape above which was a throne for Claude and Gertrude. In its turn that throne with the sign of the cross looked like a gravestone; thus the director gave an explanation to the future fate of the king and queen. Also there one could see the king`s bedroom with coming down transparent curtains. The present conventional image decoration served as an expression of the play`s aim that stressed a mother`s betrayal.

The statement "The epoch has gone out of its right way, and it`s my duty to return it to its place" was used as a leitmotif of Hamlet and during the performance it was spoken for several times by T. Saidov who performed as Hamlet. This case served as a difference from the previous versions of the play. Professor T. Tursunov says, that: "the expression 'the epoch went out of its way' repeated for five times shows Hamlet`s

imagination, distress, feelings in taking any decision as it was he who took responsibility to return everything to its place. In the result it adds exactness to the actor`s movements" [3, 439]. We think, that the above mentioned words uttered by T. Saidov lacked in the intonation losing its value as it was repeated for many times without any changes in the intonation.

Shakespeare gave a definite feature to the main hero, therefore the image of Hamlet should be interpreted without any heart emotions; his actions must act reasonably. So, Kh. Nurmatov, People`s artist of Uzbekistan, says: "It isn`t necessary to cry out to the empty air, shouting with foam in the mouth and creating excitement out of nothing" [6]. T. Azizov`s aim was to use just that approach in moulding Hamlet`s image on the stage and the performance of T. Saidov without any emotional feelings could answer the author`s demands. Only due to the concrete situation, particularly, on the scene where he had to reveal his mother Gertrude`s (S. Yunusova as Gertrude) actions he becomes furious showing his inner fights. In other places, especially, while expressing the most important monologues of the play the director demanded him to become quiet. In its turn T. Saidov to keep away from false pathos he approached calmly in performing monologues. "As a result, the main monologue "To die or not to die" that shook thousands of viewers turned out to be a simple sociable saying that can be heard everywhere in everyday life [5]. This shows that both the director and actor couldn`t find 'golden center' in the performance of the monologue, in the result of which the effect of the monologue has gone down.

But despite this as the director intended, T Saidov created his hero respecting sincerity, fighting for truth, criticizing people`s thirst for wealth and post, greediness, dishonesty, impiousness, impishness and other evils of the society. The actor could show his hero`s changing character: his sharpness and tenseness before going to England and his restraint, sensitivity after returning from there. T. Saidov`s Hamlet with steps like lightning and courageous words make Gertrude – S. Yunusova a weak helpless woman who previously was a proud lady with sounding voice and active feelings in her inner world; and Claude -M. Abdukunduzov- becomes a powerless person who lost his way, not knowing what to do; once being very strict, deviant in reaching his goals, acting on the bases of a definite plan, and never regretting in committing a crime. The other heroes of the play are so weak and helpless in front of Hamlet. Thus, the director succeeded in the interpretation of the main hero, so did the actor in performing his Hamlet`s image.

There is one more hero in the tragedy – Ophelia. She was interpreted as poor who couldn`t put up with senses that fell on her head. The director chose a young actress G. Eshankulova to play Ophelia`s image. Known as performing lyric and romantic roles she could inspire the image of Ophelia. It seems that, her Ophelia wasn`t on the Earth- among people; she had her own imaginary world. Ophelia- G Eshankulova is a careless little girl, who doesn`t distinguish anything between white and black sides. This kind of approach by the director and actress shows that she becomes a victim because of her childlike faith, not due to the epoch. But during the performance her character remains without changes, that is, monotonous. Particularly, Hamlet-T. Saidov shouts at Ophelia: "Go to church". And this challenge must make a sharp turning in the play. Here it should be mentioned that "Hamlet" was staged at Lenkom theatre in Moscow by the director A. Tarkovskiy. It is important to note that Inna Churikova played as Ophelia; she could show a change just at this part of the play. "As if something came off in Ophelia`s heart, she slapped in the prince`s face…Just at this moment rejected by the prince, being thrown from the sky, she stays between her soul and mercy and the question "To die or not to die" seems to arise before her" [2, 413]. G. Eshankulova`s Ophelia simply and calmly accepts Hamlet`s challenge-which brings down the effect of the play.

T. Azizov staged "Hamlet" on the bases of psychological theatre traditions existed at the Uzbek theatre in 30–50 s of the last century. The characteristic features of the heroes in the author`s play could find their similarity on the stage as well. The conceptions, like morality, conscience, loyalty were developed in the director`s work serving as a modern interpretation of the play.

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Section 4. History

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FOUNDATIONAL AND PHILANTHROPIC ACTIVITIES OF POLISH RULERS IN THE LATE Xth – EARLY XIth CENTURIES

Abstract: The article deals with the issue of the founding and patronage of Poles' rulers in the late 10th– early 12th centuries. It is noted that the practice of foundations occupied a significant place in the activities of rulers in the Middle Ages, since it was a significant attribute for the image of the "ideal sovereign". The first examples of foundations in Polish lands spread in 1020 s during the reign of such dukes, as Casimir I the Restorer (1034–1054) and Boleslav II the Bold (1054–1079). The article outlines the main types of foundations, including the investiture of land, money, books and relics of the saints. Dukes' main tasks were to show the image of good-tempered rulers who cared for their subjects, furthermore, strengthen their relations with the Catholic Church as well as the Christianization of newly-annexed territories. What is more, the foundations were one of the subjects of Polish international affairs of that age.

Keywords: foundation, compensation, bishop's throne, duke, monastery.

The concept of patronage or foundation activity was the essential phenomenon for the political culture of the Middle Ages as well as the important social component of the state [4, P. 23; 35, P. 513]. In fact, such practice was one of the key indicators of the governmental activity for a ruler and was an integral part of the image of the ideal sovereign. Particularly, it was connected with the dominant role of religious state of mind of a medieval man and the specifics of the political culture of that time. Therefore, the study of this topic is relevant for the research concerning Medieval Ages.

It should be noted that the problem of foundational activity was investigated by several Polish historians, such as R. Michalovskii [30], J. Doboch [15], L. Veetshko [39], M. Dervich [11; 12; 13] and others. However, a significant amount of issues remains undiscovered and, especially it concerns the social role of the ducal foundations, their place in political mentality, etc. The use of up-to-date methodological approaches is extremely relevant in the field of historical anthropology, research of political mentality in particular.

The purpose of this article is to show the role of the ducal foundations in the early medieval Polish state in social and political life according to the perspective of the relations with Catholic Church as well as to explore the place of foundations in the political representation of that time.

In the beginning of the Middle Ages, there were two different institutions – the state and the church that were the embodiment of two different cultural paradigms, like barbaric and antique [39, P. 19]. The term "Barbaricum" may outline the concept of barbaric kingdoms that replaced the Late Roman Empire [31, P. 19]. In this case, the church became the personification of the ancient cultural paradigm, serving as a place of preservation of Latin language and literacy [31, P. 19]. Gradually, it led to the beginning of the rapprochement process between these institutions and this phenomenon was primarily due to the development of the idea of the sacred power as the essential component of the Christian worldview and the church doctrine. The state needed sacred legitimization from the church due to its monopoly on how to define this meaning.

One of the first steps for the rapprochement was the formation of a ritual of shifting power, mainly known as the coronation. Unlike the Byzantine tradition, according to which the sacralization was a necessary feature of recognition of the legitimated power, even if it was not obtained in the rightful way [32, S.69–89], barbarian kingdoms of Western Europe considered the sacralization of power as the approach of the formation of a new paradigm of power. Nevertheless, a crisis of the vision of the traditional political system for the barbaric world became typical for the outlined period where the ruler is rather a moral authority than a sacred one. Actually, this scheme still reflects the traditions of the tribal political system. The peculiar moral authority of the ruler was established in the first law codes, such as "Salic Law" [29, P. 5].

However, the image of ruler as a moral authority was gradually replaced by Christian concept of the implementer of God's will [39, P. 21]. In particular, it is manifested in the ritual of coronation or anointment. The first recorded case of coronation was the transfer of authority of the Visigoth king of Wambi in 672 [19, P. 501]. Subsequently, the ritual was recorded by Lombards and Franks [1, P. 142].

Thus, the ruler's power became sacred, although, church was supposed to confirm it with the presence of the main church institutions. Consequently, different methods were used in order to achieve their support, including direct material assistance for monasteries and churches, which subsequently grew into the phenomenon of foundations.

One of the first foundation benefactions was the donation of Duke of Benevento Arechis II for the St. Sofia Church [30, P. 29]. The Duke Arechis II actively collected the relics of the saints in Benevento and gave generous alms to the monasteries in Southern Italy, particularly to the monastery in Monte Cassino. In accordance with Roman Michalovsky, this appeal actually formed the phenomenon of foundations [30, P. 29].

Then, such scheme began to function in other barbarian kingdoms. For instance, it was recorded in the documents the foundation of the Frankish King Pyipin of the Short Benedictine Monastery in Pryum in 762 [13, P. 22–25], and this tradition was prolonged by his son, Charlemagne, who immediately was highly praised by the theology intellectuals [3, P. 84].

Therefore, a new image of the ruler was formed, according to which the Christian king must convert pagans into the true faith [39, P. 23–24] as well as expand the Christian world and support the church. The king began to act as a successor of Jesus Christ who ought to take care of his flock [5, P. 16] where the structural part of this flock was the clergy.

Church provided the support regarding the symbol of the ruler which had a positive outcome even despite negative consequences of the temporary decline of the prestige of the royal power that were caused, for example, by the death of Charlemagne and the Treaty of Verdun in 843. The constant struggle for the legacy of Charlemagne and the right to receive the imperial crown formed various armed conflicts.

The foundations on the territory of Poland of that time were established shortly after the adoption of Christianity. The document "Dagome" is considered as the first example of the official transferring property to the church but it was more likely to be a protection of the Holy See and Rome in general rather than the actual act of transferring the state into possession [30, P. 53; 15, P. 250–251].

The next fundamental act describes the episode of the Gniezno congress when King Boleslav I the Brave and Emperor Otto III presented the relics of St. Wojciech-Adalbert to the Gniezno Department [17, P. 401].

In general, three types of foundations can be distinguished in Polish lands: 1) money and land funds (for example, financing and investing in the real estate development) [30, P. 53]; 2) foundational books [30, P. 54]; 3) foundations of holy relics [30, P. 55].

The first pieces of information about the foundation can be found nowadays concerning the Illuminated Code, presented by Countess of Palatine of Lotharingia Matilda of Germany to the Duke Mieszko II Lambert [24; 25], which included the sequence [16; 34] "Ad celebres rex cęlice", the letter to Countess Matilda as well as the liturgical book "Liber officiorum quem Romanum Ordinem appelant" [22], which is believed to be written by Remigii Osersky [27, P. 476]. In accordance with the letter, Matilda praised Misech II as a true Christian ruler and drew attention to the fact that he had built many churches [26, P. 323].

Due to the crisis of 1037–1039, foundations were not established because of the complete collapse of the state mechanism. This practice was restored only during the reign of the Duke Casimir I the Restorer who particularly paid attention to the foundation of monasteries. Approximately in 1044 the St. Peter's Abbey was founded in Tinka near Krakow * and St. Jacob monastery in Lubyazh. Furthermore, Casimir I assisted in the creation of St. John's Monastery in 1050 in Mogilev [12, P. 226]. In addition, the Duchess Richeza of Lotharingia, the mother of Cazimir I, played the important role in the foundation of various clerical institutions, although her assistance was more connected with monasteries in German lands because they were possessed by King Henry III.

In the respect regarding such activity, Casimir I also acquired the nickname Monk (Mnich), although it was also associated more with his stay in the monastery, when he was young, rather than his donations in the construction of abbeys. There were many motives for such a policy, particularly with the emphasize on the Duke Casimir's personal state of mind, described by Hull, when he pointed out his religious past [11; 13]. Moreover, it should be noted that Casimir I was, in fact, the first Polish ruler who grew up in a full-fledged Christian environment.

One of the greatest founders in the history of the medieval Poland was Boleslav II the Bold. He continued his father's policy of supporting the monasteries and shortly after the succession of the throne, Boleslav II restored and rebuilt the monastery of St. Martin in Wroclaw [12, P. 226]. What is more, the duke contributed to the expansion of the monastery of St. John in Mohilne [20, S.105–108] and gave him significant privileges, particularly the right to collect a ninth part from the financial income, cattle and grain supplies [8, P. 360] from such 20 ducal cities, as Grudomsh, Zakrocim, Syrokh, Ripin, Novy, Radek, Vysohrud, and others. In addition,

the monastery was entitled to receive 10 silver stamps from the city of Lesin, 7 stamps from Zbietzimir, 4 stamps from Volborg, 2 stamps from Zharnov and 7 stamps from Rospyr [8, P. 360]. Furthermore, the abbey was granted the right to own some villages located near Mogilev. Alternatively, the letter referred to the creation of a new monastery of the Benedictine in Plotsk, which was supposed to be subject to the abbey of St. John.

It was believed to be a generous reward concerning the financial capabilities of Poland at the time, although there was not only a purely economic or spiritual act. Such a step should be considered in the political context, as Monastery of St. John belonged to the Benedictine. Boleslav II possessed the throne for a short period of time and needed a support both in internal and international affairs. The Duke sought support from the church for himself as well as his father. However, Casimir had used his authority as the restorer of the church structure in Poland, but Boleslav did not have such authority and, therefore, began to expand his father's fundamental policy.

In general, there was a widespread belief in the Boleslav's charitable character as well as his magnificent and large-scale nature, Gull wrote a rather interesting legend, which he described as the Legend of the noble and generous Duke Boleslav and one poor cleric (De liberalitate et largitate Bolezlavi et de quodam paupere clerico). Some poor foreign cleric, while visiting Duke's palace and seeing a huge amount of gold, sighed, recalling his poverty. Boleslav II took into consideration the cleric's position and sent his servants to find out what the reason was for this situation was. However, the foreigner was concerned about Boleslav's severity [17, P. 421] but still dared to tell the prince about his poverty. Finally, Duke's reaction was merely positive and charitable [17, P. 421].

On the whole, Gall represented the Boleslav's generosity, although this legend may describe the international aspect. Regarding the fact that this poor monk was not a Pole and as a foreigner in Krakow at the court of the prince, it is likely that he was a messenger from Rome, perhaps a member of one of the papal embassies or just a papal ambassador. Consequently, this generosity could serve as a kind of payment of the "tribute of St. Peter", which was supposed to be paid by his father, Duke Casimir I, which mentions the Wielkopolska Chronicle [23, P. 485]. However, it is possible that the author also took this example of the payment to Rome as a proof of the Duke' generosity.

In 1070 s the prince continued his foundational activities. For instance, two new Benedictine monasteries were founded in Wroclaw and Lubin, as well as the monastery in Tienka, founded by the Casimir I the Restorer, which was considerably enlarged. Importantly, Boleslav II the Bold established the land estate which can be proved by the diploma to the monastery in Mogilev, according to which the fact of giving the authority on the land to the church authority was recorded for the first time [8, P. 360]. Although, the phenomenon of land, granted to the monasteries, was quite common in European countries, but in Poland this legal procedure was fixed only by the mentioned above Boleslav's act. Similar tendencies were widespread before, but they were not recorded in written sources.

After the coup in 1079, the duke's throne was acquired by Boleslav's brother, Wladyslaw I Herman. Foundational activities also occupied an important place in its domestic policy. Doubtless, it had smaller scale than the foundations of his father, Duke Casimir I and his brother, Duke Boleslav II. Mostly his donations were related to the need of succession. His marriage with Duchess Judita was childless for a long time. However, the duke had a son Zbigniew, but he needed a hereditary line from a marriage with Judita. Therefore, Wladyslaw actively donated to the monastery. It was a common practice of generous rewards in the event of infertility of his wife. In particular, Gall Anonymus pointed out the text of the diploma where donations to the monastery of St. Eygius in Provence were described [17, P. 426]. What is more, Wladyslaw built a church, dedicated to St. Aghidia near Sandusky [15, P. 160].

Another important foundation was the transfer of the bishop Stanislav's holy relics to Krakow, which took place in the same year 1086 *. The information about this event was described in many sources, particularly Vincent Kadlubek wrote about it in the biography of St. Stanislav in the early years [15, P. 161]. In general, this event was very significant and Wladyslaw tried to rehabilitate in the eyes of the clergy for the actions of his brother Boleslav. In addition, such acts have always been important for the medieval man. The political aspect can also be outlined, as Wladyslaw raised the importance of Krakow in the system of the Polish state. In addition, it was the first step towards the canonization of Stanislav, which further allowed strengthening the position of the Polish church in general, including in opposition to the German Archbishop.

Overall, the Duke Wladyslaw I Herman distinguished himself with active foundations for the development of the Krakow Department. Thus, in 1088 St. Wenceslaus Cathedral was built in Krakow where were appointed 24 canons with prebendaries of land holdings [23, P. 493]. Wladyslaw actively sought the assignment of the status of Archbishopric to the Krakow Department, which corresponded both with the state and church needs. It should be noted that there was a large donation to the Bamberg Monastery for the amount of 2 zlotys which was considered to be a high price.

One of the most significant foundations of Prince Wladyslaw was the reward of an illuminated gospel to the Plosky Episcopal Department. This manuscript is known as Codex Aureus

Pultoviensis and is exposed nowadays in the Czartoryski Museum [21, P. 40]. The code was created in Regensburg due to the order of the first wife of Duke Wladyslaw, Judita of Czech. Researchers [2, P. 74] noticed the similarity of this code with the Visegrad code, commissioned by the Czech king Vratislaus II of Bohemia for his coronation [38, P. 282; 33].

Another treasury is the Golden Gniezno Code, which is the illuminated gospel and is currently in the exhibition at the Archbishopric Archives of the Gniezno Department [10, P. 10]. There is not clear evidence how the document appeared on this territory, but it is supposed to appear thanks to the Duchess Judita [30, P. 99]. Moreover, it is necessary to point out that the founders were not only rulers because such practice was also typical for the nobility. For instance, it is likely that partly the founder of the construction of St. Andrew Church in Krakow was palatine Seetshech, palace commissioner under the reign of Wladyslaw I Herman [9, P. 138–139].

In general, the description fundamental policy of Boleslav III is difficult task, as sources do not tell us at all whether Boleslav was donating money for building a particular church or monastery. Gallo Anonymous pointed out that Boleslaw "has always sacrificed something for the needs of the church, and for the most prominent places, only gold and the pallium" [17, P. 481], but at the same time did not provide any specific examples of charities.

It is known that the Krakow Department began to develop vividly thanks to Wladyslaw I Herman that can be proved by the construction of the Cathedral in 1142 for Archbishop Robert [36, P. 833]. Obviously, the construction did not develop due to the lack of building materials and financial aid. On the other hand, the cathedral in Plotsk achieved benefactions in 1127. Plotsk was attacked by Pomoryany and the cathedral was destroyed. Thus, the restoration of the church was entrusted to the local bishop Alexander, who during the next 20 years was engaged in the construction of the church. An important fact was the place of offertory because Duke Wladyslaw's father was buried in Plotsk. In fact, Boleslav intended to turn the Plotsk church into a family mausoleum and, therefore, provided a significant financial assistance despite his constant employment in the Pomeranian affairs [15, P. 184].

Active financial support for the construction of religious buildings caused the respect even from foreign authors. For example, prior Bertold indicated that the duke "handed many silver, gold and other things to needs" [6, P. 6] for the needs of his monastery in particular. The author also stated that duke's second wife Salome also donated a significant amount of money to the monastery, particularly 4 stamps of silver as well as other jewelry [6, P. 6]. Nonetheless, it was consider an exceptional case of the Boleslaw foreign foundation, which was more likely connected with the fact that this monastery was in Swabia, where his wife Salomea was born. All other ducal foundations were concentrated within the borders of the Polish lands.

Boleslav III actively assisted the Benedictine Order, which at that time was the most powerful monastic order in Europe. He continued the policy of his uncle Boleslav II, who also distinguished himself from foundations in favor of the monks. Thus, two new Benedictine monasteries were founded in Wroclaw and Lubin, as well as a monastery in Tienka, founded by Casimir I the Restorer, which was significantly expanded.

Most likely, one of the first appeals to the Benedictine was the donation to the rebuilding of the Monastery of the Immaculate Conception near Lubin. Actually, this fact was confirmed by later records in the book of the founders of the monastery, where Duke Boleslav and Duchess Salomey [15, P. 187] were listed. There were some debates regarding their identity, but it was found out that the monastery was reconstructed in 1124 [7, P. 57] and other Duke Boleslav and Duchess Salomea could have been in this period. The foundations for this monastery were extended by the sons of Boleslav III, in particular by Wladyslaw II.

Another Boleslav's great foundation was the donation to the Benedictine Abbey in Mohilno. More or less confirmed information about this foundation can be found in Duchess Salomey's letter, dated 1143, where she gave as a gift Radzeyuv village in order to commemorate the memory of the Duke Boleslav [37]. It is difficult to say whether it was Salomey's or Boleslav's will, but it should be noted that the construction of this abbey had also a political aspect. This monastery was located near the Pomeranian lands and Boleslav was extremely interested in strengthening both the border and newly-attached territories. Overall, Boleslav III had close contacts with the Benedictines. It was before this monastery that Bishop Otto from Bamberg arrived to begin his missionary trip to the Pomeranian lands.

Furthermore, Boleslav III helped other Benedictine monasteries, which is shown by the version in "Wielkopolska Chronicle" about the Benedictine monastery in Setzechow that was founded on the duke's order *, and the author emphasized that it was the monastery dedicated to St. Benedict [15, P. 191]. The Duke handed over to the Benedictines the villages of Łysieć, Slup, Rataje, Boleszyn, Ciepłą, Głodno, Koniemłoty and the Church of St. Voitecus near Sandomier [15, P. 193].

It should also be noted the considerable benevolence to the monastery in Tremeshno that most likely belonged to the Benedictine. It can even be assumed that this monastery was founded by Boleslav III because the first mentions are found in the document dated 1145, which is likely to be later

falsifications, but the date on its foundation is recorded exactly during the reign of Boleslav III [9, P. 160].

Boleslav III initiated the resettlement of German monks here, most likely Benedictine. They were headed by their monk Bernard, whom he personally invited [15, P. 195]. The establishment of this monastery should also be linked with Boleslaw's Pomeranian policy, since it was imperative for the duke to strengthen local newly created archdioceses in the newly-attached territories, which needed support, including the recruitment. Monasteries gradually became centers for the preparation of priests and missionaries for these territories [15, P. 195] and the active constructions of the monasteries dated 1126–1138.

As a consequence, the founding activities of Polish rulers played an essential role in social and political life of Poland. The purpose of such practice was considered: 1) to form the image of a Christian well-mannered ruler who cared about his subjects and the church in particular; 2) to strengthen the relationship between state power and the church for the sake of the stability of internal life; 3) to Christianize the newly-annexed territories of Poland and strengthen the power of the Polish rulers; 4) to be the tool of foreign policy regarding the Empire and Rome. Foundations on the territory of Poland were extremely valuable due to the allocation of significant amounts, especially thanks to Boleslav II the Bold (1054–1079) and Boleslav III (1102–1138).

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THE MAIN DIRECTIONS OF THE DEVELOPMENT OF THE ACADEMY OF SCIENCES OF UZBEKISTAN IN THE 50–60TH YEARS OF THE XX CENTURY

Absrtract: The article outlines the achievements of the Academy of Sciences of Uzbekistan in the 50–60th years of the XX century, newly opened scientific research institutes, the achievements of the academy in training national scientific personnel, the role of the Academy in the development of Republican National Academy, agriculture and work of Habib Abdullayev as the President of the Academy of Sciences.

Keywords: Academy of Sciences, Presidium, Scientific Research Institute, archives, national economy, agriculture, industry, development.

It was not in vain that at the beginning of the Second World War, Academia of the Academy of Sciences of Uzbekistan was focused on the development of agriculture which formed the basis of the economy of the Republic at that time.

Scientific institutions of the Academy of Sciences have carried out researches and studies on development of economy, industry and agriculture.

Specifically, land resources of Karakalpakstan were initially studied and then the issue of using desert and steppe zones in the territory of Uzbekistan.

In recent years, the Academy of Sciences has continued its scientific researches in this area, and since 1953 the Angren mining industry and from 1954 the Zarafshan oasis in the mining and its opportunities in agricultural industry, prospects of manufacturing resources were studied on a scientific basis.

Besides that, Habib Abdullayev mentioned in his letter which was written to the Central Committee for Advocacy and Advocacy of VKP that institutions of the Academy would work on the following actual problems of national economy:

– cotton problems;
– personalizing deserts and new lands;
– economic zoning of using water resources in irrigation and energetic and proper orientation of production forces.

It should be noted that during this period a great deal of attention was paid to the establishment of a number of new, modern research institutions within the Academy. In particular, new scientific research institutes such as Water Problems and Hydro-technical Institutes, Institute of Plant Chemistry, Experimental Medical Institutes, Institute of Polymer Chemistry, Philosophy and Law Institute were established. Also, Institute of Geology and Recycling of Oil and Gas Mines was opened. Institute of Physiology and Plant Genetics was established on the basis of the Agricultural Institute. Major researches have been done to improve cotton grade in this institute.

Commenting on archeological monuments and historical buildings in the territory of Uzbekistan, Habib Abdullayev has suggested the idea of accelerating scientific researches in this area.

Indeed, selfless labor has yielded its fruit. The Academy has made great strides especially in the field of cadres training. They used to satisfy the needs of academia or other research institutes and higher education institutes. Especially, the number of local native representatives has increased. However, as the scientist regretted, there were still unresolved problems.

What's more, one of the pitfalls was training of doctors. Especially, there were no Uzbek doctors in the Academy of Sciences in cotton, irrigation, hydrotechnics, silk, physical and technical aspects.

While the number of was increasing, Academy of Sciences used to follow the previous standards regarding the personnel in the scientific research institutes, which led to the need to continue research through doctrine system.

For this reason, sending dozens of graduate students to Moscow and other cities has become one of the urgent tasks of the board of directors of the Academy.

It has been years since the Academy of Sciences' experience in postgraduate and doctors of science, especially sending postgraduate and doctoral students to leading research institutes and laboratories in major cities such as Moscow, Leningrad, Kiev, Baku. Habib Abdullayev was personally involved in this matter. Organizing a large-scale preparation of highly qualified scientific cadres required a lot of effort, strength, constant attention and parental care. Habib Abdullayev showed courage and skill in this work too. No matter how little time he had, he never forgot to answer the letters which were written by his graduate students and give them his advice.

According to the analysis of archival materials, discrimination of Uzbek postgraduates sent to some major scientific research institutes showed that attitude towards them was not the same.

The open letter to the first Secretary of the Central Committee of the Communist Party of the Soviet Union, one copy

was mentioned to be sent to the President of the Academy of Sciences H. M. Abdullayev, said:

We, the postgraduates from Uzbekistan, ask you to accept range of criteria to strengthen the training of scientific and pedagogical cadres. First of all, we would like to express our gratitude to the scholars of Moscow, Leningrad and other central cities of the Union which are showing sincere compassion.

Training of postgraduate students in Moscow and other central cities is deeply different than here. There is a great experience base, there are many advanced scientists with extensive experience in training of scientific and pedagogical cadres. We are grateful to the USSR Minster's Council and the Uzbek SSR for their efforts to send us to the central universities and research institutes.

Under the current conditions, the happiness of development is primarily due to the highly skilled staff. We need to strengthen our training and training by sending our best specialists, especially youngsters, so tat we sill not be left behind in the future.

To do this, it is necessary to eliminate the difficult conditions in the dormitory for postgraduate students.

Can the Central Committee of the Communist Party of Uzbekistan and the Council of Ministers really not solve this problem?

Apparently, they are not that interested in cadres. As you know, a room for postgraduate students from the Minster's Permanent Government Halls has been allocated. This is room is used as a hotel also the fee for staying is charged according to hotel rate.

We cannot live hotels and there is absolutely no opportunity to work, secondly, it is expensive for us. Some of our graduate students cannot go for a postgraduate course because of the lack of residential place in Moscow. We have asked you to to take our circumstances into consideration and reduce the cost of living. We had spoken to you on the phone, but have not received any answers yet. It is unfair. Those in the campus of the Institute pay 3–4 rubles and we (Uzbeks) pay 15 rubles. As if we (Uzbeks) are from another planets. We are not only charged 15 rubles for living, but also blamed with words such as " You(Uzbeks) are living in a deficiency for us"

Therefore, are writing the second letter, we do not need to be kept in a special dormitory, but rather ask for a place for postgraduate and doctoral students to have the necessary living conditions and reduced pay for living. Hopefully, you will not leave our letter with no answer this time. Respectfully.

When Habib Abdullayev was in Moscow, Leningrad, Kiev, Baku and other cities, he used to bring together the postgraduate students who were studying there, carry out talks with them in different topics, if necessary, provide material and spiritual support. Especially, he cared for the future of every single future doctor. He used to help to choose advisors(consultants) from all aspects.

M. Rasulov described Habib Abdullayev's contribution to the training national cadres and conflict regarding it:" 1961. The next inquietude. "Cleaning up" of cadres. The period when the Moscow authorities are again actively intercepting officials. Hundreds of thousands of organizers and managers were publicly dismissed and imprisoned. Of course, national cadres, independently thinkers, those who care for the development of Uzbekistan firstly faced that "cleansing". H. M. Abdullayev openly supports Uzbeks and tries to prepare scientific personnel from them. Surely, it was a powerful weapon to fight against the militants for Uzbek independence. There has always been a pretext to make others think that nationalist and private proprietor are enemies.

Nevertheless, recent investigations based on recent petitions and unsubstantiated letters to the board of directors have made a numbers of shortcomings in the Presidium of the Academy.

A commission investigating the activities of the Academy concluded that studies in research institutions are not practically implemented and in 1961, it was marked as a serious shortcoming that only 25 of 44 researches of Academy were utilized into production.

Also, it was pointed out that the Academy should elaborate serious measures to address the abovementioned deficiencies and make clear explanations on the historical decisions of the XXII Session and the new CPSP programs.

Nevertheless, in 1961, the commission of the Academy of Sciences of the USSR concluded that, as a result of the investigations, there were shortcomings in a number of fields of the Academy of Sciences, particularly in the chemistry, genetics and other institutions' researches and the following "situations" were specifically noted:

– serious researches in the fields of power engineering, telemechanics and synthetic chemistry are insufficient. Researches on the physical conditions of cotton are almost stopped;

– the Institute of Geology of the Academy of Sciences and central Asian Geological and Mineral Resources Scientific Research Institute are not functioning properly;

– the fact that no institute has created industrial establishment in research laboratories;

– majority of institutes are still not provided with new methods of development(radioactive isotopes, ultrasounds, optical devices) in researches;

– failure to carry out scientific seminars, which should be regularly conducted at scientific research institutes;

– abundance of inaccuracies in the completed research reports of scientific research institutes and the ineffectiveness of the obtained results;

– the lack of good governance at the Presidium of the Academy of Sciences, and even incompleteness of scientific research plans in 1959

– the Presidium of the Academy of Sciences has established scientific researches and has failed to introduce scientific achievements in the national economy;

– it was shown that the Presidium of the Academy of Sciences never presented completed scientific researches into practice to the KPC of Uzbekistan.

If inspecting the functioning of the Academy of Sciences and unreasonable blaming the governance are looked under the circumstances of the Union, it was as if aimed to lower the reputation of the academy which created new scientific inventions in 50s of XX century in front of other academies.

Habib Abdullayev showed enthusiasm in creating new directions and fields within the Academy of Sciences. The fields of Hydrogeology and Computing Technology were firstly established in Central Asia during the presidence of Habib Abdullayev in the Academy of sciences. Habib Abdullayev highly contributed to the establishment and development of the Institute of Hydrogeology, Geology and Exploration of Oil and Gas Fields in the Academy of Sciences of Uzbekistan, as well as the Institute of the Problems of Fuel, Water Problems, Nuclear Physics, Mining, as well as the Central Asian Geology and Mineral Resource Network and showed leadership.

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Section 5. Information technology

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APPLICATION OF ALGORITHMS FOR CALCULATING ESTIMATES IN THE PROBLEMS OF ADAPTIVE ASSESSMENT

Abstract: In this article, we consider a method based on the calculation of estimates of the definition, complexity of test questions for the formation of a database of adaptive test control data for an objective assessment of students' knowledge in the process of teaching in academic credit systems.

Keywords: estimation algorithms, adaptive control of knowledge, adaptive estimation, recognition, academic credit system.

Knowledge control is a task of recognition based on learning. Various methods of knowledge control are known: linear and piecewise linear, based on the Bayesian approach to decision-making under uncertainty, using linear adaptive models of estimates and a matrix representation of the parameters of educational material and control results, etc. The listed methods have a number of disadvantages: they require a large amount of information during the learning phase and a significant amount of computer memory during the recognition phase, do not takes into account the student's inaccurate responses, the possibility of several attempts to complete the task, etc. Therefore, we have investigated the possibility of using automated learning systems based on the calculation of estimates.

An algorithm based on the calculation of estimates was first proposed by Yu. I. Zhuravlev [1; 2] and later was used to classify trainees by levels of preparedness [3; 6]. At the core of the algorithms of this class is a very natural heuristic principle, which is used often and willingly – the principle of precedence or partial precedence, i.e. making decisions by analogy, namely: in similar situations, it is necessary to act similarly.

The essence of the method of calculating estimates consists in assigning an object (test task, trainee) to one of the stable classes, taking into account the set of characteristics that determine the model of the given object (test task, trainee). In this case, a special procedure is used to calculate the degree of similarity (evaluation) of the recognizable string (the set of features of the object) on strings that are known in advance to classes.

The task of knowledge control in this method is solved in two stages [7; 8]. At the training stage, based on the training sample data (a priori information I_0), a training table is constructed T^0_{nm}, in which each line is a description (set of characteristics) of the object (test task, trainee) (Table 1).

Table 1. Presentation of training informations

Features (a_m) / Objects (S_n)	1	2	...	m	Classes (K_l)
1	*2*	*3*	*4*	*5*	*6*
S_1^1	X_{11}^1	X_{12}^1	...	X_{1m}^1	1-class
S_2^1	X_{21}^1	X_{22}^1	...	X_{1m}^1	
...	...	...	...	...	
$S_{n_1}^1$	$X_{n_1 1}^1$	$X_{n_1 2}^1$	...	$X_{n_1 m}^1$	
S_1^2	X_{11}^2	X_{12}^2	...	X_{1m}^2	2-class
S_2^2	X_{21}^2	X_{22}^2	...	X_{2m}^2	
...	...	...	...	...	
$S_{n_2}^2$	$X_{n_2 1}^2$	$X_{n_2 2}^2$	...	$X_{n_2 m}^2$	

1	2	3	4	5	6
S_1^l	X_{11}^l	X_{12}^l	...	X_{1m}^l	
S_2^l	X_{21}^l	X_{22}^l	...	X_{2m}^l	l-class
...	...	...	...	...	
$S_{n_l}^l$	$X_{n_l 1}^l$	$X_{n_l 2}^l$	...	$X_{n_l m}^l$	

where l – is the number of classes; S_i^j – is i^{th} object (trainee) of the l^{th} class;

$i = 1, 2, \ldots, n_j$; $j = 1, 2, \ldots, l$; n_j – is the number of trainees in the j^{th} class; $\sum_{j=1}^{l} n_j = n$ – is the number of rows in the table T_{nm}^0; m – is the number of features; $I(S_i^j) = \left\{X_{i_1}^j, \ldots, X_{im}^j\right\}$ – is description of the object (trainee) S_i^j.

We have three cases of recognition when teaching and controlling knowledge using automated learning systems:

– determination of the complexity of the test task, i.e. assignment of the task to one of four ($l = 4$) classes that determine the level of complexity of the test task (a – "simple", b – "medium", c – "complex", d – "very complex");

– the valuation, i.e. assignment of the trainee to one of the four ($l = 4$) classes that determine the rating assigned to him (2, 3, 4, 5);

– definition of rank, i.e. the assignment of the trainee to one of three ($l = 3$) classes (1 – "weak", 2 – "average", 3 – "strong") depending on the level of his preparedness.

Thus, in the training phase, in order to use the method in question, it is necessary to form three training tables in the automated learning systems (to determine the level of complexity of the tasks – T_{nm1}^0, for the student's grading – T_{nm2}^0 and to determine the rank – T_{nm3}^0). The construction of the training tables, and is carried out by the result of the training sample. To assess the trainees, we chose five characteristics that characterize each trainee ($m = 5$) [5]:

– the number of tasks offered by the trainee (n);
– the average score received by the trainee (A);
– the number of attempts to perform tasks (C_y);
– the number of references to reference information (C_u);
– the rank of the trainee (r).

When determining the level of complexity of test questions, we chose six characteristics that characterize each job ($m = 6$):

– expert evaluation (M_e);
– the results of susceptible testing (R_t);
– types of job responses (multi–choice, single-text, text) (B_t);
– the time of execution of tasks (t_t);
– type of tasks (text, graphic, formula, code);
– attempt to complete the task.

At the training stage, the system of support sets of the algorithm $\{Q_j\}$ is also formed, each of which is a subset of the set of attributes with length q. Subsets Q_i can be formed by all possible combinations, formed, for example, taking into account their informativeness. So, we have formed the following two systems of support sets:

– to calculate the trainee's score

$$\begin{aligned} Q_1 &= <a_1, a_2, a_3, a_4, a_5>; \\ Q_2 &= <a_1, a_2, a_4, a_5>; \\ Q_3 &= <a_1, a_4, a_5>; \\ Q_4 &= <a_2, a_3, a_4>. \end{aligned} \quad (1)$$

– to determine the rank

$$\begin{aligned} Q_1 &= <a_2, a_3, a_4>; \\ Q_2 &= <a_1, a_3>; \\ Q_3 &= <a_1, a_4>. \end{aligned} \quad (2)$$

– to determine the level of complexity of tasks

$$\begin{aligned} Q_6 &= <a_6, a_7, a_8, a_9, a_{10}, a_{11}>; \\ Q_7 &= <a_6, a_7, a_8, a_9, a_{10}>; \\ Q_8 &= <a_6, a_7, a_9, a_{11}>; \\ Q_9 &= <a_6, a_7, a_9>; \\ Q_{10} &= <a_6, a_8, a_{10}>. \end{aligned} \quad (3)$$

At the recognition stage, the degree of similarity of the totality of characteristics of a particular trainee

$$I(S) = \{\beta_1, \ldots, \beta_m\}$$

on the lines included in the training table T_{nm}^0, on the basis of which the assignment to a certain class k_j is carried out.

For this purpose, the number of rows of each class k_j, which are close to the classified object S, is calculated.

$$\Gamma_o(S, k_j)$$

The learning table string $T_{nm}^0\, I(S_i^j) = \left\{X_{i_1}^j, \ldots, X_{im}^j\right\}$ and the recognized string $I(S) = \{\beta_1, \ldots, \beta_m\}$ are considered similar if the following inequalities are satisfied:

$$\left|X_{ik}^j - \beta_k\right| \le \varepsilon_k, (k=1, \ldots, m), \quad (4)$$

here ε_k is the accuracy of comparison.

The values of ε are determined at the learning stage by adjusting the algorithm [1; 4].

The quantity $\Gamma_{Qk}(S, k_j)$ found in this way represents a special estimate of the object S for the class k_j over the support set Q_k:

$$\Gamma(S_i^j, k_j) = \sum_{k=i}^{N} \Gamma_{Q_k}(S, k_j),\ j = 1,2,\ldots,l,$$

where N is the number of support sets in the system.

Then the analysis of the obtained estimates $\Gamma(S, k_j)$ is carried out and the decision is made to assign the trainee to the corresponding class k_j. Usually the trainee belongs to the class k_j having the maximum score:

$$max\ \Gamma\ (S, k_j), j=1, 2, \ldots, l.$$

The process of knowledge control under this scheme is shown in (Figure 1).

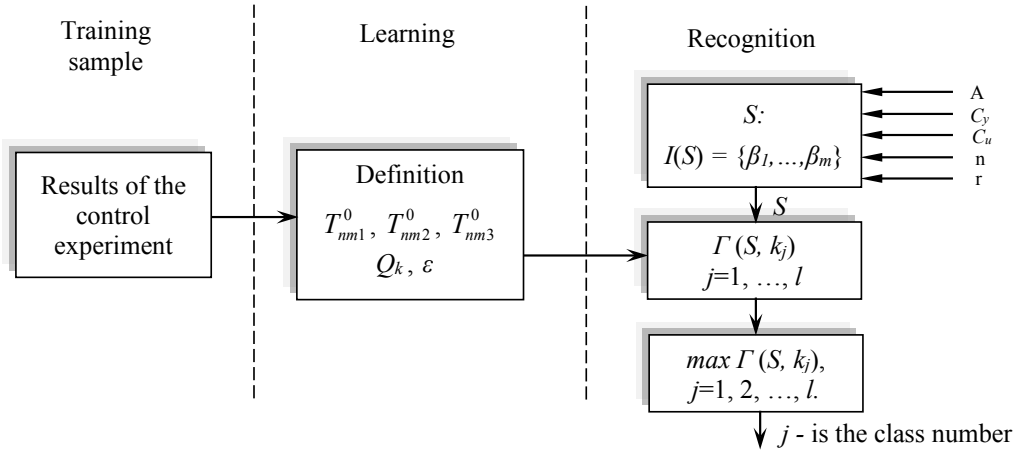

Figure 1. Scheme of the process of knowledge control based on the method calculation of estimates

Definitions of control parameters. In the method based on calculation of estimates, the parameters of knowledge control is:

– training tables to determine the level of complexity of assignments, for grading and for ranking;

– a system of support sets $\{Q_i\}$;

– values of ε_i (accuracy of comparison).

Tables of training, T^0_{nm1}, T^0_{nm2} and T^0_{nm3} formed according to the results of the training sample.

The system of reference sets $\{Q_i\}$ is formed by all possible combinations of features or by means of a pseudorandom number sensor. The systems (1), (2), and (3) used by us are chosen on the basis of the analysis of the informative character of the features by the expert survey method.

The values of ε_i for formula (4) are determined by setting the algorithm (in this case, $\varepsilon_1 = 3$; $\varepsilon_2 = 0.6$; $\varepsilon_3 = 1$, $\varepsilon_4 = 1$, $\varepsilon_5 = 0$) [1; 4].

The results of the conducted studies showed that the choice of a method for knowledge control depends on the specific operating conditions of the automated training system, i.e. if a higher degree of coincidence is required, then a method of calculating the estimates should be applied.

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Section 6. Materials Science

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ADHESIVE COMPOSITIONS ON THE BASIS OF CHLOROSULPHONED POLYETHYLENE FOR PROTECTION OF CONCRETE AND REINFORCED CONCRETE PRODUCTS

Abstract: The article presents the results of research on the use of new materials based on chlorosulfonated polyethylene, epoxy resin and polysulfide rubber. The proposed adhesive compositions contribute to increasing the strength and frost resistance of concrete and reinforced concrete products when exposed to chloride salts.

Keywords: corrosion of concrete, strength reduction, frost resistance of concrete, epoxy compositions, chlorosulfonated polyethylene, adhesion, modifier.

Introduction

Despite the variety of building materials possessing more and more perfect qualities, the issues of ensuring reliability in the operating conditions of structures remain relevant. Reinforced concrete structures made with observance of all requirements of regulatory documents are free from corrosion problems of building materials. This process can occur absolutely in any systems where water and cement contact occurs. Therefore, the corrosive destruction of concrete and reinforced concrete structures and methods for their effective protection is important.

Consider the problem of corrosion of reinforced concrete, as well as methods of protection on the example of blocks of fencing barrier type of roads, the main purpose of which is the device of the separation barrier between the opposing lanes. The blocks of the fence, made with the observance of different technologies, have excellent aesthetic and physico-mechanical characteristics, which makes them relevant in ensuring the safety of vehicles. However, the climatic conditions of operation of such structures urgently require the development of effective methods of protection against the development of corrosion processes in them in order to ensure long-term operation.

The severity of this problem can be traced when analyzing the state of cement concrete pavements and various auxiliary elements of the roads of the mountainous and foothill regions of the Republic of Uzbekistan.

High summer (+ 50 ÷ + 55 °C), low winter (–20 ÷ –30 °C) temperature leaves its mark on the development of destructive processes leading to their partial or complete destruction (Figure 1).

To ensure the smooth and safe passage of vehicles in the winter, various reagents are used.

The use of chemicals to combat snow and ice is based on the fact that when interacting with ice and snow, chemical substances, having internal energy, cause the destruction of the crystal structure of ice, as a result, the ice melts and forms a solution with the reagents. When moving the solution and snow wheels of vehicles, the resulting mixture is distributed over the surface of the crystals of unmelted snow and creates a kind of film-frost. At present, a mixture of sand and sodium chloride is used for icing. This technique contributes to the stable and uninterrupted operation of transport during the winter cold season, but does not guarantee the protection of structures from damage due to the development of corrosion processes.

Studies of the destruction of fencing blocks were carried out at sites: from 108 to 208 km of the A-373 "Tashkent-Osh" highway of the Kamchik pass.

Figure 1. Ruined blocks of fencing on mountain roads

In the practice of road use, a polymer composition based on chlorosulfonated polyethylene is used. It includes chlorosulfonated polyethylene and, as a modifying additive, epoxy resin and polysulfide rubber [1].

To mitigate the conditions conducive to the resolution of structures during operation, the road workers use glycerin, when applied to the surfaces of products, waterproof films are created.

The method used improves the corrosivity of products in sulphate environments. However, concrete and reinforced concrete products impregnated in this way are characterized by insufficient frost resistance in chloride salts. Due to the simultaneous action of negative temperature and anti-icing reagent – chloride salts, the road fence blocks are destroyed after 3–5 years of operation, without having served the service life (30–40 years), provided by the manufacturer. As a result, to ensure safety, operational road services are forced to replace the destroyed blocks with new ones. It should also be noted that the components of these compositions imported, expensive, are purchased for hard currency, from a technological point of view are complex and do not allow to fully solve the problem of providing frost resistance under the action of chloride salts.In order to eliminate the shortcomings inherent in film-forming compositions based on glycerol, the composition proposed is significantly different from those used in practice, not only by availability, but also by physical and mechanical parameters [2].

Comprehensive studies have shown that the coating of concrete and reinforced concrete products with modified chlorosulfonated polyethylene provides for a long time increased strength and frost resistance when exposed to chloride salts.

The mechanism for ensuring the above positive indicators in the proposed protective composition is examined as follows:

Chlorosulfonated polyethylene is modified with hemisulfide rubber and epoxy resin. The chlorine group provides polymer resistance to various salts and chemicals, the sulfur group improves weather resistance and oil resistance, and the epoxy group ensures good adhesion of chlorosulfonated polyethylene to concrete.

Results of the research

The proposed method of protection of concrete and reinforced concrete products as follows. After a set of concrete and reinforced concrete products of brand strength, a surface based on chlorosulfonated polyethylene and a modifier is applied onto the surface prepared and impregnated with glycerin.

The test results of the samples when determining the strength and frost resistance are presented in (Table 1).

Table 1.– Strength and cold resistance of impregnated samples

№	Name of indicators	Indicators of samples					
		Soaked in glycerin	Soaked with glycerin and composition consumption kg/м²				
			0.7	0.8	0.9	1.0	1.2
1.	Ring crush resistance, MPa	350	365	385	400	410	410
2.	Bending resistance, MPa	4.63–6.12	5.0	6.1	7.3	8.1	8.1
3.	Frost resistance according to the second base method, cycle	250	260	275	285	300	305

In contrast to the three-layer glycerin coating, which cracks when cracking in concrete and reinforced concrete structures due to shrinkage, temperature and other deformations, the coating based on chlorosulfonated polyethylene, epoxy resin and polysulfide rubber, having a greater elasticity, can withstand a crack in size 0.2–0.3 mm.

Conclusion

Impregnated with glycerin with the subsequent application to the surface of the product of the proposed composition – chlorosulfonated polyethylene and modifier, concrete and reinforced concrete products have increased strength and frost resistance in chloride salts.

This composition also contributes to an increase in the service life of concrete and reinforced concrete products, ensures a reduction in operating costs.

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Section 7. Machinery construction

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THE METHODOLOGY FOR CALCULATING OF GAS COOLERS FOR TURBOGENERATORS IN THREE-DIMENSIONAL SETTING

Abstract: the methodology for calculating the thermal state of gas coolers of Turbogenerators with hydrogen and water cooling is presented in the paper. The method for estimation of the reliability determination of carried out calculation is shown.

Keywords: Turbogenerator, Gas Cooler, Thermal State, Finning.

Introduction

The world market of Turbogenerators is very extensive. Its segmentation is made by the type of fuel of power plants that can work on coal, natural gas, nuclear fuel and other sources (biomass, geothermal sources, joint generation, combined: thermal and energy ones). In addition, the classification of the market is based on Turbogenerators rated from 10 MW up to 175 MW, from 175 MW up to 550 MW, 550 MW and over, as well as the type of cooling in these generators: air, hydrogen and water.

At the turn of the 50 s of the 20th century the greatest development was given to power plants based on steam turbines and Turbogenerators rated from 200 MW to 300 MW. These systems had sufficient reliability, and the possibility of modular arrangement let significantly save considerable time for the design and commissioning of new powers.

The important peculiar characteristics of Turbogenerators market is its segmentation based on such regions as the Asian-Pacific region, Europe, the Middle East and Africa, North America and South America, which are in belts with a tropical and subtropical climate. In the Asia-Pacific region, there will be a high demand for Turbogenerators and the global market for these machines will reach 10 billion US Dollars by 2019, the average annual growth rate will increase by 0.7% from 2014 to 2019. At that at a period between 2014 and 2019, power increasing is expected and by 2019 it will reach 6.62 billion US Dollars.

According to the source Marketsand Markets Analysis, the share of the Turbogenerator market by geographic region for 2013 is shown in (Figure 1).

It is necessary to pay special attention to the fact that the design and operation features of the Turbogenerator are determined by its cooling system.

For today, almost all operating units have been designed on the basis of the methods using the empirical dependencies proposed in the last century, and excess heat and strength margins permit the extension of the design life resource without taking

into account the effect on reliability indices, which is a significant advantage for existing ones and a disadvantage for the newly developed designs, as having a low specific power per unit mass.

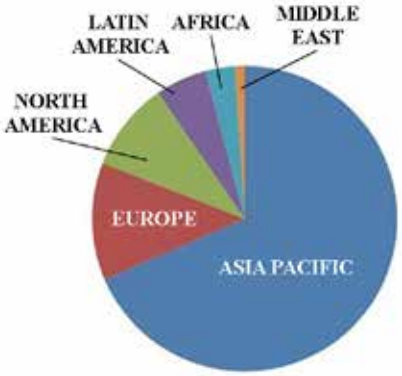

Figure 1. Turbogenerators Market

Purpose of the Work:

– to develop a methodology for calculating of gas coolers, allowing to take into account the actual state of the cooling gas by the CFD method in a three-dimensional setting.

Description of Ventilation System Design of Turbogenerator rated 220 MW

In Turbogenerators with hydrogen-water and air cooling, two head elements (Fig. 2) namely are an axial fan and a centrifugal compressor. The axial fan detects the movement of the cooling gas through the gas cooler and then the cooling of the stator core. The stator iron is cooled by an entire system of radial channels. In order to more evenly cool the stator, 8 compartments are arranged along its length, in 7 of which gas is directed by an axial fan, and in the 8th located on the drive side, the cooling gas is directed by the compressor. Cooling of the rotor winding is gas. The required flow rate is provided by a compressor whose characteristics are shown in Fig. 3. All gas enters the gap between the stator and the rotor and leaves the gap in the gas coolers from the side of the contact rings.

The axial fan determines the cooling gas flow through the gas cooler and then the cooling of the stator core. The stator iron is cooled by an entire system of radial channels. In order to provide more even cooling of the stator, 8 compartments are arranged along its length, in 7 of which gas is directed by an axial fan, and in the 8-th located on the drive side, cooling gas is directed by the compressor. Cooling of the rotor winding is gas. The required flow rate is provided by a compressor characteristics of which are shown in Fig. 3. All gas enters the gap between the stator and rotor and leaves the gap in to the gas coolers from the side of the slip rings.

At that, the existing compressor shall provide the necessary air flow to maintain the heat balance at all elements of the design in accordance with the requirements of GOST 535–2005 Turbogenerators.

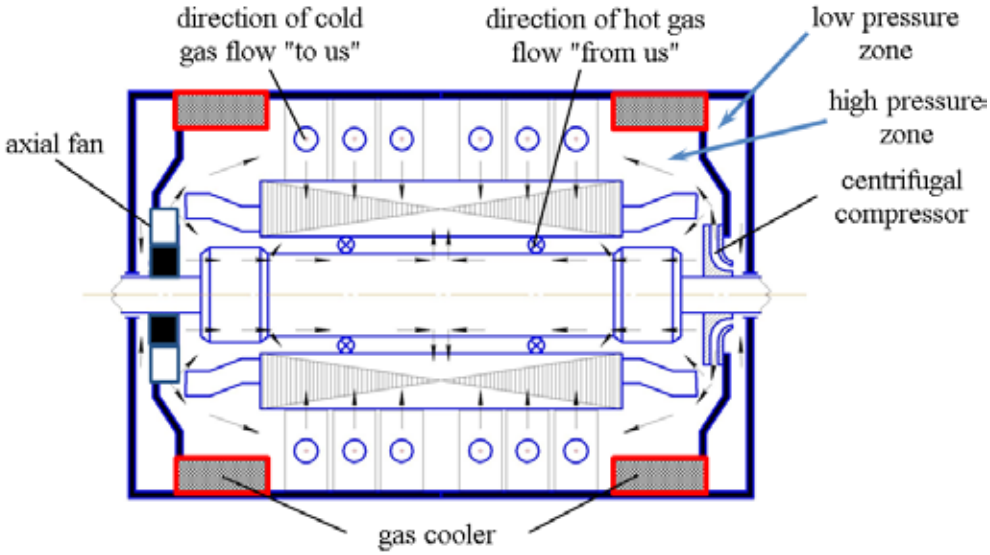

Figure 2. Ventilation Diagram for Turbogenerator Rated 220 MW

Determination of Thermal State of Gas Cooler in Three-Dimensional Setting

According to the chosen diagram of the ventilation system of Turbogenerator (see Figure 2), the cooling gas temperature inside the gas coolers was calculated in a three-dimensional setting, taking into account the effect on the thermal state of all the elements of the unit.

In the limits of the proposed method, the turbulent flow of gas is described by a system of averaged Navier-Stokes equations written in generalized curve-linear coordinates, with the Jacobian of transformation *J*.

The SolidWorks software package contains a Flow Simulation application module that allows numerical modeling of internal and external flows of liquids or gases. The sufficient

accuracy of this module makes it possible to apply it to solve the most engineering problems. The basic methods and description of the mathematical apparatus used in SolidWorks FlowSimulation are presented in [1].

Long-term operation of Turbogenerator is ensured with the following parameters of hydrogen and water:

a) parameters of hydrogen: over-pressure in the housing is $3.5 \cdot 10^5$ Pa; purity by volume is not less than 97%; the temperature at the outlet of the gas coolers is 50 °C;

b) water parameters, coming in to the gas coolers: flow rate is 111.1 l/s; the temperature at inlet is 42°C;

c) parameters of water entering the first circuit of the heat-exchanger: flow rate is about 56 l/s; the temperature at inlet is 42 °C.

Three-dimensional model, the initial and boundary conditions necessary for a three-dimensional calculation are shown in (Figure 4). Three-dimensional grid of a gas cooler is shown in (Figure 5).

Figure 3. Characteristics of the Compressor

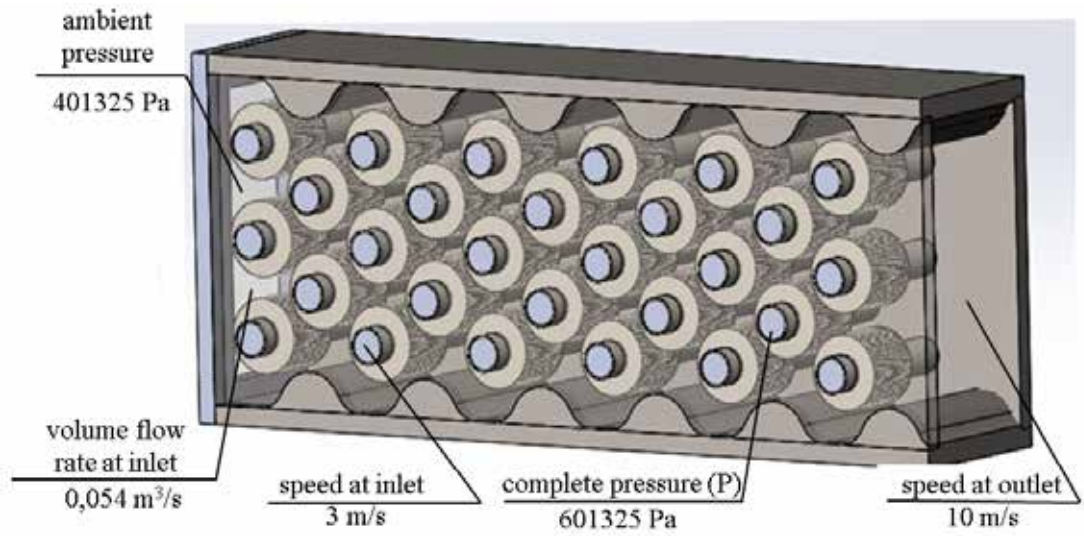

Figure 4. Three-Dimensional Model, Initial and Boundary Conditions

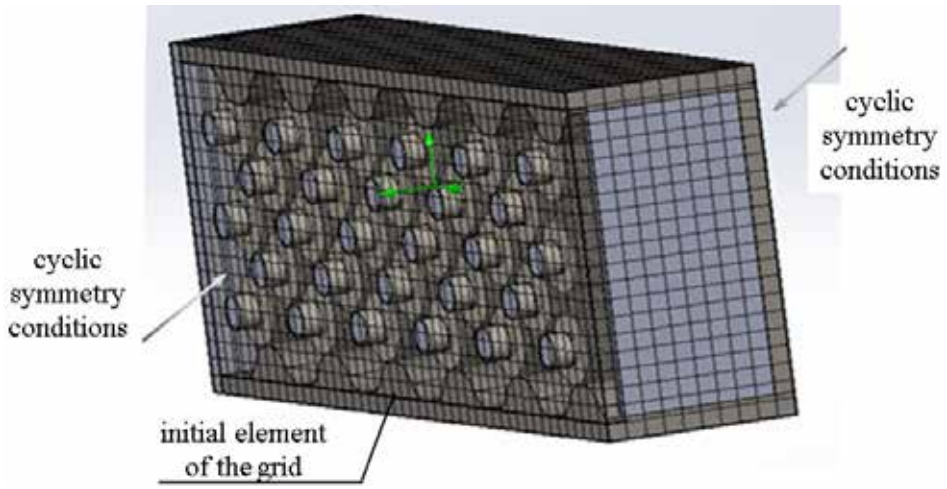

Figure 5. Three-Dimensional Grid of the Gas Cooler

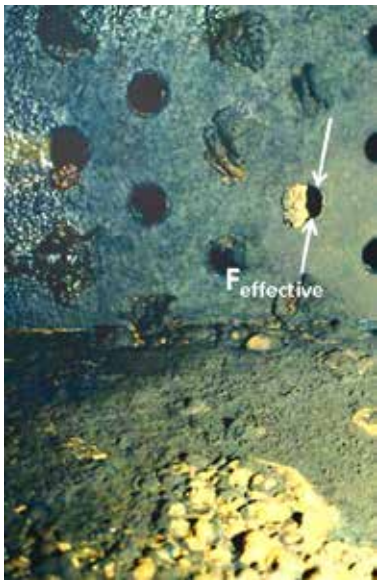

Figure 6. Plugging of Tubes

At that it shall be taken in to consideration that according to the works of Samorodov Yu. A. [2], the tubes of gas coolers of Turbogenerators are subjected to clogging and plugging during operation (see Figure 6).

In order to take into consideration this circumstance, it is supposed to take into account the change in the water pressure in the tube for both a sharp jump and a change in the effective area of the working cross section, according to the work of Berman S. S. [3]. In this case, the values of the parameter P shall decrease according to decreasing in the area of cross-section F.

As a condition for the convergence of the solution, the following criteria were chosen for the volume: minimum, average and maximum values of solid and fluid temperatures, minimum, average and maximum speed, and average temperature and speed flow rate values. The calculation was carried out until the convergence criterion was reached and at least three purges of the calculation area were executed.

An additional condition is the condition of symmetric repetition along the width of the gas cooler.

The results of a three-dimensional calculation of the thermal state of the gas cooler in accordance with specified initial and boundary conditions are shown in (Figure 7).

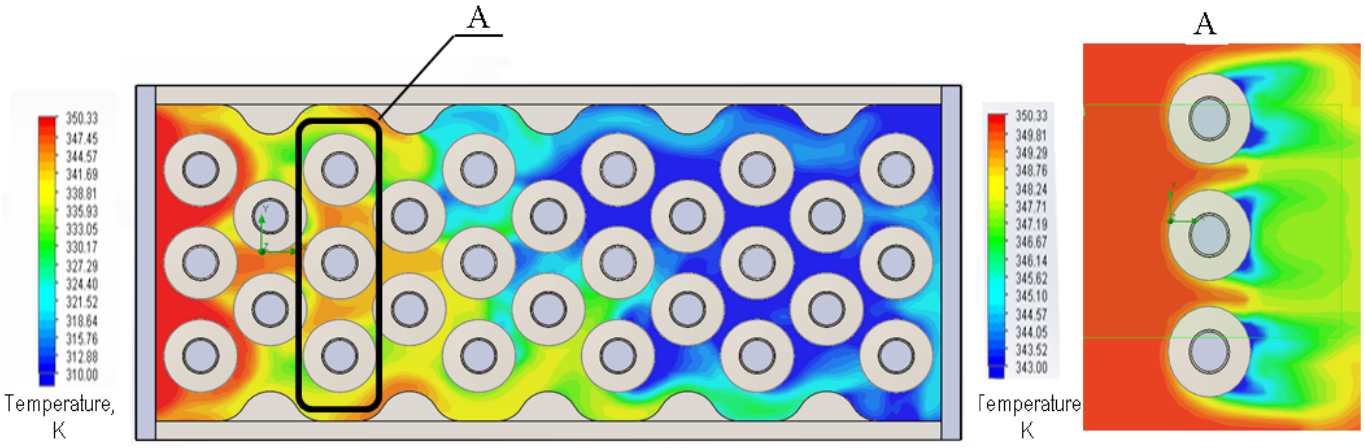

Figure 7. Calculated Field of Temperatures

Analyzing the obtained results it can be concluded that the values of the obtained temperatures are at the level of admissible ones and satisfy the requirements of GOST 535–2005 for the cooling medium of Turbogenerators.

Comparison of Calculated and Experimental Data

In order to calculate the coolers of Turbogenerators, in which cooled coolant by its physical properties differs from that used in experiments, it is necessary to present the experimental data in similarity criteria.

Criterion equations for the intensity of heat transfer and hydraulic resistances have the following relationships:

$$Nu = f(Re; Pr) \text{ and } Eu = f(m; Re)$$

where Re – Reynolds criterion;

Nu – Nusselt criterion;

Pr – Prandtl criterion;

Eu – Euler criterion;

m – number of rows of tubes along the depth of the bundle.

When processing of the experimental data in the criterial form, the values of the physical constants of air are determined depending on the average air temperature. For the defining geometric dimension, for example, for tubes with loop-wire finning, the wire diameter of the loop is accepted equal to 0.69 mm.

In the similarity criteria for Reynolds and Euler, the airflow speed in the live section was determined in the same way as in the processing of experimental data used in the form of graphical dependences $a_{пр} = f(W_ж)$ and $\Delta P = f(W_ж)$.

In Nusselt similarity criteria, a convective heat transfer coefficient shall be introduced that does not take into account the thermal resistance of the ribs and reflects only the intensity of the heat transfer process.

The existing graphical dependence $E_u = f(Re)$ (see Fig. 8), obtained earlier at the stand of SE "PLANT "ELECTROTYAZHMASH", can be represented by an equation in the criterial form on one transverse row of finned tubes, namely:

$$E_u = 6400 \cdot Re^{-2,0}$$

Or for "m" rows: $E_u = 6400 \cdot m \cdot Re^{-2,0}$.

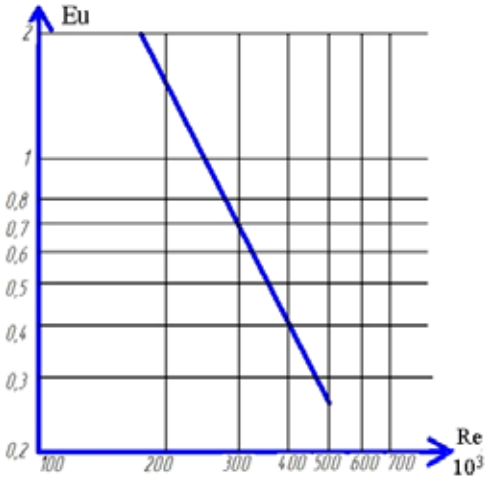

Figure 8. Dependence Eu from Re

The obtained equations in the criterial form can be used in heat-engineering calculations of heat-exchangers only for surfaces having the same geometric characteristics as the investigated surface within *Re* from 150 up to 500.

In order to measure the temperature, control devices with a working range of 0÷100 °C were used, with a division rate of 0.1 °C.

In the course of the carried out analysis it was determined that the error of the proposed method is at the level of errors of the measured instruments.

Conclusions

1. The method for calculating of gas coolers of Turbogenerators in a three-dimensional setting, taking into account the geometric characteristics of the cooling system design of the whole unit, is developed.

2. For the first time the influence of the head elements of the rotor and contamination of the water supply system to the thermal state of cooling gas is taken into consideration.

3. The analysis of the comparison of the experimental data with the results obtained with the help of proposed method is carried out. It is shown that the calculated values are in the range of the measured errors of temperature control devices of Turbogenerator.

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Section 8. Psychology

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PSYCHOLOGICAL ASPECTS OF INFLUENCE OF BEHAVIOR OF ECONOMIC AGENTS ON THE PROCESS OF ECONOMIC MANAGEMENT

Abstract: The characteristic feature of every person, social group, society, ethnicity, nation as an economic agent, is its economic behavior. It can be cognitive or impulsive, manageable or unmanageable. Any form of manifestation of economic behavior is conditioned by psychological factors. The article emphasizes the fact that in any state, the development of the economy and its effective management depends on individual and ethno-psychological characteristics of its economic subjects as well, and since they predetermine the economic behavior of economic subjects of society, they can become either concomitant or hindering factors for the process of economic management.

Keywords: economic activity, economic subject, economic behavior, economic psychology, psychological factors, individual and ethno-psychological characteristics, ethnostereotypes, interethnic economic cooperation, effective economic management.

The economic sphere is a significant sphere of life in any society. By means of public institutions of the state, all members of society are involved in the economic sphere. That is why any phenomenon in the economic sphere becomes a subject of research not only for economists, but also for politicians, sociologists and psychologists. In particular, psychologists investigate the impacts of economic processes on the psychology of different social units (a person, a family, a group of people, a community, ethnicity, a nation), which can lead to different manifestations of their social behavior. The knowledge of the trends of the population's behavior caused by economic phenomena, as well as the consideration of the interests, needs and goals of different social classes of society, will allow state institutions to use human potential more purposefully and rationally.

In modern theories of economics and social sciences, any unit of economic activity is considered not only to be an object of influence of economic relations, but also a subject of economic relations (as economic agents). Based on this, in socio-economic studies the economic behavior of a person, a public and a political unit is not considered a category that results from purely economic phenomena. The economic behavior of social units (which, no doubt, is conditioned by their psychological characteristics) is regarded in modern economic theories as a factor in the processes of developing economic relations and economic management. That is why economic psychology, which is currently developing rapidly, is of great practical importance in economic research. As an interdisciplinary science, economic psychology includes theoretical provisions, methodological principles and approaches of economics as well as psychology and the results of their experimental research [9, 12]. From the perspective of psychology, running the economy is a social activity that arises from the individual needs of a person to achieve economic well-being and is characterized by his goals, motives and actions.

The goal of economic activity of any person is to earn income according to his inclinations and aspirations. In economic development and management issues, as a subject of research, economic psychology pays a special attention to those psychological characteristics that are conditioned by purposes, interests, conscious or unconscious motives of economic entities and can cause different manifestations of their behavior. Economic psychology explores the impacts of those factors that influence the economic entities' perception and assessment of social and economic phenomena, their motivation, behavior and work. The adaptation of every member and every class of society, the development of economy and the effective management of the economy are also conditioned by those factors.

The economic behavior of public entities may be conditioned by cognitive, affective or conative motives. It can be

both manageable and unmanageable. The economic behavior of the society, regardless of its conscious or subconscious manifestations, implies management, due to legal norms and their implementation. Reasonable management does not only promote the effective economic behavior of economic agents, but also the principles of establishing desirable cooperative economic relationships between different classes of society, trends and directions of economic development of the state. As a cooperation between subjects and objects, the management of economy is effective only if the process of management takes into account the possible psychological effects of management principles, approaches and styles on the behavior of economic agents.

The behavior of the population of a state is the base of the transformation of the economic system, the social institutions and social relations of that state. The predictable economic behavior of the population is the guarantee of socio-political and economic stability in any country. Any change in the economic system (for example, in post-soviet countries) requires a change of a previously formed system of social values, norms and stereotypes. No matter how much the changes have been dictated by the demands of new socio-economic relationships, they will be conditioned by the psychological characteristics of communities within the state. Consequently, both individual and ethno-psychological characteristics of economic agents will have an impact on the state's economic development and management processes.

Every ethnicity as a historically formed public unit consists of people who have the same stereotypes of consciousness and behavior. To solve the survival problems in various natural and social settings, each member of ethnicity hands down these stereotypes from generation to generation as an integral part of the ethnic traditions, culture, worldview, and global coexistence. In the same way, each nation is distinguished by its dominant characteristics, which are inexplicitly manifested in the economic thought and behavior of each of its representatives. Ignoring the ethno-psychological dominant characteristics may lead to a decline in the capacity to engage people in economic activities in the society, which, in its turn, can hinder the development of the country's economy and its effective management, especially in countries where market economic relations (for example, in the Republic of Armenia) have taken place recently.

In the interpretation of economic behavior the neo-classical economic theories are based on the "perfect efficiency" economic model of the "Homo Economicus", according to which the behavior of economic agents is considered absolutely effective, as it is based on the theory of maximization (when the consumer tries to overestimate the importance of meeting his needs, and the manufacturer's aspiration is to make a maximum profit) [1; 6; 7; 8]. Both try to choose effective means to achieve their goals. This process of choice, of course, is conditioned by the preferences of economic agents and the normative restrictions provided by the state. The preferences that are manifested in individual psychological features include not only objective but also subjective needs of economic agents. Normative restrictions determine the realistic opportunities of economic agents. Consequently, in case of limited means, the behavior of economic agents stems from their ability to look for effectiveness, which is also limited. If we take into account the fact that, along with the development of society, people's preferences are not stable, it turns out that rational behavior is impossible. That is the reason why the neo-institutional model of economic behavior is based on the principle of "limited effectiveness" [2; 3; 4], which also takes into account social norms, laws, habits, stereotypes of thinking, as well as the fact that in case of lack of information, a person cannot make a rational choice. In fact, economic behavior here is considered a category based on subjective psychological factors. A number of adherents of modern Russian School of Economic Psychology (O. S. Pasipanova, V. P. Poznyakov, V. V. Spasennikov, V. M. Sokolinskij and others) also believe that even though the economic relationships of economic agents are considered an economic interaction of subjects involved in business relations, they are influenced by individual psychological characteristics of economic agents [12; 13; 16; 18].

Obviously, the effectiveness of economic cooperation within the society depends on the ethno-psychological stereotypes (autostereotypes and heterostereotypes) of its social units. As social psychological concepts, autostereotypes and heterostereotypes are interrelated. They characterize a group's consciousness and have a significant impact on each member of the group. Ethnic stereotypes cannot only be a factor in the manifestations of group economic behavior and intercommunity economic relationships, but can also influence the economic activity of the whole society. Thus, regarding people living in different regions of a certain country as economic agents, it is possible to examine their economic behavior based on their ethno-psychological characteristics in order to reveal the objective and subjective psychological factors that can have an impact on the economic development of the country and its effective management processes.

Man cannot be equally involved in all social relations. Based on their personal motives, everyone selectively enters into certain social relationships and appears in a social environment, becoming a member of a society. The social environment as an integrated system of people's material, economic, political, spiritual and cultural activities affects the processes of formation and development of each member of the society. In this process of socialization, every person, besides acquiring

personal experience and convictions, also gains public experience and obtains public convictions, either consciously or unconsciously. Consequently, the mechanisms of economic activity and economic behavior of each member of the society are conditioned not only by their individual psychological characteristics but also by psychological characteristics of his community. That is, every member of a society as a member of any social group is a product of historical and current socio-economic processes. The existing socio-economic relations, reflected in people's consciousness, form a certain type of individual economic consciousness and consequently, economic behavior. In the same way, every state, as a community of different social units, has its socio-economic and cultural characteristics conditioned by ethno-psychological factors, as well as by its historical development. Therefore, the mechanisms of the economic activity and economic behavior of every economic agent are conditioned not only by their individual psychological characteristics, but also by ethno-psychological characteristics of the whole society.

In conclusion, the economic policy carried out in a country, where the economic benefit of an individual is at the center of its interests, should depend on historical, cultural, ethno-psychological characteristics of the communities that shape the society. In particular, the behavior of any economic agent, based on the social stereotypes and attitudes that are determined by psychological preconditions, can be aimed at the development of the state's economy only if the psychological characteristics of all social units are taken into account.

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KEY ASPECTS OF THE STUDY OF PSYCHOLOGICAL EFFECTS OF MONEY ON THE MODERN YOUTH OF KAZAKHSTAN

Abstract: The issues of negative impact of money on a human being, his/her psychology and behavior are poorly explored, as they are a kind of taboo. This paper identifies not only the background of this research in Kazakhstan, but also the main steps thereof, including the strategies of the "Monetary coping" theory.

Keywords: money, youth, strategies, coping, coping behavior.

Pervasive changes in Kazakhstan driven by the complex economy change process entailed changes in all spheres of society that demanded adaptational modernization of consciousness. The realities of market economy made their own corrections in every aspect of human relations substantially expanding and changing the habitually established bounds of perception of money functions. Aside from economy of abundance and the capability to travel all over the world, the global challenges in the form of "terrorism", recruiters, sectarian preachers, Black Friday, pyramid schemes and other suggestive manipulative monetary manifestations have come into the day-to-day routine of Kazakhstanis.

The most exposed population stratum to the temptation of getting "quick" and "easy" money is the youth. The instability of immature psyche, accompanied with surges of deviant behavior, has always been of mankind concern, while the increasing aggression of the young generation in our times even more so. Peter Mucke, the Executive Director of the international children's relief association Terre des Hommes in his interview to the Neue Osnabrücker Zeitung newspaper made known that over seven thousands of children were roaming the streets of Germany leaving the home well-being for the homelessness. One of the main factors for the situation P. Mucke names "the deepened disproportion between the poverty line and wealth. To make matters worse, according to him, the symptoms are becoming clear that ties to family and stability on the family front recede into the past" [1, 1]. It should be borne in mind that these data were given in January 2007, i.e. before Germany and other European countries have been occupied by refugees.

The main trends of the psychological effects of money are outlined in the papers of G. Simmel, who argues that money is: the God of our times; a "transport medium" for personal development; equal to a "prostitute" changing questions "who" and "what" to "how much", and leading an individual to degradation and the nadir of human dignity [2, 485; 379].

Centuries-long peculiarities of pragmatic nurturing the attitude to money have been described in detail by M. Weber and other research workers [3, 808].

Besides the actual facts of the growing number of street children in such wealthy countries as Germany and the USA, worryingly the trend is that the modern youth (regardless of their religion) are falling into ranks of terrorist organizations like Daesh (ISIL). The studies have been conducted by the authors starting in 2015, and the results are represented in the following papers: "The tolerance policy in Kazakhstan, and extremism deterrence"; "Utilizing religious values by extremist organizations"; "Psychological and pedagogical prevention of the adverse impact of extremist groups on military servants to be – teenagers and young adults", and others [4, 30; 5, 81; 6, 29].

Any war connotes unhappiness, destruction, and death. While defense of one's country or home from enemy intrusion is based on a morally sound foundation, a murder for the sake of money (destructive from the outset) cripples human mind and health. Can these people later live amicably and work in a traditional society – that advocates respect for the individual, family, and family values – manifesting in their actions a genuine desire for tolerant and social communications and altruism? There has been no answer to this question yet, though there are approved results of psychological investigations successfully controlling sale predictors of Black Friday and pyramid schemes [7, 1].

A. Furnham and M. Argyle believe that the current studies in the area of money psychology are notionally divided into: rules of disposal; forming perceptions in children; habits related to spending; psychological disorders; and wealthy people

ideation. It is notable that psychological causes of poverty they attribute mainly to the unreasonably high level of consumer ambitions and the complete lack of financial control [8; 15].

In Kazakhstan, very little research has been carried out concerning the money effects on a person, as this topic is a taboo, since the questions about money are considered as extremely improper even among the nearest and dearest. Obviously, every person has his/her own subjective pattern of "moral and monetary values". However, it is important to note that parents, when propagating their perceptions about money to their children, now and then disregard the moral and financial paradigm shift. The mankind has age-old religious and legislative postulates, and nevertheless, 90 per cent of criminal offences in the world are committed precisely because of money. All that relates to a human being is based on his/her psychology. It is psychology that interconnects into a whole all the other sciences, as they only have been created and exist owing to human thinking. There always have been, are, and will be in the world psychological methods of regulation of human behavior, aimed at monetary profit, since chrematistics, on the authority of Aristotle, knows no limits [9, 38]. Hence, a discovery of psychologically efficient "monetary antidote" enabling stabilization of human mind and health is highly needed for the social and legal stability of any developed country. On the grounds of premises above, we started our research on the topic "Axiological aspects of the attitude toward money of the youth with different patterns of coping behavior". The methodology was chosen after studying works of F. Engels, C. Jung, E. Fromm, P. Feyerabend, S. L. Rubinstein and others, including the works of Kazakh scientists Masalimova A. M., Madaliyeva N. V., Tashimova F. S., Kim A. M., Mun Z.B, Rizulla A. R., etc. In particular, the methodological aspects of unity of consciousness and activity of Rubinstein S. L. are definitely in line with the nature of our investigations, as coping behavior is primarily based on the rationality of a human action. Other investigations fed on works of scientific professionals across the globe are represented within the given context under the rubric of report on main steps of subject studies: "Monetary theories and psychological effects of monetary phenomenon" [10, 115]; "Monetary problem in psychology and attitude types toward money [11, 132]; "Axiological attitude toward money" [12, 133]; "Axiological aspects of attitude toward money in foreign studies" [13, 3]; "Influence of patterns of coping behavior on individual axiological aspects and ability to cope with stress" [14, 55]; "The theory of 'Monetary coping' and 'Axiological aspects of the attitude toward money of the youth with different patterns of coping behavior' " [15, 57]. Consolidated results of empirical studies are currently under applicable check phases for correlation and test validity with the use of mathematical analysis.

In conclusion, it should be noted that besides the above listed arguments, the relevance of the study of coping behavior towards money is also resides in the fact that amid the exacerbation of the global financial crisis, the number of suicides along with mental and psychosomatic illnesses resulting from "monetary" frustrations is growing fast. In this regard, the research tasks involve revealing productive patterns of coping behavior towards money and family values. The practical implications are that the identified rewarding coping strategies towards money will be recommended for extensive use in order to block deviant and addictive behavior, channel the energy of human activity into the constructive stream of creative personal growth, and maintain traditional family values built on love and respect.

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Section 9. Agricultural sciences

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CROP CLASSIFICATION IN KARSHI STEPPE USING REMOTE SENSING INFORMATION AND GOOGLE EARTH ENGINE TOOL

Abstract: Land use and land cover data are essential for water resource management, water supply planning, flood control and waste water treatment James et.al. [2] land use and crop pattern change information is the basis of better use of land and water resources. The Karshi steppe is one of the areas that is experiencing water management issues in Uzbekistan, since the economy of the region is highly dependent on agricultural fields which are irrigated from water diverted from Amudarya River that is located on the lower altitude from the irrigated area. Therefore it is a necessity to carefully study and understand the current situation and develop models for sustainable water management in the area. This study aims to learn temporal changes of main crops using satellite data for mapping crop pattern change analysis for this region. The output will be served as a basis for for further water management aspects. Crop classification using Google earth engine platform and Normalized Difference Vegetation Index (NDVI) Tangjaitrong et.al. [6] methodology was performed for the years of 1987, 2000, 2016. The overall accuracy of the classification is 81% NDVI approach.

Keywords: Karshi Steppe, NDVI, Classification, Landsat, Google earth engine.

Introduction

Water resources in Central Asia are very much important for many sectors. With the increase of Central Asian demography and potential to climate change, we as human being should more actively act to ensure the life for tomorrow's generation in this region. When we look back into the second decade of 20th century, we can observe huge developments of deserts into irrigated lands for the purpose of increasing crop production in this area. The Karshi steppe is one of the main examples to this point, which has already tripled the irrigated area in size as a result of massive developments of deserts during Soviet Union period. The karshi steppe was about 100 thousand hectare in size in 1970 s but now it has turned into about 350 thousands of hectares. It has started to increase its size after the extension actions of cotton fields in Central Asia started during the Soviet time. After about 1980 s, the scarcity of water and energy were clearly visible in the area, also influenced to soil, and ground water quality as well as quantity has changed over time. Taking into account all above mentioned problems we obviously should look back and understand how the changes over past periods has come out in that area and learn crop change dynamics. The change dynamics illustrated in this paper will help us to better understand what the size of the study area was in fact in the past and how the dynamics developed with time. It is of advantage to have change dynamics analysis in order to make proper decisions that should mitigate possible changes of study area for the future if further irrigation extension/reduction is required. Considering all above mentioned issues, this study was carried out where the outcome can be useful information for several sectors dealing with similar

cases in another part of Central Asian countries in order to protect the nature and establish better water recourse management.

Objective

The objective of this study is to conduct crop classification based on vegetation development curve over time using multiple images in a year. The innovative modern instrument so called – Google earth engine were elaborated for the entire process of this study.

Study area

The study was carried out in Karshi Steppe south of Uzbekistan and western slopes of Pamir Mountains. The irrigation of an area of interest is fed by Talimardjan reservoir. Water is pumped up to the reservoir with special pumps through Karshi Magisterial canal and filled during winter time and used its water in summer.

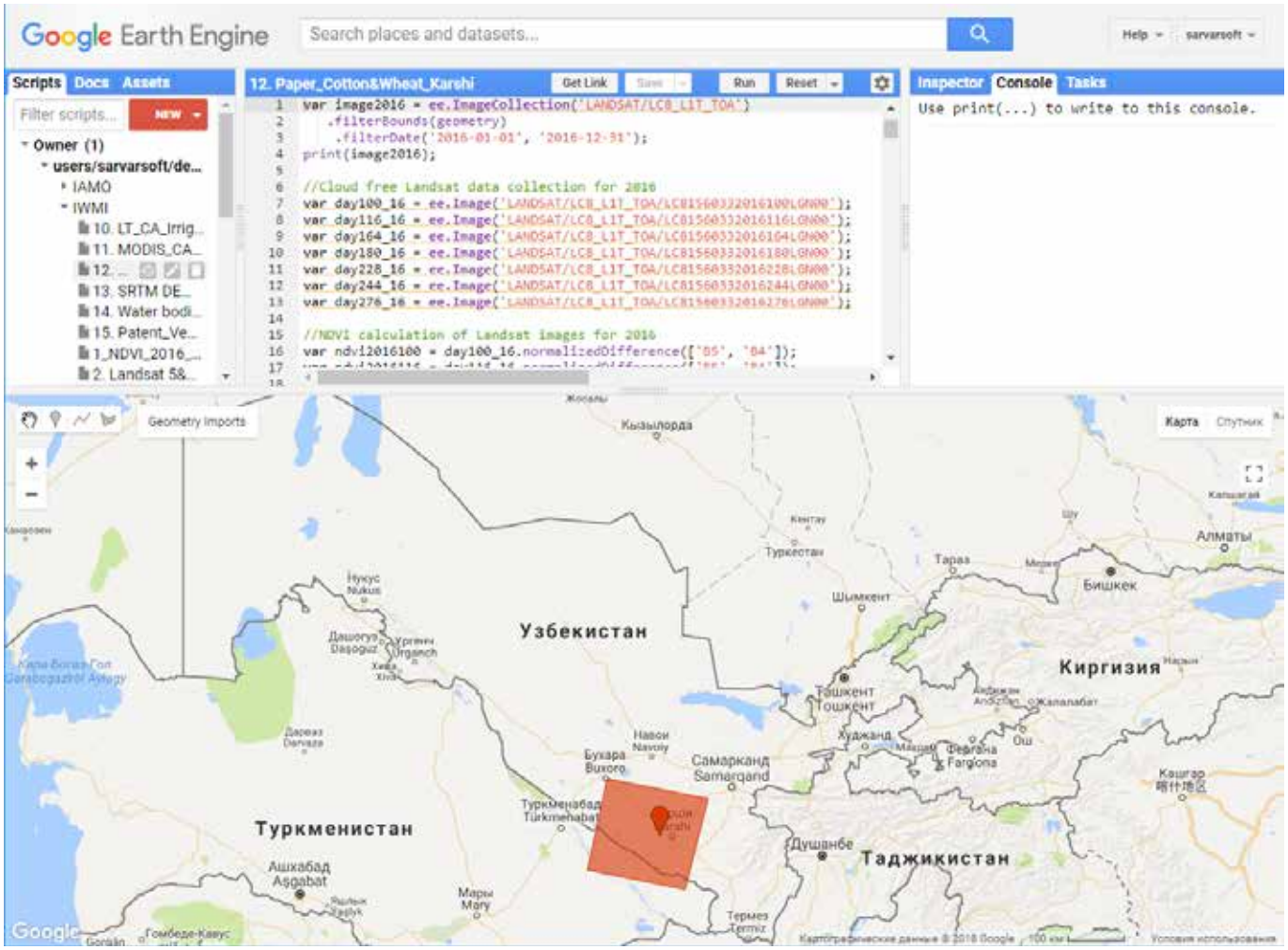

Figure 1. Interface of the developed model in Google Earth Engine Platform

Methods and materials

In the last three decades, the remote sensing technologies and methods have dramatically improved and available data for observations are increased Rogan & Chen [4]. Using remote sensing data has demonstrated and proved usefulness and effectiveness on detecting and mapping of agricultural, residential and urban areas Selçuk et .al. [5]. (Figure 1) shows the interface of the developed program and a study area location, which is designed to identify cotton and winter wheat from remote sensing images, and can also be used for improved, accelerated interpretation and classification of data. The program is developed in the Java programming language, which is customized to use the information of the Google Earth Engine database. Google Earth Engine is a new web platform for analyzing satellite images, which helps to improve the efficiency of data processing. It allows to analyze satellite images in the cloud system of the server, which allows to minimize several stages of processing satellite images and to deduce the final results for making decisions more quickly, saving labor and time resources. Landsat images are used in this model, which are recognized as the optimal source of information Rouse et.al. [3], due to open online access and an accessible time series of images with a spatial resolution of 30 meters are sufficient for determining crops. To classify

the crop, a classification method based on expert knowledge and crop phenology using NDVI was applied Hord et.al. [1]. NDVI can take values from –1 to 1. Most of the vegetation ranges from 0.1 to 0.8. In places with a large NDVI value (close to 1), usually thicker vegetation. In the places of a picture with a low value, especially less than zero, there is usually no vegetation. NDVI helps to minimize changing lighting conditions, viewing aspects, atmospheric conditions and inclination deviations. Classification of the crop using this program is based on existing knowledge of plant growth in a given territory and phenology. NDVI layers are created for the given source images and the type of culture is determined in accordance with the change in the profile of this index during the year. In this case, the Google Earth Engine develops a decision tree and Java code for each year to identify land use in the field of research. In the proposed script, the model is developed based on the experimental plot of the Karshi region for the period 1987, 2000 and 2016. It should be noted that, in accordance with the goals and objectives of the study, time period and location of study area can be easily changed.

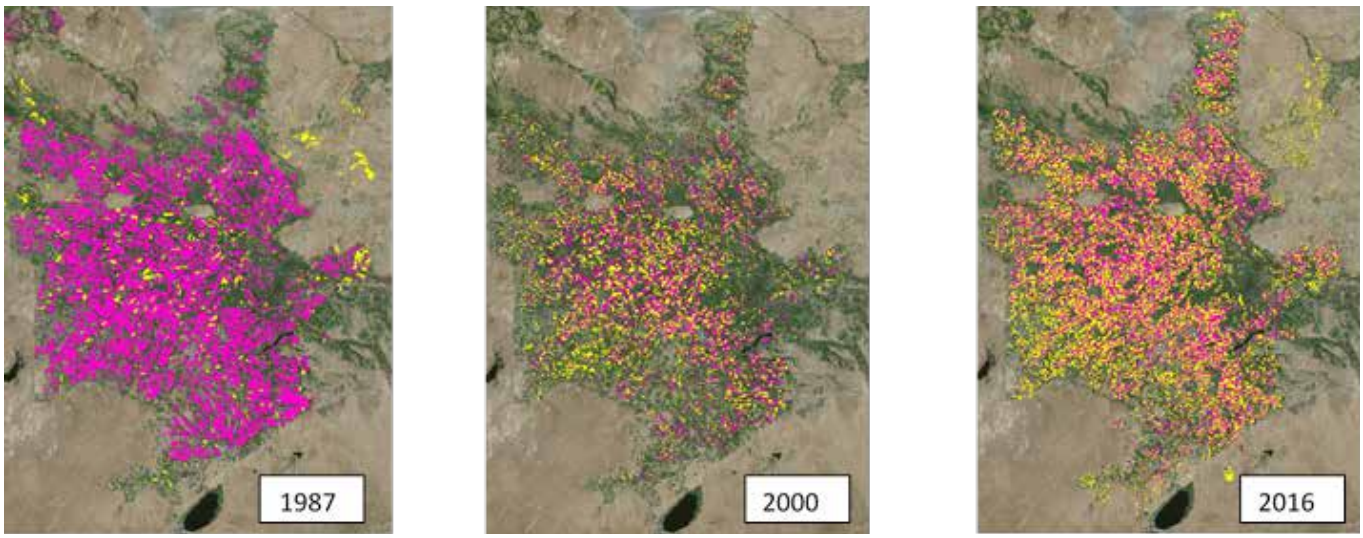

Figure 2. Changes of cotton and wheat over time, cotton wheat

Conclusion

Result shows crop pattern change between 1987, 2000 and 2016 land cover types of Karshi steppe for different time spans. The results gave land cover values for different years and for different crops. Through this study it was possible to demonstrate that one can easily demonstrate crop type dynamics in agricultural fields using innovative tools and remote sensing information. The illustrations of crop type change in different years in this study can be very important in demonstrating the Karshi regions agricultural areas including different sectors and at different level. Outputs can be used for further application to find out Evapotranspiration (ET) of individual crops and etc.

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THE DEPENDENCE OF THE YIELD OF WINTER WHEAT WHEN WEED CONTROL BY CHEMICAL MEANS

Abstract: Abstract: The results of field experiments with the use of the herbicide Atlantis against weeds on the fields of winter wheat in the south of Uzbekistan are presented. The herbicide Atlantis is a sulfonylurea-based combination product that destroys both monocotyledonous and dicotyledonous weeds.

This article describes the terms and standards for the use of the herbicide Atlantis on the yield of winter wheat. The use of the herbicide Atlantis contributes to an increase in the yield of winter wheat grain at the expense of the norm up to 18.7 c/ha and due to the terms up to 11.8 c/ha.

Keywords: winter wheat, weeds, monocotyledonous and dicotyledons, Atlantis, chemical method, yield, grain.

Introduction

In the conditions of the steppe zone of southern Uzbekistan, in winter wheat crops, methods have been developed to control monocotyledonous weed plants with herbicides with the active ingredient fenoxaprop-P-ethyl + an antidote that, by inhibiting acetyl-Co-A-corbaxilase, destroys monocotyledonous weeds, stopping cell growth and division [5, 10–18].

Under these conditions, methods of combating dicotyledonous weed plants and herbicides with the active substance trebenuron-methyl have also been developed, which destroys dicotyledonous weeds by stopping the activity of the enzyme acetolactate cintase in winter wheat crops [2, 3–15].

However, the simultaneous control of monocotyledonous and dicotyledonous weed plants in winter wheat crops would be a profitable agrotechnological measure.

In this regard, it became necessary to select a herbicide, which in a single use destroys monocotyledonous and dicotyledonous weeds in winter wheat crops. The number of such herbicides is Atlantis 3.6% w.d.g. (manufacturer "Bayer CropScience" Germany), which the combined drug based on sulfonylurea is a selective herbicide for controlling monocotyledonous and dicotyledonous weeds in winter wheat crops [3, 9–11].

The active ingredient of Atlantis consists of 30 g/kg mesosulfuron-methyl sodium + 6 g/kg iodosulfuron-methyl sodium + 90 g/kg mefenpyr-diethyl. Mesosulfuron-methyl sodium inhibits the activity of the enzyme acetolactate synthetase, lethal destroys dicotyledonous weeds, at the same time destroys monocotyledonous weeds. Iodosulfuron-methyl-sodium has a systemic effect against dicotyledonous weed plants on winter wheat crops. Mefenpyr-diethyl is an antidote that weakens the phytotoxic effects of herbicidal preparations including sulfonylureas in grain crops [3, 9–11].

In this regard, the effect of the herbicide Atlantis on monocotyledons and dicotyledonous weeds in winter wheat crops in the steppe zone of southern Uzbekistan was studied.

Methods of research

Field experiments were conducted in 2015–2017 in the Kasan district of the Kashkadarya region in the south of Uzbekistan in quadruplicate. The herbicide Atlantis was applied for 3 terms (March 20, April 1, and April 10) in 4 variants (without herbicide and norm 250, 275, 300 g/ha) in a working solution of 300 l/ha.

Harvest data were carried out by mathematical processing according to the method of Dospekhov [1, 294–311] and Peregudov [4, 193–219].

Results and discussion

As the results of the research showed, the yield of winter wheat grain varies depending on the norm and timing of the use of the herbicide Atlantis against weeds (table 1).

Table 1.– The dependence of the yield of winter wheat when weed control by chemical means

No	Experience options	Productivity. c/ha				The difference from control. c/ha	The difference from the term. c /ha
		2015 year M ± m	2016 year M ± m	2017 year M ± m	Average		
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
20 – March							
1.	Control (st)	40.3 ± 0.47	46.0 ± 0.67	42.9 ± 0.64	43.1	0	0

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
2.	Atlantis 250 g/ha	43.2 ± 0.65	51.7 ± 0.42	46.8 ± 0.83	47.2	4.1	0
3.	Atlantis 275 g/ha	45.3 ± 0.64	53.1 ± 0.61	48.6 ± 0.53	49.0	5.9	0
4.	Atlantis 300 g/ha	46.5 ± 0.32	54.4 ± 0.78	50.6 ± 0.75	50.5	7.4	0
1 – April							
5.	Control (st)	39.4 ± 0.75	47.3 ± 0.61	43.2 ± 0.77	43.3	0	0.2
6.	Atlantis 250 g/ha	48.6 ± 0.46	57.1 ± 0.57	52.7 ± 0.76	52.8	9.5	5.6
7.	Atlantis 275 g/ha	50.6 ± 0.34	58.9 ± 0.59	54.3 ± 0.52	54.6	11.3	5.6
8.	Atlantis 300 g/ha	52.8 ± 0.47	61.0 ± 0.65	55.7 ± 0.75	56.5	13.2	6.0
10 – April							
9.	Control (st)	40.7 ± 0.46	47.1 ± 0.56	43.0 ± 0.54	43.6	0	0.5
10.	Atlantis 250 g/ha	54.8 ± 0.58	63.2 ± 0.62	58.2 ± 0.60	58.7	15.1	11.5
11.	Atlantis 275 g/ha	56.9 ± 0.59	65.3 ± 0.39	60.3 ± 0.55	60.8	17.3	11.8
12.	Atlantis 300 g/ha	58.4 ± 0.52	66.9 ± 0.61	61.6 ± 0.44	62.3	18.7	11.8
	$SSD_{0.5}$ = c/ha* Factor A (term)	0.73	0.99	1.05			
	$SSD_{0.5}$ = c/ha Factor B (norm)	0.84	1.14	1.21			
	$SSD_{0.5}$ = c/ha Factor AB	1.45	1.98	2.09			

*Note: *smallest significant differences for 5% significance level*

When using the herbicide Atlantis on March 20 against weeds, the additional yield of winter wheat was from 4.1 c/ha to 7.4 c/ha, depending on the norm of the herbicide Atlantis.

Depending on the rate and timing of the use of the herbicide Atlantis against monocotyledonous and dicotyledonous weed plants, the yield of winter wheat grain naturally increases.

When using the herbicide Atlantis on April 1 against monocotyledonous and dicotyledonous weed plants, the grain yield of winter wheat was 52.8–56.5 c/ha, depending on the rate of use of the herbicide Atlantis, and the yield increased by 9.5–13.2 q/ha compared with the control option experience.

With the late term use of the herbicide Atlantis on April 10 at a rate of 250 g/ha against monocotyledonous and dicotyledonous weed plants, the yield of winter wheat grain was 58.7 c/ha, which is 15.1 c/ha above the control variant of the experiment. At an average rate of Atlantis of 275 g/ha, the grain yield was 60.8 c/ha and increased by 17.2 c/ha, and at a rate of 300 g/ha, the yield was 62.3 c/ha and increased by 18.7 c/ha compared to the control variant of the experiment.

If we analyze the data obtained changes in grain yield, depending on the timing of the use of the herbicide Atlantis, the terms of application have a significant positive effect on the grain yield of winter wheat. When applying the herbicide on April 1, compared with the application on March 20, the yield increased by 5.6–6.0 c/ha, and when applied on April 10, this figure was 11.5–11.8 c/ha.

From this it follows that the yield of winter wheat grain depends not only on the rate of application of the herbicide Atlantis, but also on the timing of application.

Conclusions

The use of the herbicide Atlantis on the fields of winter wheat against monocotyledonous and dicotyledonous weeds are effective agricultural technologies, which contribute to an increase in grain yield due to the application rate of up to 18.7 c/ha. And due to the time of application it contributes to an increase in grain yield up to 11.8 c/ha.

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DETERMINATION OF THE VOLUME OF FLAKY SEDIMENTS AND OTHER SEDIMENTS DEPOSITED AT THE BOTTOM OF THE SOUTH SURKHAN RESERVOIR

Abstract: The effective utilization of water resources in reservoirs of Uzbekistan is largely depends on rapid siltation of their cup. For this reason, it is important to study sedimentation of water reservoir as Surkhandarya region which with dry climate and based on agricultural irrigation. Efficient utilization of reservoirs and their related scientific and practical conclusions are one of the main issues today.

Keywords: Water reservoir, Efficient use, water, Sediment, Consumption, river, hydrology, volume, streams.

The main purpose of this article is to determine the volume of fuzzy irrigation and other sediments deposited at the bottom of the South Surkhan reservoir. The following tasks have been identified and resolved:

– Consumption of sediments Surxondarya for accounting period between 1964 and 2013, kg/s;

– The amount of sediment (Wsoy) in reservoir, brings by the rivers and streams which provided hydrometric observations;

– Amount of sediments in reservoir that can be added by rivers and streams without hydrometric observations;

– The amount of sediments which added from the surface of the reservoir to and its coastal area.

Methods and analysis. For quantitative assessment of sedimentation balance equation of South Surkhan reservoir was used the data of the standardized hydrological observations, including data of hydrometric and hydrological observations which made at special stations. Calculation of quantitative assessment of elements of sedimentation equation was performed in the following way [9]:

The volume of sediments which flows to South Surkhon reservoir by Surkhandarya is defined by the following expression:

$$W_{river} = R_{mean} \cdot T \cdot n$$

there: R_{mean} – consumption of average annual sediment flow calculated for the accounting period between 1964–2013 for Surxondarya, kg/s; T – The number of seconds in a year, its equal to 31.5410^6 seconds, n-is the number of observation years [2].

Average long-term sediment flow rates which brings to Surkhondaryo reservoir for calculation period (1964–2013) calculated using the above expression:

$$R_{d.mean} = \frac{\sum_{i-1}^{n} R_{\partial i}}{n} = \frac{6596}{50} = 131.9\ \frac{kg}{s},$$

Knowing the value of the average long-term sedimentation ($R_{d.mean}$) and value of T, calculated volume of the sediment streams to Surkhandarya's South Surkhon reservoir was determined with the help of above expression:

$$W_{Д} = 131.9\frac{kg}{s} \cdot 31.54 \cdot 10^6 c \cdot 50 =$$

$$= 208006.3 \cdot 10^6 kg = 208 \cdot 10^6 ton$$

The amount of sediment streams (W_s) which brings by rivers and streams that have hydrometric observations was also calculated by the expression:

$$W_s = \sum R_{s.mean} \cdot T \cdot n = 28.4\frac{kg}{s} \cdot 31.54 \cdot$$

$$\cdot 10^6 s \cdot 50 = 44.78 \cdot 10^6 ton.$$

For calculation the amount of sediments flows that can be added from streams without hydrometric observations to the water reservoir provided with using a soil cleaning map which created by O. P. Sheglova. As observed, there are more than 10 smaller streams which adds to South Surkhon reservoir, with the $F = 1500$ km² water collecting area. In the basin of the river and river basin's which provides hydro-meteorological observations, claning module is equal to 538 tonnes/km² [3; 4; 5]. The following steps were done to calculate this amount. The total area of the river and streams which provided hydrometric observations is equal to 10053 km². Observed that their average annual sediment stream (W_R) was 5055.6 tonnes. Using this information, claneaning module of river and streams which provided hydrometric observations was calculated as follows [2; 6; 11].

$$M_R = \frac{W_R}{F} = \frac{5712.9ton}{10625km^2} = 538\frac{ton}{km^2 \cdot year}$$

When used map of soil washing by O. P. Sheglova, it was found out that the Soil Surface Washing Module was equal to 750 ton/km² in South Surkhan reservoir bassin (Figure 1).

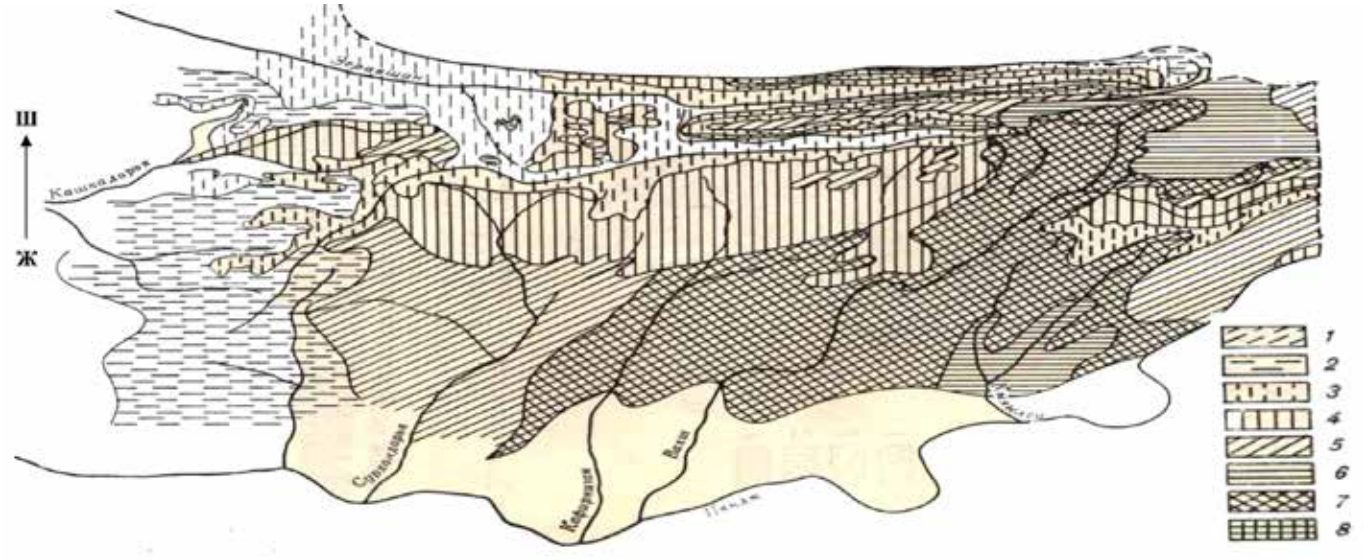

Figure 1 Soil drainage map, t/km² year (southern part of Central Asia, O. P. Sheglova) [1]

1 – < 50.2–50–100, я –100–200.4–200–500.5–500–1000.6–1000–2000.7–2000–5000.8 – >5000

Using this value above, calculated the flow of sediments in the basin of streams which not provided hydrometric observation as follows:

$$I_G = \frac{W_{chuckma}}{n} = \frac{318.3 \cdot 10^6 ton}{50 yy} = 6.36 \cdot 10^6 \frac{ton}{yy}.$$

After that, the amount of sediment flows which comes from not provides hydrometric observations was determined as follows.

$$W_{X.O} = R_{X.O} \cdot T \cdot n = 35.66 \frac{kg}{s} \cdot 31.54 \cdot$$

$$\cdot 10^6 s \cdot 50 = 56.23 \cdot 10^6 ton$$

The results of the above calculations are given in the table.

Table 1.– Calculation of the amount of sediments which incomes from streams which not carried out hyrometric observations

Amoun *t* of streams	**Area of collection basin km²**	**Average washing module, M_R, *t*/km² year**	$\bar{R}_{X,O}, \frac{kg}{s}$	$W_{X.O.C} = R \cdot T \cdot n, 106$
10	1500	750	35.66	56.23

The calculation of the amount of sediment flow (W_{qb}) which adds from the surface of the reservoir and along the coastal area of the reservoir provided as:

$W_{qb} = F_{wr} - (F_d + F_s + F_{h.o}) = 11800 - 10053 - 1500 = 247$ km².

There: F_{wr} – is a water collecting area of reservoir, equal to 11800 km²; F_d and F_s – water collecting area of of rivers and streams which provides hydrometric observations, equal to 10053 km²; $F_{h.o}$ – water collecting area of of rivers and streams which not provides hydrometric observations, it equal to 1.500 km².

As washing module equal to 750 ton/km², the amount of sediments which adds from the coastal zone and surface stream of the reservoir is calculates as follows:

$W_{qb} = F_{qb} \cdot M_R \cdot n = 247 \text{ kg}^2 \cdot 750 \, ton/km^2 \cdot 50 = 9.3 \cdot 10^6$ ton.

Using the results of the above calculations, the sediments resulting from the sinking of the muddy outlets in the reservoir during the exploitation period were as follows:

a) Determination of the amount of deposition (W_{ss}) generated by the sedimentation of rivers and rocks in the reservoir in the unit of weight measurement:

$W_{ss} = W_d + W_s + W_{ho} + W_{qb} = (208 + 44{,}78 + 56{,}23 + 9{,}3) \cdot$
$\cdot 10^6 = 318.3 \cdot 10^6 \, ton$

b) Determination of the amount of sediments in reservoir in volume measurement;

$$V_R = \frac{W_{ss}}{\gamma_R} = \frac{318.3 \cdot 10^6 t}{1.15 t/m^3} = 276.8 \cdot 10^6 m^3,$$

According to the batimetry, the cumulative weight of the precipitated sediments in the South Surkhon reservoir in 1979 has changed with following interval: the maximum value is 1.74 t/m³, the minimal value is 1.09 t/m³, and the average value of the specific weight of the sediments was taken as 15 t/m³ [2; 8].

Table 2.– Quantitative values of the bottom sediments of South Surkhon reservoir

Quantity	W_r	W_s	$W_{h.o.}$	$W_{q.b.}$	W_{ss}
10^6 *ton*	208	44.78	56.23	9.3	318.3
10^6 m^3	180.86	38.94	48.89	8.08	276.8
%	65.35	14.07	17.66	2.92	100

Conclusion

The results of the calculations show that during the exploitation period, the South Surkhan water reservoir flows 318.3 mill. tons or 276.8 million m^3 of sediments. Thus, the water value of the Southern Surkhan reservoir has been reduced to such a size.

Assessment of the intensity of overflowing of the South Surkhon reservoir with sediments in the weighing unit is:

$$I_G = \frac{W_{chuckma}}{n} = \frac{318.3 \cdot 10^6 ton}{50 yy} = 6.36 \cdot 10^6 \frac{ton}{yy}$$

б) Assessment of the intensity of overflowing of the South Surkhon reservoir with sediments in the volume units:

$$I_G = \frac{W_s}{n} = \frac{276.8 \cdot 10^6 m^3}{50\ year} = 5.5 \cdot 10^6 \frac{m^3}{year}.$$

Summary:

1. The average annual (1964–2013) sedimentation of the Surkhandarya water reservoir is equal to 208 • 10^6 tons.

2. The amount of sediment flow from rivers and streams which provides hydrometric observations is equal to 44.78 • • 10^6 *tons*.

3. The amount of sediment flow from rivers and streams which not provides hydrometric observations is equal to 56.23 • 10^6 tons.

4. The volume of sediments added to the reservoir by the surface stream and its coastal area is equal to 9.3 × 10^6 *tons*.

During the calculation period the volume of bottom sediments into the reservoir was 276.8 million. m^3. Given the fact that the water of river and streams have been blocked since 1962, it is clear that 53 years have passed since the sediments began to flood. The average annual amount of bottom sediments in the calculation period is 5.5 mill. m^3. Until now, the amount of sediment falling to the reservoir was 291.5 mill. m^3. This indicator is 36.4% with compearing with projected water volume.

In general, the results of the calculations show that the water reservoir capacity of the Southern Surkhan reservoir is 508.5 mill. m^3.

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DYNAMICS OF ALTERATIONS IN SIEROZEM-MEADOW SOILS FERTILITY OF THE DJIZAK STEPPE UNDER THE INFLUENCE OF IRRIGATION

Abstract: In this article has based scientifically on soils generating, their development, forming soil nutrients, humus, distribution to soil layers and their correlation with each other and soil changing effect of irrigation area.

Keywords: soil fertility, nutrients, light brown soil, brown-meadow soil, humus, cultivated layer, under cultivated layer, ground water, mineral substances.

Introduction. In the soil-climatic conditions of many regions in the Republic of Uzbekistan, it is impossible to obtain a crop without artificial irrigation of agricultural crops. Because, a very small amount of precipitation in the plains and foothills of our republic and having a seasonal character leads to a lower accumulation of moisture in different soil layers. Therefore, because of large-scale irrigational measures, the appearance of soil fertility and its formation undergo peculiar changes. One of these territories is the Djizak steppe (this includes the territories of the Mirzachul, Arnasay, Zafarobod, Dostlik, Pakhtakor and partially Zarbdor). Most of the soil in these areas because of irrigation periodically turns from one type of soil to another and, due to the exposure to salinity of varying degrees and erosion, the level of fertility has changed and to date, improving their reclamation state is one of the urgent problems.

Materials and methods. Field experimental works in the soils of the Djizak steppe were carried out at certain strong points. Morphogenetic details of soils, sampling and work on the determination of soil nutrients in laboratory conditions were carried out based on methods developed by scientists of the Institute of Selection, Seed Growing and Cotton, the Research Institute of Soil Science and Agrochemistry, and methodological manuals published in 1963–2004.

Results and discussion. The study of the state of fertility of irrigated soils of the Djizak steppe, in general, the study of agrochemical features and properties, including the content of nutrients and their dynamics, is of great importance in the regulation of soil processes. Analysis of the collected scientific materials and obtained data showed that the studied soils of the Djizak steppe 35–40 years ago were light gray soils and up to the development of humus content on the upper soil layers were 1–1.5%, on saline soils it was about 1%. That is why, the unblocked soils in these territories were considered the most fertile.

O. Komilov [3], N. F. Bespalov [1], Zimina [2], M. U. Umarov [5], L. Tursunov, S. Abdullaev and others studied in detail the agrophysical and water-physical properties of soils of these territories and came to the conclusion that these soils had a propensity for processing and active scientific research is currently underway to study the properties of these soils.

Because of the development and irrigation of soils over the past 15–20 years, one can see that the process of their formation and the component part has undergone drastic changes. For example, the content of humus and the mechanical composition of modern sierozem-meadow soils in 1958 averaged 1.45% humus and 38.39% physical clay (data of S. K. Ochilov and others, 2014), with the passage of time as a result of the continuation of the process of land development in these soils in the last 15–16 years the humus content decreased by 0.97%, and the content of physical clay decreased by 29%.

It should be specially noted that the above processes on these soils have been studied in the scientific studies of Uzbek scientists such as S. N. Ryzhov, B. V. Gorbunov, S. P. Suchkov, N. F. Bespalov, M. Umarov, O. Komilov and others; they studied the agrophysical properties of soils in their studies and came to the following conclusion: on the upper half-meter layer of bright sierozem-meadow soils prevalent on Mirzachul territory, the supply of such substances as humus, phosphorus, nitrogen turned out to be relatively higher than other layers of the same soils and their production ability in comparison with other irrigated soils and came to the conclusion that they can be mastered on a large scale.

Very important is the data obtained on soil humus by O. K. Komilov [3], and it was found that the humus content on the upper half-meter layer is almost uniformly distributed, and in some places in the lower seed layer its content was larger than the upper seed layer and the reason for this is the exchange of layers during the leveling of the earth. The data presented partly found its reflection in the areas studied by us.

During the past 30–40 years the reserve of humus in the cultivated irrigated soils is mainly distributed more than the subsoil layer, in our studies for 10–15 years this process has changed partially and it can be seen that the main content of humus has increased in the upper sowing layers of the earth. For example, in the upper arable and sub-cultivated layers of newly cultivated and irrigated slightly saline sierozem-meadow soils 30–40 years ago in the fields where various technical plants were grown humus was 0.24–0.60% and its total reserve in the 30–50 cm soil layer was 25–45 tons, during the last 15 years the humus content in the upper seed layers of these soils was 0.70–0.97%, and in the 0–30 cm layer the total reserve of humus reached 31–40 tons, and in the 0–50 cm layer it is 45–60 t ha (table).

Hence, over the past years, depending on irrigation, tillage, fertilization, and depending on the agro technical measures applied and the type of crops grown, the reserve of humus in these soils has increased several times.

Table 1.– Agrochemical properties of the soils of the Djizak steppe (in% with respect to absolutely dry soil)

№ section	Years	depth, cm	Content		C: N	Total content,%		Reserve, t/ha		
			Humus	Nitrogen		P_2O_5	K_2O	section, cm	Humus	Nitrogen
The newly developed sierozem-meadow soils										
1	2015	0–30	0.637	0.059	6	0.140	1.085	0–30	26.7	2.4
		30–35	0.521	0.044	7			0–50	39.3	3.4
		35–55	0.429	0.037	7					
		55–80	0.362	0.034	6					
	2016	0–34	0.701	0.060	7	0.115	0.939	0–30	29.4	2.4
		34–40	0.610	0.058	6			0–50	45.5	4.0
		40–65	0.510	0.045	6					
3	2015	0–25	0.694	0.059	7			0–30	25.9	1.8
		25–47	0.245	0.021	7			0–50	32.6	2.47
		47–75	0.205	0.018	7					
	2016	0–29	0.673	0.059	7	0.156	0.06	0–30	28.7	2.55
		29–40	0.653	0.053	7			0–50	40.4	3.1
		40–60	0.224	0.017	7					
Irrigated sierozem-meadow soils										
7	2015	0–30	0.736	b.072	6	0.175	1.883	0–30	30.9	3.0
		30–42	0.761	0.061	7	0.140	1.902	0–50	50.2	5.2
		42–60	0.583	0.049	7	0.110	1.900			
	2016	0–30	0.926	0.069	8	0.177	1.850	0–30	38.3	0.8
		30–50	0.749	0.051	8.5	0.152	1.912	0–50	59.9	1.4
		50–70	0.403	0.036	6	0.140	1.902			
2	2015	0–26	0.901	0.070	7	0.185	1.939	0–30	36.8	2.4
		26–38	0.710	0.050	8	0.162	2.041	0–50	53.4	4.0
		38–50	0.510	0.058	5	0.120	2.102			
		50–78	0.394	0.047	5	-	-			
	2016	0–30	0.975	0.074	8	0.160	1.822	0–30	40.9	1.6
		30–40	0.649	0.062	6	0.142	1.800	0–50	54.8	2.2
		40–85	0.349	0.040	5	0.101	1.921			
5	2015	0–10	0.952	0.070	8	0.145	2.746	0–30	32.0	2.7
		10–21	0.807	0.069	7	0.120	2.548	0–50	45.9	3.9
		21–50	0.497	0.046	6	0.102	2.516			
	2016	0–25	0.901	0.072	7	0.164	2.770	0–30	37.5	2.5
		25–45	0.805	0.062	7	0.120	2.712	0–50	59.9	3.5
		45–70	0.771	0.053	8	0.100	2.701			

Particularly, in our collected biennial data, it partially confirmed this process and it can be seen that due to changes in groundwater level, agrotechnical measures, and the use of organic fertilizers in some fields, the content of humus in various soil layers has undergone a partial change. As it can be seen from the data given in the table, in 2015–2017, in fields where cotton was grown and partly intermediate plants in fertilized lands, the humus content increased by 0.05–0.2% within 2 years, as a result of an increase in the level of salinity or in fields that did not receive organic fertilizers, the humus content decreased to 0.05%. However, in their sub-plow layers, the total reserve of humus was not almost not undergoing tangible changes. Hence, as it was said above, the content of humus could be increased by fertilizing the soil with 6–8 t / ha manure. However, it should be specially noted that in some saline layers, by increasing the content of mobile cations of water-soluble salts, the content of humus might partly increase.

In sierozem-meadow soils, where the studies were carried out, the content of nitrogen corresponds to the content of humus. The content of total nitrogen in the soils of the investigated territories is very low and an acute insufficiency of organic fertilizer is felt in the system of alternating cultivation of cotton-wheat. Because the scarcity of humus in the soil as compared to humic acids due to the reduction of organic compounds in their formation in soils, less nitrogen accumulates. In irrigated soils, where wheat is grown, the content of total nitrogen was much higher. It may be thought that the manifestation of such a case led to the activation of nutrients in the soil under the influence of mineral substances and irrigation in the fields under wheat. Exactly the same state can be observed in the carbon ratio of nitrogen. Because, in the fields that have received fertilizers, the nitrogen content is relatively large, and in the remaining areas, one can observe the opposite state.

Among the soils studied on their basis by the abundant total nitrogen are irrigated sierozem-meadow soils and meadow soils and total nitrogen is 0.01 to 0.10%, but the level of provision of these soils with total nitrogen is low, i.e. The ratio of carbon to nitrogen (C: N) in all soils varies between 5 and 8.5. Taking into account the need of all soils for organic fertilizers, in fields where cotton and wheat are intensively grown, the cultivation of leguminous plants that accumulate nitrogen and the formation of a system of partial crop rotation is, in our opinion, a necessary measure.

The content of total phosphorus among nutrients and the dynamics of its change within 25 to 30 years has attracted the attention of many scientists.

Among the nutrients in the sierozem-meadow soils where our studies were conducted and the study of its dynamics under the influence of its assimilation is of great importance. The change in phosphorus content in soils occurs mainly in connection with the agro technical measures carried out, the environmental conditions, the norms of organic and mineral fertilizers, the introduction of a crop rotation system and the quality of irrigated waters. In general, this indicator reliably indicates that there is a strong correlation between the accumulation of humus and other nutrients in the soil and the level of assimilation of these substances by plants and this is applicable not only to nitrogen but also to other substances.

The change in the content of total phosphorus in soils under the influence of assimilation is of great importance. According to the data of S. P. Suchkov [4] in the soddy and backing layers of virgin light gray-earth-meadow soils, the content of total phosphorus is 0.14% and decreases downwards by 0.1–0.09%. After the development of virgin lands and their irrigation, according to the literature data 20–25 years ago, the total phosphorus content in irrigated soils was 0.10–0.12%, according to our data, this index reached 0.10–0.18% and its maximum the content was concentrated in the plow and subsoil layers. Because, in these layers, biogenic processes occur more intensively than other layers, but in spite of this the phosphorus content that can be assimilated by plants is only 10–20%. The rest 50–60% of phosphorus is gradually transferred to intractable forms. The reason for this is that soil fertilization with a mobile form of phosphorus depends on its content and the level of soil cultivation. Proceeding from this, it can be said that the change in the content of phosphorus in the studied soils varies depending on the conditions of the agrotechnical measures carried out or used, the norms of organic and mineral fertilizers, the introduction of a system of crop rotation of the quality of irrigated waters. In general, this index reliably indicates that there is a strong correlation between the accumulation of humus and other nutrients in the soil and the level of assimilation of these substances by plants and this applies not only to phosphorus, but also to other substances.

The element of potassium is the most important and necessary nutrient in the nutrition of plants. Crops cannot grow and develop in a timely manner and correctly without potassium. Potassium is found more in plants than in soil.

The main source of potassium in the soil are the minerals of the group of silicates and aluminosilicates. The content of various forms of potassium in soils and the level of provision of soils with this element depends on the primary and secondary minerals. That is why our soils are richer in potassium than other soils, but they are poorly provided. Therefore, knowledge of the composition and properties of minerals is important when properly and effectively using potassium fertilizers.

In irrigated soils, the content of potassium is not high (0.815–2.77%), and this indicator in saline soils cannot regulate the growth and development of plants, as a result, growth decreases and yields drop sharply. Therefore, the question of

the availability of potassium for plants is not only theoretical, but also practical.

Conclusion. During the past periods, in the conditions of agriculture in the Djizak steppe, sharp changes in the properties and specificities of the soils occurred, firstly, a large part of the territory turned into light gray-earth meadow soils, and sierozems salinized to varying degrees of soil under the influence of irrigation. Despite this, in recent years a positive change in the content of humus and nutrients can be observed in different soil layers. These changes, of course, could occur due to the processing of land and organic fertilizers. However, these measures are inadequate and we believe that the conservation of the humus condition of the soil and measures for their improvement should be carried out at least twice.

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SOIL-AMELIORATIVE FEATURES OF THE DJIZAK STEPPE

Abstract: Based on field soil-ameliorative and laboratory-analytical studies, the main properties and ameliorative state of the soils of the foothill plain of the Golodnaya Steppe have been studied, within the territory of the Djizak steppe. The article gives data on the mechanical composition, chemical and agrochemical properties, the content of gypsum and CO_2 carbonates, generalized the salinity of soils, the patterns of their manifestation in different geomorphologic regions of the steppe. The characteristic of the modern salt accumulation is given in connection with the development of irrigation of the territory, as well as the peculiarities of the manifestation of secondary salinization on irrigated lands.

Keywords: foothill plains, irrigation, mechanical composition, ground water, secondary salinizatoin, ameliorative state of soils, degradation, amelioration.

Introduction.

One of the large and promising areas of ameliorative constructions in Uzbekistan is the Djizak steppe, where of the total area of 314.000 hectares of land and it is planned to use 219.000 hectares for irrigation, including 57.9 thousand hectares in the first place, the remaining area as unsecured in currently the water resources, belongs to the distant future. Being the southern extremity of the Golodnaya Steppe, it is a foothill plain with absolute elevations from 310 to 500 m and even more. In view of the absence of large water arteries, the need to supply irrigation water here by pumping and the availability of more convenient for irrigated farming in the Golodnaya steppe, the development of irrigated agriculture and irrigational land improvement in the Djizak steppe hampered the soil relief. Here, small-oasis irrigation was developed, based on the use of the constantly operating small mountain rivers Sangzar and Zaaminsuv. Now, when the soils of the flat areas of the Golodnaya Steppe are almost completely developed, the expansion of irrigated agriculture in this region is possible only at the expense of foothill plains. The current power supply capacity, as well as the accumulated experience of irrigation and ameliorative construction in the Golodnaya Steppe, made it possible to implement a waterfall into the Djizak steppe by pumping stations from the South Golodnostepsky Canal. In the successful solution of the tasks set by the Government of the Republic for the further development of agriculture and the implementation of the Food Program, development and introduction of a scientifically based farming system is of great importance. The vast territory of the Jizzakh steppe is characterized by a great variety of natural and economic conditions and resources for agriculture. Nevertheless, irrigation of new land is often associated with the solution of the problem of combating soil salinization. Until now, the researchers had the opinion that the foothill plains, due to significant slopes of their surface and natural drainage and dismemberment during irrigation, are guaranteed from secondary salinization. However, the experience of irrigation of individual massifs and foothill areas showed that this provision is erroneous [13; 1; 12], which results, in the main, from insufficient study of such territories. As V.V. Yegorov notes [5; 6] the foothill plains have not been sufficiently studied for irrigation and melioration purposes, many important issues have not been solved yet, and therefore the ameliorative evaluation of them is complicated by very simplified, often with unjustified notions. The Jizzakh steppe is not an exception in this respect either. The first researchers of the Djizak steppe (Golodnaya Steppe) noted the presence of saline soils here in varying degrees [9; 20; 14; 15; 7; 8; 2; 3; 16; 17; 18]. However, the problems of the genesis of salinization, the role of lithologic-geomorphological, hydrogeological conditions and irrigation in the movement of salts and the formation of saline soils in the steppe, as well as the prevention of negative impacts on irrigation soils, on the soils of irrigation of the upper land of the Tajikistan part of the Golodnaya Steppe have not been adequately studied. In view of the lack of experience in the widespread development of the foothill plains, the issues of the sequence of land development and the expedient placement of agricultural crops were insufficiently justified. Therefore, only a careful study of lithologic-geomorphological, soil-climatic and hydro-geological conditions of the Djizak steppe, revealing the true amount and composition of water-soluble salts in soil of different genesis and lithological

composition of the aeration zone will allow us to discover the causes of salinity, establish the patterns of migration and accumulation of salts, in salinization under irrigation and scientifically justified to solve issues of land reclamation.

Objects and methods of the research

To solve a set of issues, we have conducted studies in the Djizak steppe for several years (1973–1977, 1993–1996). Investigations covered the least studied and poorly used in irrigated land the eastern part of the steppe, adjacent to the northern slopes of the Turkestan Range in the south, up to the Lomakin Plateau in the west and to the South Golodnosteppskiy Canal in the north, with a total area of about 90,000 hectares. Studies were carried out by laying soil sections located in linear alignments that crossed the territory from south to north. The stems of the soil sections were laid with the account of geomorphological, hydrogeological and soil conditions. In total, four sections, each 20–22 km in length and consisting of 16–20 soil sections, are laid on the investigated territory. The first section of the soil sections covers the territory of the cones of the Lomakin plateau, the second one covers the Zaamin cone, the third one covers the right wing of the Zaamin cone of removal on the line of contact with the Khavast cone of removal. The fourth point characterizes the trail zone of the deluvial-proluvial plain of the Khavast group of rivulets. A total of 108 deep soil sections (in two stages) are laid on the territory, which reveal the entire aeration zone of soil soils (to groundwater) or to a continuous pebble horizon. Of all the soil sections without a pass through the genetic horizons, soil and ground samples and groundwater samples were selected in case of their opening. In selected samples of soil in the analytical center was conducted, according to the generally accepted method of the Soyuz NIIHI (now UzPITI) [10; 11], and the methods described in the manual of E. V. Arinushkina [1], the study of their granulometric and salt composition, the content of humus and nutrients. In groundwater samples, the degree of their mineralization and the composition of the salts were determined. The research is based on comparative-geographic, comparative-geochemical and comparative-ameliorative methods for studying soils. The obtained results of field and laboratory studies of the soil of the territory using the materials of engineering-geological and hydro geological studies [21] made it possible to carry out a schematic soil-ameliorative zoning of the territory, which served as a basis for predicting possible changes in the ameliorative state of soils during irrigation and differentiation of the recommended agro-ameliorative measures aimed at their optimization.

Results and discussions

Hydro-geological conditions of the Jizzakh steppe, as well as the entire arid zone many of the important production properties of soils, such as the degree and nature of salinity, humus content, field moisture capacity, water permeability, etc. These properties of the soil in turn determine the nature and extent of the required developmental and ameliorative measures (drainage, washing), as well as irrigation, irrigation and washing norms and irrigation regime. Proceeding from this, the most common basis for dividing the soils of the described territory was the nature of their moistening. On this basis, automorphic, semi-hydromorphic and hydromorphic soils are distinguished here. Automorphic soils are developed in conditions of deep (5–10 m and more) occurrence of groundwater and their moisture is determined solely by atmospheric precipitation. Semihydromorphic soils are developed under conditions of weak ground moistening at a depth of groundwater within 3–5 m. Hydromorphic soils are developed in areas with close (1–2 m) groundwater. In connection with the dynamism of the hydrogeological conditions of the Jizzakh steppe, in the described soil belts, especially in the belt of light gray soils, transitional soils of meadow-grey brownish and grey brownish-meadow are observed. Intensive approximation of the level of mineralized groundwater (LMG) to the day surface and their consumption mainly for evaporation promoted the formation of meadow soils with varying degrees of salinity and negative elements of the alkali soil relief. In addition to hydromorphic alkali soil, residual alkali soils are also described in the area under consideration. These are soils in which the alkali soil process has stopped and salt accumulation is relict. The territory of distribution of these soils in the geological past experienced hydromorphic conditions, and then probably, due to tectonic processes, they dropped to a depth of 6–10 m. Thus, the classification of soil in the territory is presented as follows (Table 1). A great variety of geomorphologic-lithological, hydrogeological and soil-climatic conditions of the territory caused the variegation and complexity of the soil cover in terms of mechanical composition, agrochemical properties, salinity, gypsumation of alkalinity and others.

Table 1.– Hydrogeological conditions of soil formation

Soil	Hydrogeological conditions of soil formation	
	Depth of ground water, m.	Effect of soil moistening on soil formation
1	*2*	*3*
I. Automorphic soils:		
1. Typical gray-brownish soil	> 10	No influence
2. Light gray-brownish soil s	5–10 и >10	No influence or very weak

1	*2*	*3*
II. Semihydromorphic soils:		
1. Meadow-gray brownish soil	3–5	Weak
2. Gray brownish-meadow soils	2–3	Moderate
III. Hydromorphic soil:		
1. Meadow	1–2	Intensive
2. Alkali	1–2	Intensive

The mechanical composition of meadow-gray brownish soils is heterogeneous and differs in each geomorphological region in its own and features. Loess type sediments characterized by uniformity and predominance of dust particles in the mechanical composition are characterized by the Zaamin cone of removal and the Lomakin plateau. The content of fractions of coarse dust (0.05–0.01 mm) is from 26–33% to 56–58% with a very low amount of sand fractions. The silt content (<0.001 mm) varies within a wide range from 9–10% to 18–19% (Table 2). Gray brownish-meadow soils formed on deluvial-proluvial layered sediments of very variegated texture. Heavy loams (section 7) alternate with medium and light loams, and in other cases sandy loamy soils in the upper horizons, to the bottom, will be replaced with heavy loams (section 24), the content of the silty fraction of gray brownish-meadow soils varies widely from 0.6–0.9% to 11–13%. Meadow soils are formed on deluvial-proluvial deposits of very variegated texture. Medium loam alternates with light, heavy, sometimes clay and sands (Table 2, sections 24, 2, 3, 22). The mechanical composition of soils is in most cases represented by medium and light loams. Heavily loamy and sandy loam varieties are very rare.

Table 2. – Mechanical composition of soils

No. Section	**Depth, cm**	**Fraction content in% on absolutely dry soil, fraction size in mm**							
		Sand			**Dust**			**Silt**	**Physical clay**
		> 0.25	**0.25–0.1**	**0.1–0.05**	**0.05–0.01**	**0.01–0.005**	**0.005–0.001**	**< 0.001**	**< 0.01**
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Meadow-gray brownish									
17	0–30	1.0	1.1	13.5	50.2	10.5	13.2	10.5	34.2
	30–50	0.6	0.8	9.3	58.3	8.1	12.3	10.6	31.0
	50–85	0.5	0.8	11.7	56.6	8.4	11.1	11.5	31.0
	85–125	0.9	2.2	25.5	42.5	8.7	9.8	10.4	28.9
	125–170	1.5	1.4	16.4	56.0	6.0	9.7	9.0	24.7
	170–200	0.6	0.6	6.5	56.3	11.2	12.3	12.6	36.0
32	0–30	1.4	0.6	13.0	20.3	17.3	8.7	9.0	35.0
	30–50	2.0	0.6	21.8	26.7	17.8	18.5	13.2	49.5
	50–95	1.9	0.2	19.1	26.3	19.1	13.6	19.8	52.5
	95–130	3.8	0.7	38.7	33.2	4.4	12.5	12.7	29.6
	130–165	1.2	0.4	23.3	31.5	4.3	25.4	13.9	43.6
	165–200	0.7	0.8	17.4	33.0	8.6	25.4	19.8	53.8
Gray brownish-meadow									
7	0–35	0.7	3.1	6.1	39.7	17.7	28.8	3.9	50.4
	35–73	7.6	4.5	6.0	33.5	18.7	29.3	0.6	48.6
	73–105	11.9	9.3	10.2	47.3	12.3	0.7	8.3	21.3
	105–150	0.9	16.0	24.5	29.3	9.2	9.5	11.6	30.3
	150–200	0.2	11.3	16.1	32.2	6.9	8.8	4.7	20.4
28	0–26	3.7	0.7	42.7	36.6	3.9	8.7	3.1	14.7
	26–60	5.3	2.2	38.5	37.2	3.9	5.0	7.9	16.8
	60–96	12.8	1.6	26.3	34.9	13.8	9.7	0.9	24.4
	96–130	7.0	2.2	36.4	18.2	9.3	13.6	13.3	36.2
	130–165	5.1	0.5	27.3	15.7	11.7	28.6	11.6	51.9
	165–200	4.8	0.8	21.5	27.4	14.8	22.6	8.1	45.5

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Meadow									
24	0–30	9.8	5.9	22.1	27.8	7.0	19.1	8.3	34.4
	30–48	14.3	4.7	18.4	24.2	9.2	16.0	13.2	38.4
	48–103	13.4	6.4	22.1	34.7	6.1	7.8	9.5	23.4
	103–145	7.8	0.1	22.4	35.0	9.0	15.4	10.3	34.7
	145–175	15.5	1.9	9.1	17.6	23.8	20.0	12.1	55.9
	175–200	9.6	1.5	37.8	36.4	10.8	5.6	7.3	23.7
2	0–25	0.7	0.9	21.8	45.0	8.1	19.5	3.5	31.1
	25–45	2.6	2.7	19.9	47.3	6.5	11.5	7.7	25.7
	45–76	10.5	4.0	18.1	31.5	12.2	13.8	8.1	34.1
	76–115	10.8	3.5	13.9	36.0	9.9	11.2	15.7	36.8
	115–152	15.7	4.4	16.8	34.9	5.1	10.8	10.5	26.4
	152–176	12.1	2.3	16.7	42.3	5.6	7.8	13.2	26.6
	176–200	14.6	2.9	14.3	27.4	7.1	16.2	15.7	39.0
Meadow-alkali									
3	0–27	7.3	6.8	9.5	33.3	13.5	26.8	2.8	43.1
	27–50	7.1	6.6	14.7	32.2	16.7	21.9	0.8	39.4
	50–90	11.9	3.6	11.1	25.5	27.6	20.0	0.4	47.9
	90–120	6.1	1.6	9.3	19.5	37.1	25.4	1.0	63.5
	120–170	0.04	0.2	3.0	30.2	29.7	26.7	10.1	66.5
	170–210	0.07	0.1	2.0	34.6	24.4	28.2	10.8	63.4
22	0–28	4.0	4.8	15.4	33.2	10.5	10.3	21.8	42.6
	28–50	7.8	4.1	22.4	31.0	9.0	15.4	10.3	34.7
	50–80	3.6	0.4	34.6	36.2	9.2	12.7	3.3	25.2
	80–118	3.5	0.3	46.1	27.1	6.1	11.5	5.4	23.0
	118–160	4.0	0.6	44.4	34.0	6.1	6.0	4.9	17.0
	160–200	8.2	0.6	49.8	27.0	3.8	8.2	2.4	14.4

The predominant fraction of the described hydromorphic meadow soils, as in gray-brownish soils, is large dust (0.05–0.01 mm), the number of which reaches 50%. The silt content in individual horizons reaches 21% (Table 2, Section 22).

The described soils in terms of the upper 30 cm thickness are mainly represented by medium and light loams, less often heavy loams underlain by layered sediments (Table 2). Alternation of these layers can be clearly traced along the entire 3–5 m thick soil, consisting of light, medium and heavy loam, sandy loam, sand and clay in places. In all studied soils, a rather high content and uniform distribution of coarse-grained (0.05–0.01 mm) fractions with their variation in a five-meter thickness of soil from 30–33 to 60%. Even in lighter sandy soils of soil soils, a high content of coarse-grained particles is observed. A. N. Rozanov [19], who studied the features and origin of the parent rocks of this part of the Golodnaya Steppe, also noted that the fraction of large dust contained in an amount of 40–80% is the main component of all layers, regardless of their membership in sandy loam or loam. The second place belongs to the fraction of fine dust and the third-clay fraction.

Table 3. – Chemical and agrochemical properties of soil

No. section	**Depth, cm**	**Humus%**	**C: N**	**Gross,%**			**Mobile, mg/kg**		**CO_2 Carbonate,%**	**$CaSO_4 \cdot 2H_2O$ (Gypsum)**	**pH aqueous**
				N	**P**	**K**	**P_2O_5**	**K_2O**			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Meadow-gray brownish											
17	0–30	0.721	4.4	0.095	0.124	0.844	14.0	120	5.80	14.40	7.36
	30–50	0.583	5.3	0.064	0.138	0.769	26.0	200	6.40	16.03	7.42
32	0–30	0.996	6.0	0.096	0.132	1.575	5.4	302	4.10	3.33	7.54
	30–50	0.615	4.9	0.073	0.092	1.251	4.9	320	4.15	2.08	7.51

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Gray brownish-meadow											
7	0–35	1.346	5.8	0.135	0.170	0.967	17.0	180	5.58	12.61	7.76
	35–73	0.887	4.8	0.107	0.120	1.306	14.0	190	5.70	13.70	7.86
28	0–26	0.898	5.4	0.096	0.220	0.583	16.0	238	5.75	18.55	7.68
	26–60	0.545	4.2	0.075	0.096	0.608	6.0	130	5.37	18.91	7.34
Meadow											
24	0–30	1.441	5.7	0.218	0.189	0.601	7.0	325	5.03	3.94	7.82
	30–48	1.197	5.0	0.138	0.200	0.892	4.0	325	4.93	4.37	7.36
2	0–25	0.982	5.9	0.097	0.189	1.575	5.8	484	4.99	14.53	7.52
	25–45	0.875	5.6	0.090	0.148	1.483	5.3	424	5.98	15.37	7.21
Meadow-alkali											
3	0–27	1.380	6.4	0.125	0.106	2.988	4.1	328	5.44	3.85	7.48
	27–50	1.191	4.5	0.153	0.112	3.740	5.1	440	5.18	14.99	7.63
22	0–28	0.095	6.6	0.086	0.112	0.680	6.0	220	5.35	5.06	7.74
	28–50	0.879	4.9	0.104	0.106	0.563	4.0	180	5.00	5.56	7.82

In relation to humus content, the soils under consideration are of great variety. Depending mainly on the salinity of the mechanical composition, the humus content in the upper arable and sub-plow layers is from 0.545–0.583 to 1.380–1.441%. The amount of humus below the arable horizon, with a rare exception, as a rule, decreases. In accordance with the degree of humus content, the content in nitrogen soils also changes (Table 3).

Conclusion

1. The complex geomorphic structure of the investigated area also determined no less complicated hydro geological processes, that the ground waters formed, as well as a large number of surface irrigation waters, do not have or have a very weak outflow and are mainly used for evaporation and transpiration, and this leads to intensive salt accumulation on a large part of the area and consequently to the general unfavorable ameliorative state of irrigated soils.

2. The intensive irrigation that began in the last 35–40 years radically changed the hydro geological conditions of the area and as a result of the loss of a large quantity of irrigation water from the canals and from the irrigated fields, a sharp rise in the groundwater level occurred. The high waterfall for irrigation accelerated the transformation of automorphic soils into semihydromorphic and hydromorphic and soil cover of the territory at present is represented mainly by meadow-gray brownish, gray brownish-meadow, meadow soils and alkali, differing in mechanical composition, the nature of the underlying rocks, salinity, depth of occurrence and mineralization of groundwater eats natural and artificial drainage, agrochemical properties, which indicates the unevenness of the ameliorative state of soils.

3. Depending on the conditions of relief, lithologic-geomorphological and hydro-geological conditions and the nature of soil-forming stocks, semihydromorphic (meadow-gray-brownish) and hydromorphic (gray brownish-meadow and meadow) soils with different salinity degree were distinguished in the soil cover with a predominance of medium, strong and very strong salinity.

4. A great variety of natural and irrigation-farming conditions of the area where secondary salinization is increasing is now defining a great variety in its manifestation, both the qualitative and quantitative composition of the salt accumulations, and the intensity and general direction of the salinization process. On the whole, the variegation of salinity is observed along the profile of soil and space, showing the alternation of slightly saline and medium saline soils with strong, very strong salinity, places and alkalis. Among the described soils, it is now possible to single out all possible variants both in terms of the degree and type of salinity, and the position of the salt horizon.

5. The amount of humus in the profile of the described soils does not exceed 1.380–1.441%, they are very low and low-provided in the content of mobile phosphorus, and the exchange of potassium is mainly medium and high-yielding. The carbonate profile forms two maxima – from the surface and in the transitional carbonate-illuvial horizon, where the carbonate content in CO_2 reaches 5–6%. Gypsum in the lower and upper parts of the profile is manifested in various amounts. The reaction of the soil solution is slightly alkaline – pH = 7.3–7.8.

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IMPACT OF MINERAL FERTILIZERS ON VEGETATION PERIOD AND PRODUCTIVITY OF PEANUT VARIETIES IN THE CONDITIONS OF UZBEKISTAN

Abstract: This study was conducted in the experiment fields in the Plant Science Department of Tashkent State Agrarian University in 2012–2014. It was determined that the fertilizing rate has a statistically significant effect on pod yield, days to maturity, days to 50% flowering date, number of pods per plant, plant height, shelling percentages, pod yield per plant, and 100-seed weight. The results showed that the suitable fertilizing rate was 150 kg ha^{-1} for "Salomat" variety and 200 kg ha^{-1} for the variety of "Mumtoz".

Keywords: Peanut (Arachis hypogaea L.), experiment, statistic, flowering, maturity, seed weight, pods, yield.

Introduction

The cultivated peanut or groundnut (*Arachis hypogaea* L.), originated in South America (Bolivia and adjoining countries) and is now grown throughout the tropical and warm temperate regions of the world [1; 4]. This crop was grown widely by the native people of the New World at the time of European expansion in the sixteenth century and was subsequently taken to Europe, Africa, Asia, and the Pacific Islands [3; 5].

In solving the problem of increasing grain production and solving the protein problem in Uzbekistan, such a valuable culture as peanuts is of particular importance. Groundnut is the sixth most important oilseed crop in the world. It contains 48–50% oil and 26–28% protein, and is a rich source of dietary fiber, minerals, and vitamins. The aims of this study were to determine the most appropriate fertilizing rate for the soil-climatic condition of Uzbekistan and to investigate the effect of different fertilizing rates on some agronomic traits and yield components of 2 local peanut varieties.

Materials and methods. Field studies were carried out at the experimental station of Tashkent State Agrarian University. The experimental station is located near Tashkent, in the upper part of the Chirchik river, Kibray district of the Tashkent region, at an altitude of 481 m above sea level, 41^0 11^{II} northern latitude and 38^0 31^{II} east longitude. The terrain of the site is uneven, slightly wavy, with a general slope to the Salar canal. Irrigation water was pumped from the Bozsu channel.

Table 1 – The soil characteristics of the experimental area

№	Depth (sm)	Gross content, %				Mobile forms, mg/kg		
		Humus	Nitrogen	Phosphorus	Potassium	$N\text{-}NO_3$	P_2O_5	K_2O
1.	0–30	0.925	0.083	0.152	1.33	4.8	47.1	180.7
2.	30–50	0.715	0.070	0.134	1.30	3.2	40.3	162.0

The soil of the experimental site is long-irrigated sierozem, non-saline, with a low content of humus 0.9–0.7%, nitrogen 0.082–0.066%, phosphorus 0.153–0.139%, potassium 1.33–1.30%.

Field and laboratory methods of research, developed by the Uzbek Research Institute of Plant Production, were used. Phonological observations were conducted according to the "Methodology of the State Variety Testing of Agricultural Crops". Statistical processing of data was carried out according to B. Dospekhov [2]. Application of organic and mineral fertilizers and necessary agro technics on these soils, enable to obtain the high yields of field crops.

Climatic conditions. The climate of Tashkent region, as well as of Uzbekistan in general, has a sharply continental character. Spring comes early: at the beginning of March, the air temperature rises noticeably, although sometimes a sharp cooling occurs. During this period a significant part of the annual precipitation falls. Summer is long, hot and dry.

Table 2. – The climatic conditions during the growing season and long years mean (LEM = 1960–2014)

Month	Mean temperature (°C)				Total rainfall (mm)			
	Long years mean	2012	2013	2014	Long years mean	2012	2013	2014
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
January	0.2	–0.4	3.7	2.6	62.3	276.2	86.7	92.4

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
February	2.4	–1.4	4.9	–3.4	74.5	219.7	65.1	38.7
March	8.0	7.2	11.2	8.9	87.8	232.8	132.3	100.4
April	14.8	19.2	14.9	13.7	71.8	58.1	55.8	70.4
May	20.1	21.3	20.9	23.1	39.9	15.7	8	15.2
June	25.4	26.1	26.2	26.8	12.1	40.3	10.7	7
July	27.2	27.7	27	26.3	4.0	28	0	0
August	25.4	27.5	25.6	26.6	2.5	0	1.7	0
September	20	20.6	22.6	20.7	4.8	0	2.9	1
October	13.7	14.5	14.3	12.7	33.4	4.7	16.5	61.4
November	7.4	6.5	8.2	5.2	55.2	83.6	24.8	76.4
December	2.5	1	4.4	3.1	70.2	50.7	91.6	35.4
Average	**13.9**	**14.1**	**15.3**	**13.9**	**518.5**	**1009.8**	**496.1**	**498.3**

Sometimes precipitation falls in the month of June in the form of rains, but then comes hot and dry weather, usually continuing until late autumn. The maximum air temperature reaches 43 °C in July, sometimes in August.

Results. It was observed that in the years of the experiment, depending on the climatic conditions, field germination period and duration of the field germination of the peanut variety seeds were different. It was established that peanuts are a thermophilic crop. The optimal temperature for the growth and development of this culture is 25–30 °C. At temperatures below 12 °C, no fruit is produced. Usually sprouting of peanuts seeds begins at a temperature of 14–15 °C. In 2012, the variety "Salomat" in the treatment with the use of mineral fertilizers, friendly shoots were formed on April 29–30. After 9–10 days, a friendly growth was observed and, average 50% of plants sprouted.

In the variety "Mumtoz", friendly shoots were observed on May 1–2, and 50% of the plants germinated for 11–12 days.

The phase of flowering, in the variety "Salomat", began 30–32 days after germination, May 30-June 1. It should be noted that the variety "Salomat" is a medium-early variety, therefore, taking into account its biological features, we observed earlier onset of the flowering phase. And in the variety "Mumtoz", the flowering phase began for 37–38 days June 6–7 after germination.

In varieties of peanuts, the difference in the phases of germination was 2–3 days, and in the flowering phase, this difference increased to 6–7 days. The variety "Mumtoz", as its biological characteristic is a late ripe variety, so the flowering phase occurred on June 6–7.

In the control variant, in the "Salomat" and "Mumtoz" varieties, the transition to the phase of bean formation was observed on June 12 and 20. In 2 and 6 variants, where the fertilizer was used in the norm of $N_{100}P_{150}K_{100}$ kg/ha, the delay in the formation of beans with respect to the control was observed for 2–3 days; when using the fertilizer in the norm of $N_{200}P_{150}K_{100}$ kg/ha, in the 4th and 8th variant, the delay in formation beans make of 4 days.

Studies have shown that with increasing doses of nitrogen fertilizers leads to later periods of formation of flowers.

In the variety "Salomat", in the control where fertilizers were not used, research over three years showed that the ripeness phase began on September 6–10, and in the variety "Mumtoz" in variant 5 it began on September 20–25.

According to phonological data, the impact of fertilizers norm was considerable on local peanut maturing period. The use of fertilizers was normal $N_{150}P_{150}K_{100}$ kg / ha and $N_{200}P_{150}K_{100}$ kg/ha in the variety "Salomat" a phase of full ripeness was observed 4–6 days later, that is, September 10–12, than in the control variant. In the Mumtoz variety, in the control version 5, the ripeness phase began on September 20, the use of fertilizer was normal $N_{150}P_{100}K_{100}$ kg/ha and $N_{200}P_{150}K_{100}$ kg/ha, in the 7–8 variant, compared to the 5th variant, the ripeness phase began at 7–8 days later, that is, September 27–28.

When cultivating peanuts, in variants using fertilizers, the effect on yield was observed. The obtained data on fully developed and undeveloped beans (pieces), their ratio (%), yield from one plant (g), peel yield (%), weight of 1000 seeds (g) in the phase of full ripeness, counting plants in the laboratory, Weighing on electronic scales, as well as the calculation of results using by Microsoft Excel are shown in (Table No. 3).

In our experiments, the varieties "Salomat" and "Mumtoz" in the phase of full ripeness, a certain number of plants were collected that were dried under laboratory conditions and the beans were separated from the stalks. In each of the studied varieties of three replications, fully ripened and not ripened number of beans were counted, and their ratio was determined.

Table 3.– Impact of fertilization norms on the development stages of peanut varieties (*in account of date and month*)

№	Rate of mineral fertilizers, kg/ha	Germi-nation	Starting of flowering	Setting of been (pod)	Time of maturity	Active(growing) period
"Salomat" variety						
1.	Control	30.04	01.06	12.06	06.09	129
2.	$N_{100}P_{150}K_{100}$	29.04	30.05	14.06	10.09	134
3.	$N_{150}P_{150}K_{100}$	29.04	01.06	14.06	10.09	134
4.	$N_{200}P_{150}K_{100}$	30.04	01.06	16.06	12.09	135
"Mumtoz" variety						
5.	Control	01.05	06.06	20.06	20.09	142
6.	$N_{100}P_{150}K_{100}$	02.05	07.06	23.06	24.09	145
7.	$N_{150}P_{150}K_{100}$	02.05	07.06	25.06	28.09	149
8.	$N_{200}P_{150}K_{100}$	01.05	06.06	25.06	28.09	150

In control, the lowest yield was taken. During the years of research, the number of ripen and unripen beans was calculated for the "Salomat" variety. It was noted that, on average, 15 beans were formed per plant, 10 of them were ripen and 5 pieces were not ripen, the number of ripened was 68,1%.

In variant 2, when calculating ripe and unripe beans, where fertilizer was used in the norm of $N_{100}P_{150}K_{100}$ kg/ha, on average 21 bean were formed on one plant. Of these, 15 pieces matured, 5 pieces not mature. This accounted for 74.4% of the ripe beans. The highest index was observed in 3.4 variants with the use of fertilizers in the rate of $N_{150}P_{150}K_{100}$ kg/ha and $N_{200}P_{150}K_{100}$ kg/ha. When calculating the ripened and unripen beans, we obtained the following indicators, relative to the control: 12 and 15 pieces of beans were more formed in variants 3 and 4, and also 11 and 13 pieces more ripe, which was 10,9 and 13% more.

Analyzing table 4, we can draw up the following conclusions, with an increase in the rate of fertilizers, $N_{150}P_{150}K_{100}$ kg/ha, in 3 and 7 variants of the varieties "Salomat" and "Mumtoz", on average, 27–29 pieces of beans were formed on a single plant, respectively, of which fully matured amounted to 21–22 units, 79.0–77.9%.

Table 4.– Impact of fertilization norms on biometric parameters of peanut varieties (2012–2014)

№	Rate of mineral fertilizers, kg/ha	Numbers of nuts per plant, *pieces*			Amount matured nuts, *in-%*	Productivity one plant, *in-gr*	Output of kernel, *in-%*
		Riped	Not riped	Total			
"Salomat" variety							
1.	Control	10	5	15	68.1	10.71	66.87
2.	$N_{100}P_{150}K_{100}$	15	5	21	74.4	16.72	69.17
3.	$N_{150}P_{150}K_{100}$	21	6	27	79.0	20.71	72.70
4.	$N_{200}P_{150}K_{100}$	24	6	30	81.1	22.28	75.33
"Mumtoz" variety							
5.	Control	12	5	17	72.0	10.64	68.43
6.	$N_{100}P_{150}K_{100}$	18	6	25	74.4	18.99	70.23
7.	$N_{150}P_{150}K_{100}$	22	6	29	77.9	22.66	74.30
8.	$N_{200}P_{150}K_{100}$	26	6	32	82.1	23.92	75.73

When using fertilizer at the norm $N_{200}P_{150}K_{100}$ kg/ha, the local varieties of peanuts showed the highest biometrics. For example, in the variety "Salomat" with the use of fertilizer in the norm of $N_{200}P_{150}K_{100}$ kg/ha, 30 peanuts were formed on one plant. beans, of which fully matured amount was 24, 81,1%.

In the variety "Mumtoz", when using fertilizers at the rate of $N_{200}P_{150}K_{100}$ kg/ha, in variant 8.32 beans were formed on one plant, 26 of them were ripen which amounted to 82, 1%.

We found that the use of nitrogen fertilizers, with a double feeding, affects the growth, development and yield of plants.

However, in the cultivation of peanuts, it was studied that the use of high doses of fertilizers does not always give positive results.

So, when cultivating the variety "Salomat", with a fertilizer rate of $N_{200}P_{150}K_{100}$ kg/ha, a large amount of vegetative mass was observed, during the full ripeness phase, the soil was over-moistened in September, at the temperature of 20.6–22.7 °C, the first ripe beans sprouted, and this in turn negatively affected the yield.

Table 5. – Impact of fertilization norms on the yield of peanut varieties (dT/ha)

№	Rate of mineral fertilizers, kg/ha	Years			On average 3 years	Extra yield from fertilizers, dT/ha
		2012	2013	2014		
"Salomat" variety						
1.	Control	14.3	12.2	12.7	13.1	–
2.	$N_{100}P_{150}K_{100}$	21.5	19.5	20.1	20.4	7.3
3.	$N_{150}P_{150}K_{100}$	26.7	24.7	25.5	25.6	12.5
4.	$N_{200}P_{150}K_{100}$	28.3	26.6	27.2	27.4	14.3
	NSR_{05} = dT/ha ***NSR_{05} = %***	***0.59 dT/ha*** ***2.59%***	***0.64 dT/ha*** ***3.08%***	***0.73 dT/ha*** ***3.41%***	***0.65 dT/ha*** ***3.03%***	
"Mumtoz" variety						
5.	Control	13.9	12.8	13.4	13.4	–
6.	$N_{100}P_{150}K_{100}$	24.3	23	23.7	23.7	10.3
7.	$N_{150}P_{150}K_{100}$	29.2	27.7	28.5	28.5	15.1
8.	$N_{200}P_{150}K_{100}$	30.6	29.3	30.2	30.0	16.6
	NSR_{05} = dT/ha ***NSR_{05} = %***	***0.54 dT/ha*** ***2.20%***	***0.69 dT/ha*** ***2.97%***	***0.74 dT/ha*** ***3.08%***	***0.66 dT/ha*** ***2.75%***	

Making conclusions that in the cultivation of local varieties "Salomat" and "Mumtoz" we recommend using fertilizer with the norm $N_{150}P_{150}K_{100}$ kg/ha for the variety "Salomat" and for the variety "Mumtoz" with the norm $N_{200}P_{150}K_{100}$ kg/ha.

It should be noted that in the cultivation of local varieties of peanuts, it is necessary to take into account factors such as soil fertility, biological characteristics of varieties, climatic conditions, optimal dates, patterns and norms of sowing, irrigation schemes, the rate and periods of application fertilizers, the degree of weed infestation and pests, terms of harvesting, etc. that affect the growth, development and productivity of plants.

In the control, as in the variety "Salomat" and in the variety "Mumtoz", the lowest yield was observed. A three-year research, in the "Salomat" variety, in the control variant, the yield was 13.1 dT/ha, and in the "Mumtoz" variety, the yield was 13.4 dT/ha.

When using fertilizers in the norm of $N_{100}P_{150}K_{100}$ kg/ha, in both variety with respect to the control, the yield increased up to 7.3 and 10.3 dT/ha. With an increase in the rate of fertilizers to $N_{150}P_{150}K_{100}$ kg/ha the yield were 12.5 and 15.1 dT/ha higher in "Salomat" and "Mumtoz" varieties, respectively, compared to the control

Conclusions. According to the 3 years of field experiments, we came to the following conclusions: increase rate of fertilizers, it does not always lead to positive results. So, when cultivating the "Salomat" variety with the fertilizer rate of $N_{200}P_{150}K_{100}$ kg/ha, there was an increase in the vegetative mass, high soil moisture, at the air temperature of 20.6–22.7 °C, in September, germination of full-grown peanut seeds was observed, and this in it's turn reduced both the yield and quality as well.

In the experiments, the highest yield was observed with the use of fertilizers $N_{200}P_{150}K_{100}$ kg / ha, for the variety "Salomat" it was 27.4 dT/ha and for the variety "Mumtoz" it was 30.0 dT/ha. But it is necessary to take into account that in these varieties during the growing season, the addition of 50 kg of N per hectare reduced the additional yield. For example, the additional yield was slightly decreased in this treatment and estimated to be 1.8 dT/ha, and 1.5 dT/ha in "Salomat" and "Mumtoz" varieties, respectively.

Application the fertilizer norm $N_{200}P_{150}K_{100}$ kg/ha resulted the lowest value of the additional yield. Based on three years of research, we recommend the use of the most optimal rate of fertilizers in the standard $N_{150}P_{150}K_{100}$ kg/ha for the "Salomat" variety and $N_{200}P_{150}K_{100}$ kg/ha for the "Mumtoz" variety.

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Section 10. Technical sciences

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NEW METHODS OF IMPROVING THE DURABILITY OF ROAD CONCRETE AND FERROCONCRETE PRODUCTS

Abstract: The article describes new ways to increase the service life of road concrete and reinforced concrete products of highways. The proposed methods increase the strength and frost resistance of concrete and reinforced concrete products with the action of chloride salts on them.

Keywords: additive, corrosion of concrete, strength reduction, frost resistance of concrete, epoxy compositions, chlorosulfonated polyethylene, adhesion, urea, modifier.

Introduction

The expansion of highway networks in the world, increasing the volume of cargo and passenger transportation, especially when the axle load is 13 tons or more in the composition of the stream, makes us think about building stronger and more durable cement concrete pavements. In addition, concrete and reinforced concrete products are widely used in order to ensure safety, arrangement and construction of artificial structures.

The main reason for the destruction of concrete and reinforced concrete products is the appearance of corrosion due to exposure to chlorides. In this regard, abroad, special attention is paid to preventing corrosion from the effects of aggressive chlorides.

Literature review

Currently, the corrosion of concrete and reinforced concrete is the most urgent problem for transport facilities. Under the conditions of concrete corrosion, the improvement of tasks on the problems of durability and reliability of building structures was studied by such world-wide researchers as M. Akiyama, M. Matsuzaki, D. H. Dang, A. Decò, V. V. Bolotin, L. I. Iosilevsky, V. P. Chirkov, V. O. Osipov, A. A. Potapkin, I. A. Urmanov, V. I. Shesterikov, S. N. Alekseev, V. M. Moskvin, E. A. Antonov, S. S. Gordon et al.

In our country, under the conditions of concrete corrosion, a number of scientists have carried out research in the field of improving issues devoted to the problems of improving the durability of structures. In particular, by the reliability of building structures A.A. Ashrabov, by predicting the resource of spans of reinforced concrete bridges R.K. Mamazhanov, T. Mukumov and N. Z. Saatova conducted research and obtained important positive results.

To date, the processes of corrosion of concrete, the relationship between the corrosion of concrete and reinforcement have been deeply studied, and recommendations have been given for taking them into account in calculations. But at the same time, work to improve the methods of exploited concrete and concrete products is still not resolved. Analysis of the above thoughts shows the lack of recommendations when using local materials in protecting concrete and reinforced concrete products from chloride salts [1].

On the roads of Uzbekistan, mainly technical salt is used, which is mined in the territory of Karakalpakstan, which is currently the cheapest and most effective anti-icing agent.

The laboratory carried out a chemical analysis of salt used on the roads of the Republic (Table 1).

Table 1. – The chemical composition of technical salts [2]

Name of the indicator	The main indicators of salts	
	Belarus, Ukraine	Karakalpakstan
Mass friction of sodium chloride	90.00%	97.11%
Mass friction of calcium – ion	0.80%	0.28%
Mass friction of magnesium – ion	0.80%	0.04%
Mass friction of sulphate	0.20%	0.75%
Mass fraction of insoluble residue in water	3.7%	0.55%
Mass friction of humidity	4.5%	1.27%
Mass friction of calium	no more than 0.01%	–

As can be seen from the (table 1), the salt content of Karakalpakstan contains more sodium chloride, which causes corrosion, than salts used in other countries. The use of salts with a high content of chlorides against ice and a low level of road maintenance can lead to a massive deterioration in the condition of concrete and reinforced concrete products and a decrease in their service life and operational reliability.

The materials and methods of research

In the experiments, glue-composition based on chlorosulfonated polyethylene was used as a protective material, after which a transparent, elastic, glossy film was formed on the surface of the product [3]. The industry of Uzbekistan does not produce this polymer. It is purchased for hard currency. The authors of the invention allow to produce these products from local raw materials in the right quantity for consumers.

This method increases the strength and corrosiveness of products in sulfate environments. However, concrete and reinforced concrete products impregnated in this way are characterized by insufficient frost resistance in chloride salts. Due to the simultaneous action of negative temperature and anti-icing reagent-chloride salts, the road fence blocks are destroyed after 3–5 years of operation, without having served the service life (30–40 years), provided by the manufacturer. As a result, to ensure road safety and an aesthetic point of view, operational road services are forced to replace the destroyed blocks with new ones. This leads to unexpected costs.

Long-term monitoring of the state of the protective coating made it possible to establish that the use of glue - composition significantly increases the corrosion resistance of reinforced concrete products. However, upon receipt of chlorine gas complicates the process. In order to prevent damage to human health and the environment, compliance with relevant standards is required.

In order to eliminate these drawbacks, as well as expand the range of materials, methods have been developed to protect concrete and reinforced concrete products based on chlorosulfonated polyethylene and urea [3], as well as chlorosulfonated polyethylene and polysulfide rubber [3].

The main physicomechanical properties of these composites are given in (table 2).

Table 2. – Basic physical and mechanical properties of the mixture

№	Name of the indicators	Indicators	
		[3]	[4]
1.	Color	mustard	milky
2.	Density, g/cm^3	1.2	1.1
3.	Operating temperature range, °C	(–40) ÷ (+100)	(–40) ÷ (+100)
4.	The degree of elastic recovery,%	90–100	95–110
5.	Resistance to petroleum products	resistive	resistive
6.	Chemical resistance (acids, alkalis, salts)	resistive	resistive
7.	Water resistance	great	great
8.	Wear resistance	great	great
9.	UV Resistance	great	great
10.	Mushroom resistance	great	great
11.	Corrosion Resistance	great	great
12.	Adhesion score	1	1

The method is as follows. After a set of concrete and reinforced concrete products of grade strength, a surface is applied onto the surface prepared and impregnated with glycerin on the surface-compositions based on chlorosulfonated

polyethylene and modifier or chlorosulfonated polyethylene and urea. Preliminary surface preparation consists in removing irregularities and protrusions. In the presence of small sinks and dimples, they are leveled by grouting with a cement-sand mortar, then it is mechanically cleaned.

Results of the research

In contrast to the three-layer glycerin coating, which cracks when cracking in concrete and reinforced concrete structures due to shrinkage, temperature and other deformations, coatings based on chlorosulfonated polyethylene, epoxy resin and polysulfide rubber and chlorosulfonated polyethylene and urea, having a greater elasticity can withstand cracking size 0.2–0.3 mm. The strength and frost resistance of the impregnated samples are given in (table 3).

Table 3. – Strength and cold resistance of impregnated samples

№	The name of the indicators	Sample rates			
		Impregnated with glycerin and composition consumption, kg/м²			
		0.8	0.9	0.8	0.9
		[3]		[4]	
1.	Compressive resistance, MPa	385	400	390	400
2.	Bending resistance, MPa	6.1	7.3	5.9	7.1
3.	Frost resistance according to the second base method, cycle	275	285	280	290

Thus, the combination of features in the proposed methods allowed to obtain a positive effect, namely, that concrete and reinforced concrete products impregnated with glycerin and subsequent impregnation with a composition of chlorosulfonated polyethylene and urea, chlorosulfonated polyethylene and polysulfide rubber increase the strength and frost resistance in chloride salts.

Conclusion

These methods help to increase the service life of concrete and concrete products, significantly reduces operating costs.

Economic efficiency of the proposed development is achieved by increasing the service life of concrete and concrete products, reducing operating costs, import substitution and saving hard currency.

In the future, measures are envisaged for the implementation of this development on the objects of roads and railways in various areas of the national economy.

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RESEARCHES ON DEVELOPMENT GRAIN GRINDER-CRUSHER FOR SMALL FARMERS

Abstract: In Uzbekistan the cattle is being fed by private or peasantry farms, farmers and other types of agricultural organizations. There is no any grain grinder for farmers who have a few numbers of the cattle. Therefore, the small grain grinder-crusher was developed for them.

Keywords: livestock-breeding, grinder-crusher, work quality indicators.

In Uzbekistan productions of agriculture and cattle are mainly being produced by farmers and peasants. Therefore, it is being paid great attention to produce new technics and technologies for these farms and many actions have been carrying out [1; 2; 3; 4; 5].

The livestock-breeding is one of the important branches of agriculture of Uzbekistan. One of the particular aspects of cattle branch of Uzbekistan is the organizing the cattle branch in peasant or private house farms that have less number of cattle and mini producing power.

This method is servicing not only increasing the volume of producing, but also, it is servicing to employee the population too. Nowadays, in our Republic 88,1 per cent of the total cattle are being fed in peasant or private house farms.

Although livestock-rising is developing in peasant or private house farms. In these farms many operations such as feeding them, forage preparing are still being done by manual labor. Because, farms have no mini equipment and implements for rising cattle and forage preparing.

According to above observed analysis, it was aimed that to develop mini equipment which is used for preparing forage in peasant and private assistant farms and also basing its parameters that provide work-quality according to defined requirement.

The analyzing of present equipments showed that, the total defect of rotor grinder and their work organs might be illustrated that they work at high rotation number, therefore they demand high energy and the balance of the work organs is broken down very fast. Almost all of the produced hammer grinder-crusher machines were adapted to grind and crush straightly.

According to situation of issue and analyze of the done researches until today the above written defect of the hummer grinder-crusher equipment may be arranged by influencing to the grinding grain step by step, namely the supposition was guessed that at first grain is ground, then it is crushed. For this idea the particular grinder should be created, that must break the grain at particular sizes, so it should be provided that grinding, then the ground grain should be crushed according to present requirement and come out. For this, the particular the first part of the grinder rotor should grind the grain, and the second part should crush the grain that ground and it should send the ready ground forage to the out side.

Depending on above written, we carried out researches on development the small sized grain grinder-crusher for farmers and peasantry farms that satisfies its work efficiency and price, it can answer to the present days requirements with together "Navai manufacturer plant".

As a result of the researches the constructive and technological scheme of the small sized grain grinder-crusher, the first requirement for preparing first sample and technical task were developed also according to them the constructive schemes of the equipment were prepared.

Thus it should be noted that, the three sized view of the grain grinder-crusher (fig. 1) and its constructive schemes were drawn by the special modern technologies on the program "COMPAS".

This gives opportunity the automatization completely to project the equipment and make its some mechanisms, serviced to make easy and fast of work that was done.

The experimental sample of the grain grinder-crusher was created according to its constructive scheme. The length of the grain grinder-crusher is 610 mm, its width is 390 mm, the height is 750 mm, the constructive weight is 150 ± 10 kg, and it consists of two grinding parts. The diameter of the both parts is equal to 300 mm. the diameter of the rotor is 295 mm, the rotation number is 2950 rpm.

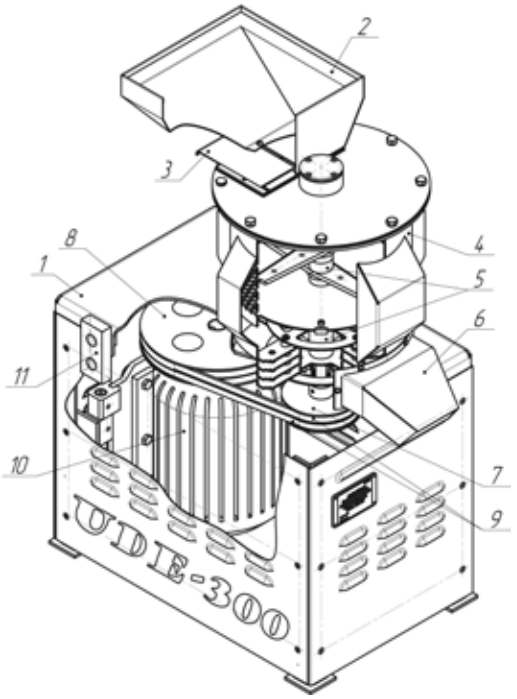

Figure 1. Three sized view of the grain grinder-crusher;
1 – frame, 2 – bunker, 3 – measuring bar, 4 – grinding part, 5 – grinding rotor,
6 – unloader spout, 7 and 8 – augers, 9 – belt, 10 – electric motor, 11 – switcher button

The grinder bars are installed on rotor in the first grinding part, their numbers are 2 pieces, and width is 50 mm, thickness 6 mm. In the second grinding part the small grinder hammers are installed with hinges on rotor, their numbers are 16 pieces and thickness is equal to 3 mm. The experimental-testing was carried out for purpose of defining the work capacity of the developed grinder-crusher. Nowadays, the grain of the corn and its cob are used considerably to feed cattle animals, that is why the corn was used as grinding material during the experiment.

According to results that were taken from prime experimental-test the first data was achieved on work quality indicators (look at the table).

Experiments showed that, when the grain of the corn moved through the first grinding part of the grinding-crusher, the grinding level of the grain was that, namely the ground grain that up to 2 mm organized 22.9 per cent, between 2–3 mm was 46.4 per cent, and more than 3 mm was equal to 30.7 per cent.

When the ground materials with exactly these indicators were moved through the second grinding part the indexes were equal to 89.3 per cent, 7.5 per cent and 3.2 per cent.

When the corncob was ground in grinder-crusher, its grinding level was much differently.

Table 1. – Work quality indicators of the grain grinder-crusher

№	Component of the ground mass	Grinding level, %	
		grain of the corn	ear of the corn
1.	**during the first passing:**		
	up to 2 mm	22.9	18.2
	between 2–3 mm	46.4	23.6
	more than 3 mm	30.7	58.2
2.	**during the second passing:**		
	up to 2 mm	89.3	74.4
	between 2–3 mm	7.5	19.8
	more than 3 mm	3.2	5.8

For instance, when the ear of the corn passed trough first grinding part of the grinder-crusher, the components that up to 2 mm organized 18.2 per cent, between 2–3 mm mass made up 23.6 per cent, and mass that is more than

3 mm made up 58.2 per cent. The production which was ground first in first grinding part of the grinder-crusher was passed through the second part of the grinder-crusher, after that in the component of the ground forage the quantity of the mass up to 2 mm increased significantly and reached to 74.4 per cent. The component of the forage that between 2–3 mm decreased slightly and it was equal to 19.8 per cent, the part that more than 3 mm went down dramatically and made up 5.8 per cent.

The grinding level of the ear corn increased dramatically during the second treatment, but in the second step their grinding level was coarser than grinding level of the grain. Also for smaller grinding the grain it was achieved only after treatment in the second part of the grinder-crusher.

According to results of the prime experimental-testing of the developed grinder-crusher the quality level of the forage production that was ground by grinder-crusher was defined by feeding the cows, horned cattle that was more than 1 years old and sheep. However, for young lamb and calf the forage has to be ground considerably smaller and it should be mixed with easy digester forage.

Depending on results the first experimental-testing of the grain grinder-crusher, in some farms its main experiments were tested. Thus, the ear corn and its grain, the grain of the wheat and barley were ground, tested and its work indicators were defined.

After grinding the ear corn, when its grain was ground, grinding efficiency was 99.6 per cent, crushing efficiency was 98.4 per cent, the work efficiency in the real work period was 172,5 kg/hour, spending energy was equal to average 3.6 kW. It can be seen that, the work indicators increased more when the grain of the corn was ground than its ear was ground, but spending the energy increased to 28 per cent.

The much better indicators of the grinder-crusher were determined when the grain of the wheat was ground. According to result the grinding efficiency was equal to 99.8 per cent, crushing efficiency was 99.1 per cent, the work efficiency in the real work period made up 185.8 kg/hour and spending the energy was less than grinding the grain of the corn, it was demanded average 3.2 kW. Also, the grain grinder-crusher could work without any difficultness.

Like this easy working was defined by the grain of barley. The work quality indicators of the grinder-crusher on grinding efficiency was 99.5 per cent, crushing efficiency was 98.7 per cent and its work efficiency was less than grinding the grain of the wheat it was equal to 157.0 kg/hour, spending the energy was 3.3 kW.

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INFLUENCE OF THE CONNECTING SUBSTANSES ON PROCESS OF IMPROVEMENT OF PRODUCTION TEXNOLOGY OF THE GRANULATED COMPOUND FEEDS

Abstract: By production of granulate compound feeds so-called binding agents which enter not only for increase in durability of granules, but also for reduction of a steam rate, energy, increase in efficiency are important. As such substances use most often fluid products, such as fat, hydrol, molasses, etc., and powdery – bentonites. Influence of binders and ways of processing on physicotechnological properties and on process of a pelletizing of compound feeds is investigated. By researches it is established that bentonitic clay and girasol flour are dispersible fodder products, having high water-absorbing properties and good flowability. Input in the granulated formula-feed mix in number of 4–6% of a binder with hashing by cold water, improves process of a pelletizing and quality of granules, reduces power consumption a little and allows to produce granulate compound feeds without use of steam and warm water. At increase in distribution of sizes of raw materials and a fat in compound feeds the crumbs of granules increases. Qualitative characteristics of forage, improvement of the production technology of the granulated compound feeds are revealed.

Keywords: Binders, properties, granulation, process, improvement, forage.

Recently in the formula-feed industry requirements to quality of compound feeds, improvement of technology continuously raise, the nomenclature of raw materials, the product range extends [1].

Are important by production of the granulated compound feeds so-called binding substances which enter not only for increase in durability of granules, but also for reduction of a consumption of steam, energy, increase in productivity. As such substances use most often liquid products, such as fat, гидрол, molasses, etc., and powdery – bentonites. Some of the listed substances increase nutritional value of compound feeds (fat, molasses), enrich compound feeds with minerals (bentonites). The amount of the added binding substances is usually small – to 5%. However for birds it is recommended to enter a large amount of fat into recipes of some compound feeds – to 6%. The fat entered in number of more than 3' by% stops being a binding component. Moreover, at input of bigger amount of fat productivity of a press and durability of granules decrease. Use of other binding substance, for example bentonite is in that case possible that allows to improve compound feed granulation process. The mineral additive having binding ability – bentonite – is binding substance at granulation of compound feeds and adsorbent. [2; 3].

According to the Internet [4], one of important features of a girasol is its balance on micro and macroelement structure. The girasol, thanks to exclusive biochemical structure and big elevated biomass, becomes one of the most popular raw cultures by production and granulation of compound feeds [5].

Recently on the basis of a girasol are made and various dietary supplements are widely applied. Their value and popularity among the population is proved.

Thus, bentonites and a girasol is important and perspective types of nonconventional raw materials at improvement and production of compound feeds in our country.

One of progressive technologies of preparation of forages is production of granules from various feeds. Such type of a forage allows to balance it on components, to improve quality and to reduce losses [1; 2].

Fierce competition among producers of finished goods for sales market demands from the enterprises of improvement of technology, production of high-quality compound feeds. Research of additional opportunities for improvement of the existing production which doesn't demand big capital expenditure for work and has small payback periods is especially important [6; 7].

Some researchers consider that thanks to high temperature and moistening when steaming and pressing the nutritiousness of compound feed owing to a dekstrinization of starch and a partial denaturation of proteins increases. Many researches demonstrate higher nutritional value of the

granulated compound feeds and also its bacterial impurity considerably decreases. Granules have the cylindrical form, their size depends on a look and age of animals [6; 7; 8].

2. Methods and technique of researches

In compound feeds defined a mass fraction of moisture, solids, volume mass and a corner of a natural slope, etc. according to the existing normative documents.

The volume mass and corner of a natural slope of raw materials and finished goods were determined according to GOST 28254–89. Compound feeds, raw materials. Methods of determination of volume weight and corner of a natural slope.

The humidity of raw materials and finished goods defined according to GOST 13496.3–92. Compound feeds, formula-feed raw materials. Moisture definition methods. Mass fraction of moisture W,%. calculated on a formula

$$W = \frac{(m_1 - m_2)^* 100}{m_1 - m}; \qquad (2.1)$$

where m_1 – the mass of a byuksa with a hinge plate before drying;

m_2 – the mass of a byuksa with a hinge plate after drying and cooling;

m – Weight, empty byuksa.

Fineness of grind of nonconventional raw materials and finished goods defined according to GOST 13496.8–72. Compound feeds. Methods of determination of fineness of grind [9].

Mass fraction of the rest on sieve Hkr,%, calculated on a formula

$$X_{kp} = \frac{m_1{}^* 100}{m}, \qquad (2.2)$$

where m1 – the mass of the rest on a sieve;

m – the mass of a hinge plate of the analyzed product,

The crumbs of granules of finished goods was defined according to GOST of Compound feed. Hkr,%, calculated on a formula

$$X_{kp} = \frac{a - b}{100 - a}, \qquad (2.3)$$

where a – quantity of the destroyed granules after processing in the device,%; b – quantity of the destroyed granules in the tested compound feed,%;

m – the mass of a hinge plate of the analyzed product,

3. Results of researches

Granulation process significantly influences change of structural and mechanical properties of loose compound feed. Besides, the received compound feed gains new properties and the best indicators of nutritiousness. Process of granulation exerts positive impact on change of physical and chemical properties of a cage. Besides, temperature increase favorably influences release of fat from fatty cages of components of compound feeds (cakes, cakes, etc.), reduces viscosity of the fat which is evenly enveloping a warm and damp surface of particles of compound feed. For studying of physicotechnological properties of compound feeds the granulated compound feeds from a consignment of loose compound feeds according to recipes for young growth and KRS are produced.

The prepared compound feeds have been subjected to granulation on the laboratory granulator with a matrix of 5 and 10 mm. (productivity is from 300 to 650 kg\h). Process of granulation of compound feeds was carried out in the dry and damp way (steam, warm and cold water) with use of the laboratory granulator with a matrix with a diameter of 5 and 10 mm at various preliminary processing.

Key indicator of quality of the granulated compound feeds is their durability. Durability of granules was determined by attrition and further sifting on sets.

Further are shown change of physicotechnological properties of the granulated compound feeds (KS-1 for MKRS) and (KC-2 for KRS) depending on input of bentonite and a girasol in number from 0 to 8% with use of steam, warm and cold water it is shown in (tables 1).

Change of the physicist – technological properties of the granulated compound feeds (KS-1 for MKRS) and (KC-2 for KRS) depending on input of bentonite and a girasol from 0–8%.

Results of granulation about the ferry.

Table 1.

result	Percent of input of bentonite and flour of a girasol,% (in a ratio 1:1)							
	0	3	5	8	0	3	5	8
	Diameter of openings of a matrix, mm							
	5 (For KRS young growth *)				10 (For KRS)			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
The humidity is initial,%	10.6	10.3	10.0	9.2	10.5	10.4	10.03	8.9
Volume weight, g/l	454	507.0	512	518	455	500.0	521.0	532.0
Corner of a natural slope, 0	29	30	35	39	30.2	31.10	34.0	39.0
Humidity of the steamed mix,%	12.24	12.03	12.60	12.0	12.1	12.02	12.9	12.7
Kroshimost,%	5.3	5.47	4.8	4.75	5.8	5.6	5.0	5.4

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Temperature of granules, 0C	51	53	56	57	52	52	55	58
Pass sieve of 2 mm,%	0.6	0.53	0.40	0.35	0.51	0.5	0.3	0.1
Productivity, kg \hour	390	393	425	422	430	438	445	440

** – when using shelushenny barley in recipes of compound feeds*

At granulation steam and with input of bentonite clay and girasol flour from 0–8% physicotechnological properties of loose compound feeds have changed. Has a little decreased humidity 1 option from 10.6 to 10%, volume weight with 504 to 518, a kroshimost I have decreased with 5.3 to 4.75, and in the 2nd option humidity from 10.5 to 10.03%, volume weight has raised according to 455 to 532, a kroshimost I have decreased with 5.8 to 5.4. A corner of a natural slope 1 option with 29 to 39 and in the 2nd option 30 to 39. The best technological properties input of bentonite clay and girasol flour up to 5% had, and his increase up to 8% flowability I have worsened, and a kroshimost has increased.

Change of the physicist – technological properties of the granulated compound feeds (KS-1 for MKRS) and (KC-2 for KRS) depending on input of bentonite and a girasol from 0–8%.

Results of granulation by cold water

Table 2.

result	**Percent of input of bentonite and flour of a girasol,% (in a ratio 1:1)**							
	0	**3**	**5**	**8**	**0**	**3**	**5**	**8**
	Diameter of openings of a matrix, mm							
	5 (For KRS young growth *)				**10 (For KRS)**			
The humidity is initial,%	10.6	10.3	10.0	9.2	10.5	10.4	10.03	8.9
Volume weight, g/l	454	470.0	518	520	455	518.0	525.0	532.0
Corner of a natural slope, 0	29	30	34	37	30.2	32.10	35.0	36.0
Humidity of the steamed mix,%	14.24	14.03	14.60	15.0	14.1	14.02	14.49	14.4
Kroshimost,%	4.7	4.65	4.6	4.65	4.8	4.76	4.7	4.75
Temperature of granules, ° C	23	35	36	40	23	35	38	48
Pass sieve of 2 mm,%	6.6	6.3	5.10	5.5	8.1	7.5	5.3	6.1
Productivity, kg/hour	490	495	505	502	460	478	485	470

** – when using shelushenny barley in recipes of compound feeds*

At granulation by cold water and with input of bentonite clay and girasol flour from 0–8% physicotechnological properties of loose compound feeds have changed. Has a little decreased humidity 1 option from 10.6 to 10%, volume weight with 554 to 518, a kroshimost I have decreased with 4.7 to 4.65, and in the 2nd option humidity from 10.5 to 8.9%, volume weight has raised according to 455 to 532, a kroshimost I have decreased from 4.8 to 4.75 Corner of a natural slope 1 option with 29 on 37 and in the 2nd option 30–36. The best technological properties input of bentonite clay and girasol flour up to 5% had, and his increase up to 8% flowability I have worsened, and a kroshimost has increased.

Change of physicotechnological properties of the granulated compound feeds (KS-1 for MKRS) and (KC-2 for KRS) depending on input of bentonite and a girasol from 0–8%.

Results of granulation by warm water

Table 3.

result	**Percent of input of bentonite and flour of a girasol,%(in a ratio 1:1)**							
	0	**3**	**5**	**8**	**0**	**3**	**5**	**8**
	Diameter of openings of a matrix, mm							
	5 (For KRS young growth *)				**10 (For KRS)**			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
The humidity is initial,%	10.6	10.3	10.10	9.2	10.5	10.4	10.03	10.0
Volume weight, g/l	454	517.0	519	521	455	520.0	525.0	530.0
Corner of a natural slope, 0	29	32	33	36	30.2	33.10	34.0	35.0

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Humidity of the steamed mix,%	14.24	14.03	14.6	14.0	14.1	14.02	14.9	13.7
Kroshimost,%	6.7	6.5	6.4	6.75	6.8	6.76	6.7	6.87
Temperature of granules, ° C	31	36	39	40	32	36	40	41
Pass sieve of 2 mm,%	6.0	5.13	4.60	4.75	7.1	6.5	4.7	6.1
Productivity, kg \hour	480	491	505	502	430	448	465	440

** – when using shelushenny barley in recipes of compound feeds*

At granulation by warm water and with input of bentonite clay and girasol flour from 0–8% physicotechnological properties of loose compound feeds have changed. Has a little decreased humidity 1 option from 10.6 to 10.1%, volume weight with 454 to 521, a kroshimost I have decreased with 6.7 to 6.4, and in the 2nd option humidity from 10.5 to 10.0%, volume weight has raised according to 455 to 530, a kroshimost I have decreased with 6.7 to 6.4. The corner of a natural slope 1 option has increased with 29 on 36, and in the 2nd option with 30.2 to 35. The best technological properties input of bentonite clay and girasol flour up to 5% had, and his increase up to 8% flowability I have worsened, and a kroshimost has increased.

Conclusions:

On the basis of the obtained experimental data of production of compound feeds with use of binding substances in the granulated look, it is proved by a number of their advantages before loose compound feeds: granules have higher fodder value, the best physicotechnological properties, losses at transportation and storage decrease. Thus, by researches it is established that bentonite clay and girasol flour are disperse fodder products, having high hygroscopic properties and good flowability. Input in the granulated formula-feed mix in number of 4–6% of the connecting substance with hashing by cold water, improves process of granulation and quality of granules, reduces power consumption a little and allows to produce the granulated compound feeds without use of steam and warm water. At increase in particle size distribution of raw materials and cellulose in compound feeds the kroshimost of granules increases. Further pilot studies will continue.

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STUDY OF PAVING BITUMENS PROPERTIES MODIFIED BY COMBINED ADDITIVES

Abstract: In this article, the effect of combined modification of road bitumens on complex properties of the composition is considered. The increase in the softening temperature and the physical and mechanical properties showed an optimal modifier content.

The effect of combined modification of paving bitumen on the complex properties of the composition is analyzed. The increase in softening temperature, physical and mechanical properties is shown and establishes the optimal content of the modifier.

Keywords: bitumen, non-standard, composition, modifier, recycled rubber, crumb, technology, paving bitumen.

Introduction. Use of recycled materials as well as fuel and energy resources is of crucial importance in the creation and improvement of existing road-building composite materials and technologies [1].

Today, the research in improving the quality and durability of pavement surfacing is focused on modification of bitumens by using various additives to improve the basic properties of asphalt homogeneity, strength, resistance to frost, cracking, moisture and high temperatures [2].

This article presents the results of studies on the modification of the properties of paving bitumen with combined additives obtained on the basis of recycled rubber and gas-pyrolysis resin.

Subjects and methods of research. Modified BND (Petroleum paving bitumen) 60/90 paving bitumen with combined additives in the following mass ratios: recycled rubber (R) to gas-pyrolysis resin (GPR): 1.5:1; 2:1; 2.5:1, and BND 40/60 paving bitumen to ensure quality of BND 60/90 bitumen grade – with high gas-pyrolysis resin content combined additives in the following mass ratios (R: GPR): 3:1; 4:1.

Studies of the properties of bitumen were carried out in accordance with the following GOSTs: GOST 11507–08 "Petroleum bitumen. Method for determination of Fraas break point" using the ATH-20 (АТХ-20 – automatic apparatus for determining the breaking point of petroleum bitumen) device; GOST 11505–75 "Petroleum bitumens. Method for determination of ductility" using DB-2M (ДБ-2М) ductilometer; GOST 11506–73 "Petroleum bitumen. The method of the determination of softening point by ring and ball" using KISH-20 (КИШ-20 – automatic apparatus for determining the softening point of petroleum bitumen and bituminous materials); GOST 11501–78 "Petroleum bitumens. Method for determination of depth of needle penetration" using the penetrometer PN-10 (ПН-10).

Results and discussion. Tables 1 and 2 show the quality data of the modified bitumen. The analysis of the quality data of the modified bitumen has established that modifying the BND 90/130 bitumen with the additives obtained allows us to improve its quality of almost all of its parameters.

The softening temperature and the breaking point temperature of modified bitumens increase, high values of penetration are achieved at 0 °C, and the values of softening temperature and weight loss of bitumens after heating are improved. Adhesive properties of bitumen modified with a combined additive (R + GPR) in a mass ratio of components in it 1.5: 1.0 and 2: 1. BND 60/90 bitumen, modified with combined additives, had higher values of quality parameters compared to the requirements of the standard. The resulting combined additives contain

crumb rubber, which forms an independent dispersed phase in bitumen, which can affect the sedimentation stability of binders during operation, transportation and storage. Therefore, for modified bitumen, the dependency of the stability factor (Figure 1) and the particle sizes of the dispersed phase (Figure 2) on the content of the combined additives were investigated.

Table 1. – The quality data of BND 90/130 paving bitumen, modified with combined additives, obtained on the basis of recycled rubber and gas-pyrolysis resin

Additive ratio,% mass	Temperature, °C		Penetration, 0.1mm		Heating mass change ratio,% mass.	Heating softening temperature change, °C	Adhesion
	softening	breaking	at 0 °C	at 25 °C			
0	45	–35	27	79	0.80	6	3
Crumb rubber: gas-pyrolysis resin = 1.5:1.0							
2	52	–31	33	79	0.60	3	2
4	63	–25	33	80	0.65	3	2
6	78	–26	35	81	0.65	3	2
8	89	–23	35	81	0.70	4	2
Crumb rubber: gas-pyrolysis resin = 2.0:1.0							
2	54	–27	32	79	0.60	3	2
4	69	–29	39	82	0.70	3	2
6	84	–27	39	83	0.70	4	2
8	94	–28	35	84	0.80	4	2
Crumb rubber: gas-pyrolysis resin = 3.0:1.0							
2	53	–35	29	79	0.60	3	3
4	68	–33	26	82	0.70	4	3
6	82	–33	25	83	0.80	5	3
8	86	–41	26	83	0.80	5	3

Table 2. – The quality data of BND 60/90 paving bitumen, modified with combined additives, obtained on the basis of recycled rubber and gas-pyrolysis resin

Additive ratio,% mass	Temperature, °C		Penetration, 0.1mm		Penetration index	Adhesion
	softening	breaking	at 0 °C	at 25 °C		
0	55	–11	60	24	0.50	3
Crumb rubber: gas-pyrolysis resin = 3:1.5						
2.2	55	–12	64	64	0.49	2
4.9	65	–14	70	70	0.18	2
7.0	79	–15	72	70	0.11	1
8.9	91	–17	84	74	0.20	1
10.7	88	–17	89	80	0.15	1
11.8	86	–19	88	80	-0.08	2
12.8	80	–20	82	80	0.07	2
Crumb rubber: gas-pyrolysis resin = 4:2						
2.4	55	–13	58	58	0.35	2
4.8	67	–15	68	67	0.19	2
6.5	89	–14	90	88	0.27	1
9.0	88	–13	90	87	0.52	1
10.5	72	–17	94	88	0.12	1
11.1	68	–19	92	86	0.01	2
13.0	60	–17	92	86	0.36	2

From the obtained dependencies it was found that with an increase in the content of the combined additive, 1.5: 1.0 and 2:1, the stability factor of bitumen and the size of the particles of its dispersed phase increase. Apparently, this is due to the

increase in the intermolecular interaction forces between the dispersed phase, also formed by large rubber aggregates and the dispersion medium of bitumen at a given ratio of components in the combined additive. With the introduction of a combined additive in bitumen with a mass ratio of components (R + GPR) = 3.0:1.0 in an amount of more than 1% mass, the stability of the system decreases, and the particle size of the dispersed phase has a maximum value with the introduction of 4% mass supplements. This is apparently due to the formation of a coarse-dispersed system due to the increased content of aggregates of rubber crumb in the volume of bitumen.

According to the dependencies shown in the figures, the best composition of the combined additive was established (mass ratio R: GPR = 1.5:1) and its content in bitumen (2–4% mass) in order to obtain thermodynamically stable systems.

The results presented in Table 3 demonstrate the feasibility of using bitumen modified with combined additives (R + GPR) as binders for asphalt concrete mixtures. Asphalt concrete complied with the requirements of GOST 9128–97 in all major quality parameters, and the strength properties and water resistance of asphalt concrete improved significantly.

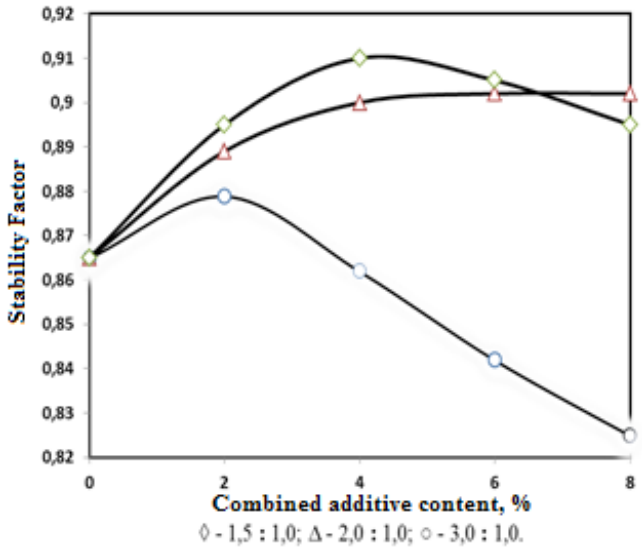

Figure 1. Stability factor of bitumen modified with combined additives (R+GPR)

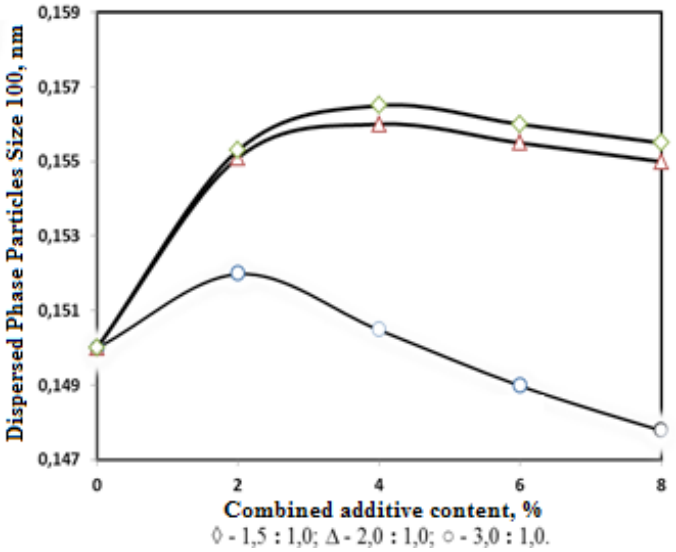

Figure 2. Particle size of the dispersed phase of bitumen modified with combined additives (R+GPR)

Modified 2% mass combined additive consisting of gas-pyrolysis resin in a mass ratio of 1.5:1.0 can be recommended as a binder for asphalt bitumen for practical use. The compounding technology of bitumens with a combined additive (R + GPR) allows to improve the properties of low-quality oxidized paving bitumens with the help of cheap elastomeric modifiers (rubber crump), to obtain bitum rubber binders, in which rubber does not decompose, but is evenly distributed in the dispersion medium of bitumen and exhibits its high operational properties in the composition of the new composite material.

Table 3. – The quality of asphalt concrete, obtained on the basis of bitumen, modified with combined additives on the basis of rubber crump and heavy pyrolysis resin

Parameter	Basic bitumen	Modifier		
		1% mass R + PR1.5:1.0	2% mass R + PR1.5:1.0	7% mass R+PR1.5:1.0
Compressive strength at 50 °C, MPa	0.9	1.0	1.0	0.9
Compressive strength at temperature 20 °C, MPa	2.4	3.2	3.4	2.9
Crack resistance at splitting ductility strength, 0 °C	4.1	4.2	3.7	3.2
Water resistance, not less	0.78	0.90	0.95	0.90
Water saturation,%, volume	2.0	3.1	2.9	3.2

The results of research of improvement methods of the quality of BND 60/90 paving bitumen, obtained from paraffin tar from the Fergana oil refinery by combined additive. Table 4 presents the main quality parameters of modified bitumen with a combined additive obtained on the basis of rubber crump and gas-pyrolysis resin at a 2:1 ratio by mass. This ratio of the components in the additive has been selected with the aim of addition of aromatic compounds in the basic bitumen. The research has shown that the obtained modified bitumens had higher values of softening temperature and adhesion index, and the breaking point temperature satisfied the technical requierments.

Table 4. – The quality data of bitumen obtained by oxidation of tar of the Fergana oil refinery, modified with a combined additive (rubber crump and gas-pyrolysis resin in a mass ratio of 2:1)

Additive ratio, % mass	**Temperature, °C**		**Penetration, 0.1mm**		**Heating mass change ratio,% mass.**	**Heating softening temperature change, 0°C**	**Adhesion**	**Plastic range, 0 °C**
	Softening	**Breaking**	**at 0 °C**	**at 25 °C**				
0	44	–36	56	90	0.90	4	3	79.9
1	58	–27	55	75	0.90	4	2	75.1
2	67	–29	53	78	0.90	3	2	76.3
3	78	–27	54	80	0.95	3	2	74.8
4	88	–26	56	79	1.00	3	2	74.1
5	89	–23	57	80	1.10	4	2	71.9
7	89	–24	57	82	1.20	4	2	72.4

Conclusion. The research results indicate the possibility of adjusting the basic quality of unbalanced or non-standard bitumens with a combined additive based on crump rubber and gas-pyrolysis resin for the production of various bitumens.

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SIMULATION OF THE PROCESS OF ONE-DIMENSIONAL MOTION IN FULL SUBMERGED COCOON IN AN AQUEOUS MEDIUM

Abstract: The article presents the results of an analysis of the motion of a submerged cocoon in the process of winding an elastic thread on a reel in a viscous medium. A model of a completely submerged cocoon is considered, which moves vertically upward in an aquatic environment.

Keywords: raw materials, silkworm breeding, cocoon, deformation, Kinematic scheme.

Cocoons are bodies of various shapes (an ellipsoid, two spheres with a hyperboloid of rotation that unites them into a single body), the envelope of which consists of fibroin (silk) threads of a silkworm (or silkworm) glued together with sericin and densely packed in a strong system that protects the pupa from External influences, allowing it to breathe and develop into a butterfly.

The density of the shell and pupae is higher than the density of water (up to 1.2 kg/dm^2), but the air inside the cocoon makes its average density much less than the water density so that the dry cocoons possess high buoyancy.

When the cocoons are smeared, sericin is partially removed (digested) from the shell and water enters the cocoon volume, pushing out air from there. In connection with this, the bulk density of the cocoon increases, tending, in the limit, to a value exceeding unity, since the density of the fiber and the pupa is certainly greater than unity.

In the absence of external forces, the cocoon immersed in the aquatic environment is in a state of equilibrium under the action of the gravitational force of the buoyancy force of Archimedes.

Let us study the process of winding an elastic thread on a reel that is unwound from the surface of the cocoon. In this case, the cocoon is immersed in a viscous medium and makes a vertical movement in it (Fig. 1).

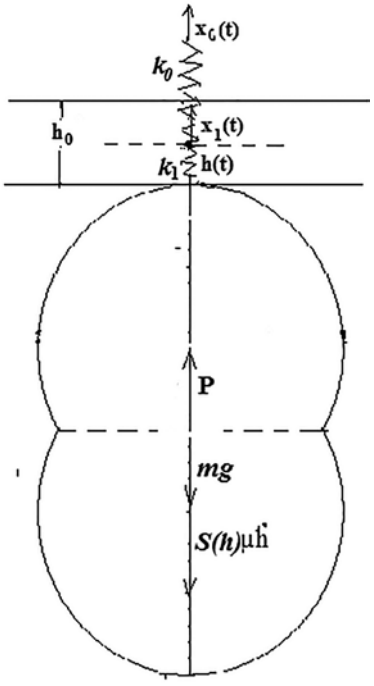

Fig. 1. The scheme of the action of external and elastic forces on the cocoon

We believe that the filament from the surface of the cocoon descends continuously, and the contact of the thread with the cocoon takes place through the elastic element. The upper end of the element makes movement according to the law and is conjugated to a segment of a deformable filament

moving with the reel according to the law. We replace the segment deformed by an elastic element with a stiffness coefficient (– Young's modulus of filament,– the cross-sectional area and the length of the filament). We also denote by the stiffness coefficient of the connection of the yarn with the cocoon converging from the surface. The equation of equilibrium at the conjugation point of two elastic elements is written

$$[k_1(x_1(t)-h(t)]-k_0[x_0(t)-x_1(t)]=0$$

From where we determine the displacement of the end of the elastic element

$$x_1=\frac{k_0}{k_0+k_1}x_0(t)$$

The coefficient of elasticity of the bond k1 of the yarn with the cocoon depends on the degree of wetting by its aqueous medium and determines the degree of fixation of the converging thread to the surface of the cocoon. During the removal process, continuous filament removal takes place and by the poet this coefficient in the general case is a function of the difference by moving the lower end of the wound and moving the cocoon. The form of this function is determined experimentally. To simplify the problem, we assume that the binding force of the filament to the surface of the cocoon varies periodically, at the initial instant of time this force reaches a maximum value, then, as a result of sericin dissolution, the process of continuous separation of the filament from the cocoon surface takes place and the resistance decreases to a minimum $k_1 = K$ min at time $t = tpr$ and again increases to the maximum. Such a pattern of variation of the coefficient k_1 in time, for example, can be represented by the formula

$$k_1=k_1(t)=(k_{\max}-k_{\min})(1+\cos\pi t/t_{np})/2+k_{\min} \qquad (1)$$

Here the values, and can be determined by experience.

Until the start of winding, we assume that the cocoon immersed in the liquid medium is in static equilibrium.

Taking the cocoon as an ellipsoid of rotation, we consider the case when the cocoon occupies a vertical position in the aquatic environment, and its upper point is at a depth from the surface of the water (Fig. 1)

We believe that the cocoon is acted upon by the force of weight (the cocoon mass), the buoyancy force and the elastic contact force of the cocoon with the end of the thread as a result of the removal of the product from the cocoon surface and the viscous friction force proportional to the speed of the cocoon. Denote by moving the center of the cocoon.

Then the equations of motion of the cocoon in an aqueous medium under the action of the above forces are written in the form

$$m\ddot{h}=k_1(t)\frac{k_0}{k_0+k_1(t)}[x_0(t)-h]-S(h)\mu\dot{h}-mg+P \qquad (2)$$

We assume that in each moment of time the force of the weight of the cocoon and the buoyancy force according to Archimedes' law are balanced; The equality

$$mg=P=\rho_{ж}gV=2\rho_{ж}g\begin{bmatrix}2\pi R_1^2R/3+\pi z_1^2(R_1-z_0)+\\+\pi R_1^2(R-z_1-(R^3-z_1^3)/3R^2)\end{bmatrix} \qquad (3)$$

Formula (3) establishes a relationship between the geometric parameters of a cocoon, modeled by a compound ellipsoid of revolution, with a known weight.

The wetting area of the cocoon in equation (2) depends on the position of the cocoon in the aqueous medium, and for a shallow depth of immersion, we determine by formulas

$$S=2S_0 \text{ при } 0<h<h_0 \qquad (4)$$

$$S=S_0(0)+S_0(h-h_0) \text{ при } h_0<h<2R_1-z_0+h_0 \qquad (5)$$

$$S=S_0(0)-S_0(4R_1-2z_0-h+h_0) \text{ при } 2R_1-z_0+h_0<h<4R_1-2z_0+h_0 \qquad (6)$$

The speed of the thread when winding it on reel, we assume that the maximum speed of the thread is reached by contacting it with the vertices of the polygon, the smallest – when it contacts the sides of the polygon. In this case, the velocity distribution along the hexagon surface will be non-uniform, which leads to a periodic change in the velocity of the converging filament in time.

Let us determine the speed of the thread running at the time at the apex of an isosceles triangle, where, (Fig. 1). At the moment of time, the side of the triangle rotates by an angle (is the number of revolutions of the reel). In this case, from (Fig. 1), we determine the point velocity for the instants of time (7)

For the instants of time, we have

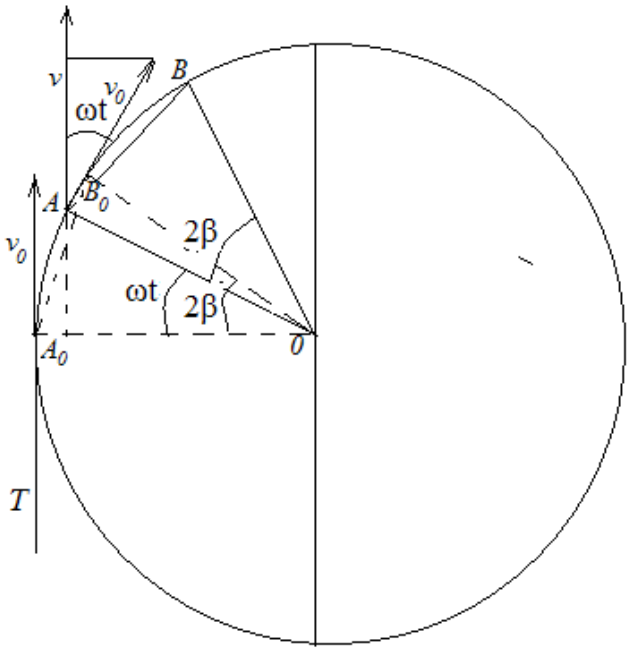

Figure 1. Kinematic scheme of motion of the point of winding of a thread along the surface of a polygon

Then this process is repeated and the speed of the thread at the point is determined by the formulas

$$v = v_3 = v_0 \cos(4\beta - \omega t) \text{ при } 3\beta/\omega < t < 4\beta/\omega,$$
$$v = v_4 = v_0 \cos(wt - 4\beta) \text{ при } 4\beta/\omega < t < 5\beta/\omega, \quad (7)$$
$$v = v_{n-1} = v_0 \cos(n\beta - \omega t) \text{ при } (n-1)\beta/\omega < t < n\beta/\omega,$$
$$v = v_n = v_0 \cos(n\beta - \omega t) \text{ при}$$
$$n\beta/\omega < t < (n+1)\beta/\omega,\ n = 4,5,6,,,, \quad (8)$$

The length of the winding thread is determined by integrating the velocity expressions (5) – (8). To simplify the calculations, we subsequently assume the winding speed constant and equal, then the movement of the end of the thread is determined by the formula

Figure 2 shows the graphical dependence of the linear speed of the hexagon reel on time (curve 2). The straight line 1 corresponds to the average winding speed of the filament. In the calculations it is accepted. The calculations were carried out for times corresponding to one complete rotation of the reel, equal to, the average velocity is

Equation (8), taking (9) into account, reduces to the form

$$m\ddot{h} = k_1(t)\left[\frac{k_0 x_0(t)}{k_0 + k_1(t)} - h\right] - S(h)\mu\dot{h} \quad (9)$$

Equation (9) is integrated numerically with the initial conditions

The calculations were performed when the geometric equality was fulfilled and for the values of the parameters:,,,, (medium water).

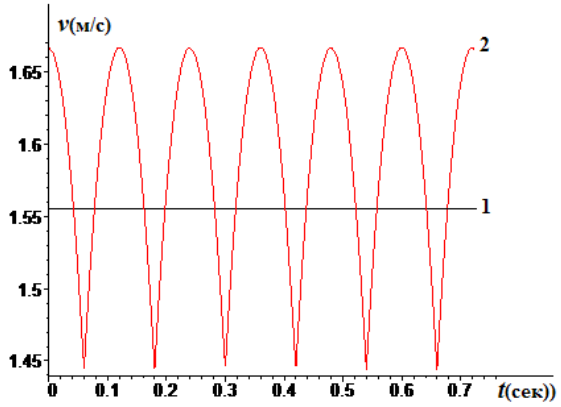

Figure 2. Change of linear speed of hexagon reel from time

In (Figure 2) are graphs of the dependence of the upward movement of the cocoon on time for different values, and. Calculations were carried out for two reel types, with the total length of the reel being wound (Fig. 3–5) shows the curves for a hex reel, where its average linear velocity will be. For moments of time corresponding to 1000 turns of the reel.

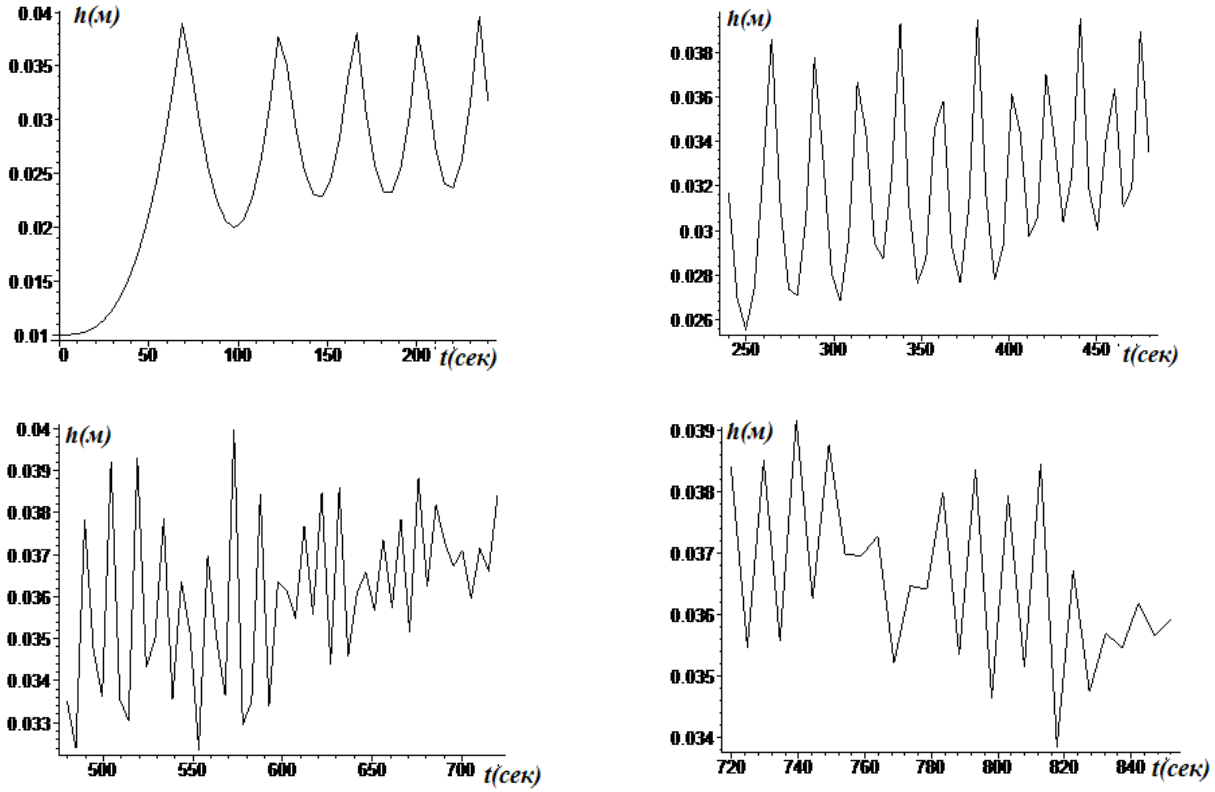

Figure 3. The graphs of the dependence of the displacement of the top of the cocoon center on time for the values of approximations z_0 = 0.005 m, R_1 = 0.0075 m centers of ellipses and the time duration

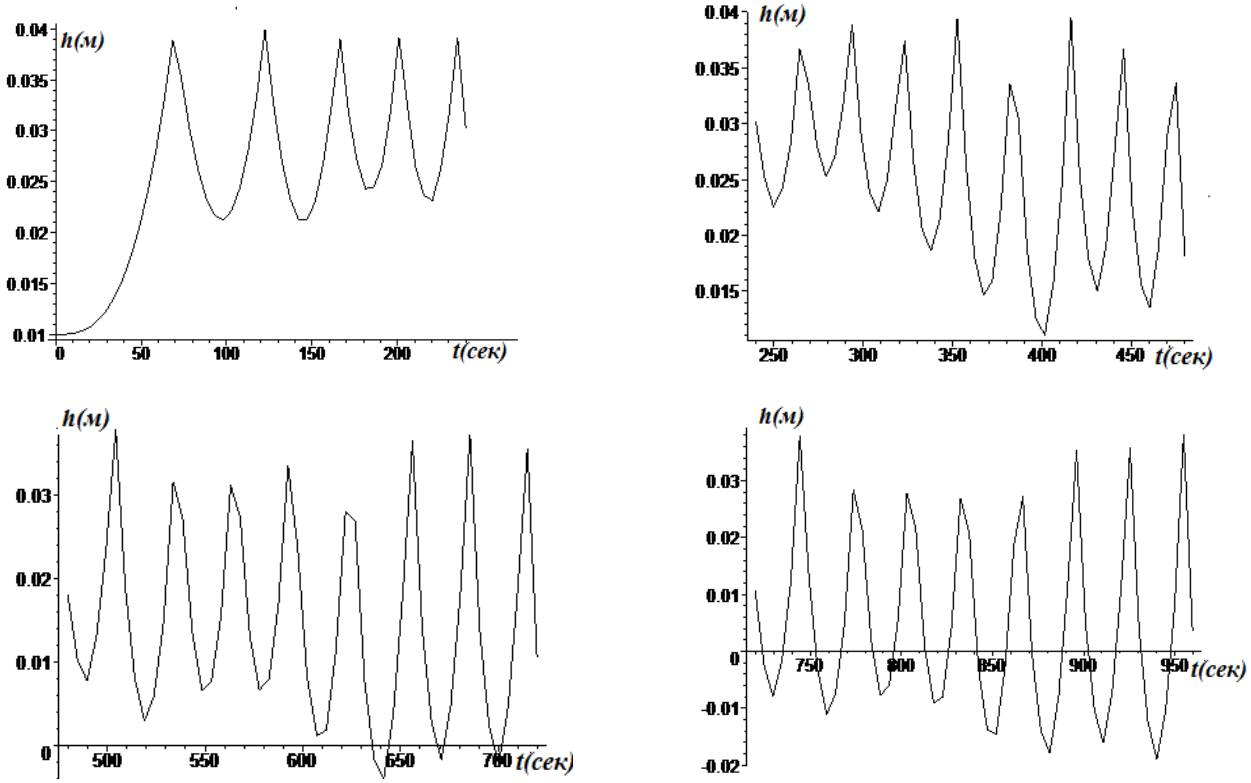

Figure 4. The graphs of the dependence of the displacement of the top of the cocoon center on time for the values of approximations z_0 = 0.005 m, R_1 = 0.0075 m centers of ellipses and the time duration

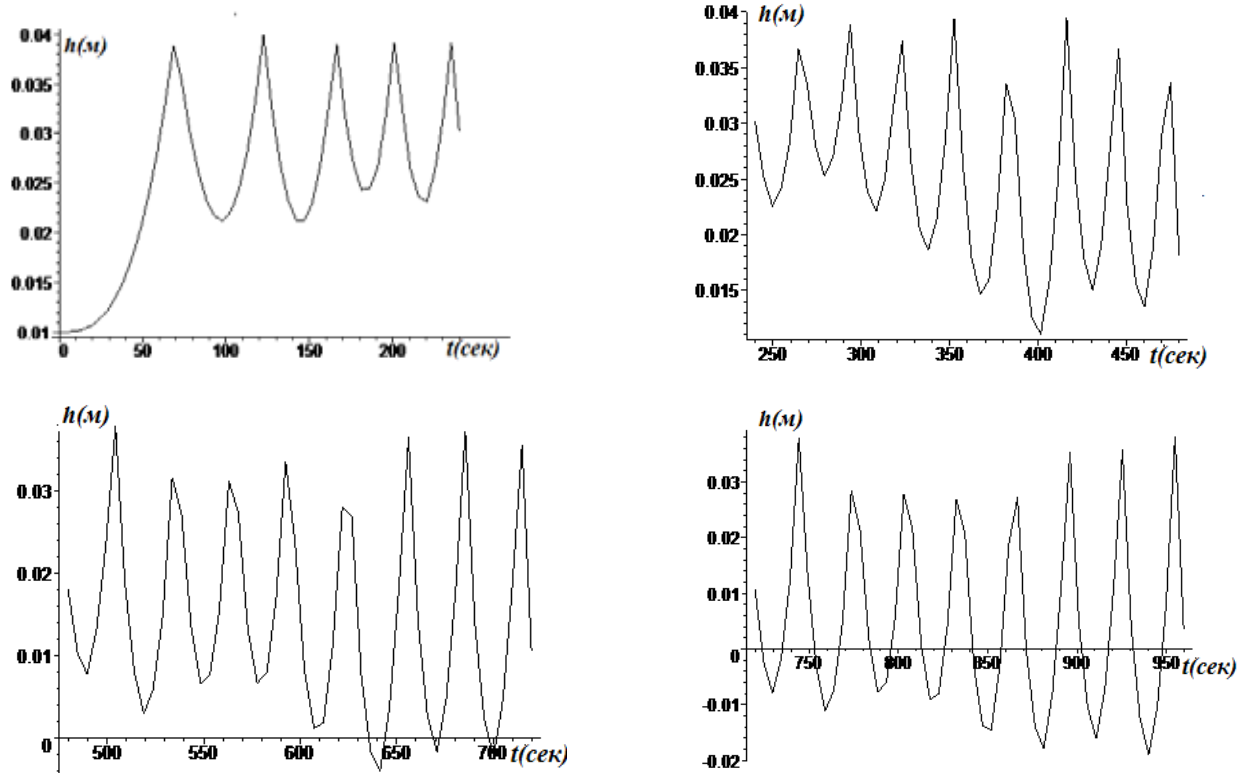

Figure 5. Graphs of the dependence of the displacement of the top of the cocoon center on time for the values of approximations z_0 = 0.005 m, R_1 = 0.0075 m centers of ellipses and the time duration *tpr* = 5 sec.

From the analysis of graphs it follows that when leaving the aquatic environment due to variability, the coupling coefficient with the cocoon surface begins to oscillate with a variable amplitude. The time of the decrease in the elastic coupling coefficient plays an important role in the law of cocoon motion. As the value of this time increases, the frequency of the cocoon's oscillations decreases, the cocoon moves towards the aquatic environment.

This shows that the character of the cocoon oscillation essentially depends on the frequency of the change in the coefficient of rigidity of the elastic connection of the filament with the cocoon. With short ranges of variation in the coefficient, the oscillations are of a high-frequency nature, and with an increase in this range, the oscillation is characterized by a long period.

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RESEARCH OF INFLUENCE OF THREAD GUIDERS WITH FLEXIBLE ELEMENTS FOR THE PROCESS OF YARN FORMATION

Abstract: The article presents a study of the effect of the yarn guider with elastic elements on the yarn formation process. At the fitting of thread guider of a new design with elastic elements, the conditions for twist propagation to the yarn formation zone are improved. At the result of the increasing in the uniform tension of the yarn and a better straightening of fibers, the breaking load of the yarn and its elongation is increased, the unevenness of the cross-section and the breaking load as well as the breakage on spinners up to 20 were reduced.

Keywords: Spinning machine, thread guider, exhausted device, twist, stability, elasticity, linear density, coefficient of variation, conductivity breaking load, breakage, yarn.

The technological process on ring spinners is designed so that at the same time there is a twisting of the thread and winding it on the pirn. This operation is carried out by a twinned-winding mechanism consisting of delivered pair of exhausted device, a thread guider, a spindle, a ring and a roller. The greatest tension of the thread during ring spinning occurs in the area between the roller and the pirn, because of the thread tension in balloon but also the centrifugal force of the roller, as well as the friction force of the roller on the ring and the thread on the roller. However, thread breakage mostly often occurs between the thread guider and the front cylinder of the exhausted device, where the low-twisted thread has the lowest strength [1].

Based on the above mentioned, an experimental study of the effect of a flexible threads guider on breakage and yarn quality indicators were conducted.

Experimental studies were carried out under production conditions of JV LLC "Uztex Shovot".

Evaluation of the influence of the thread guider construction on the yarn formation process and its quality was carried out during generating a 20-tex linear density yarn on a G-35 ring spinning machine Rieter.

Two designs of thread guiders mounted on the same spindles were investigated:

– consisting of a hook of steel wire, which forms a loop for the passage of the thread (factory);

– thread guiders manufactory with elastic elements (experienced).

The effectiveness of thread guides of different designs was evaluated by the following indicators:

– twist in the zone of formation of yarn, tw/10sm;

– conductivity breaking load of yarn, sN/tex;

– coefficient of variation for breaking load,%;

– breakage of yarn per 1000 tw.

The yarn quality was assessed by testing on laboratory equipment from Uster as well as the twist of yarn and its stability on the Auto Twist Context twister.

Breakage was recorded during the time of removal. All tests were carried out in 3 replications and measurements of twist in the yarn formation zone in five replications.

Thread guiders are the main device that prevents the spread of twist in the zone of formation of the DB yarn (Fig.1) because of the bending of the thread in the thread guider (angle φ).

As a result, a sliver at zone h_B does not receive sufficient strength and even a slight oscillation of the thread can lead to its breaking [2].

Theoretical studies show that the new design of thread guiders allows to increase the spread of twist in the zone DB by reducing the rigidity of the structure and increasing its flexibility in the zone of the bend of the thread.

To confirm this position, measurements of twist in the DB zone with sequential installation of the compared structures of the thread guiders were made.

To do this, with the help of special clamps, a portion of the DB thread (when the body of the cob was developed) was transferred to a twist meter to determine the twist.

The results of the measurements are shown in the (table 1).

From table 1 it can be seen that while using steel thread guiders, the average twist per 10 sm. of yarn in the zone of its formation was 58.4 twists, i.e. these thread guiders delay to 29.64% twist (refueling twist is 830 tw/m).

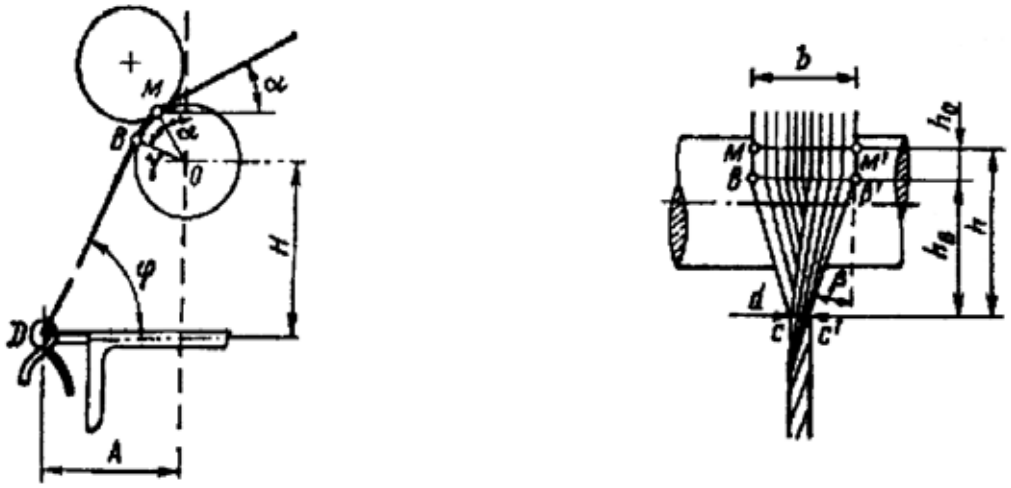

Figure 1. Scheme of the formation of yarn

Table 1.– Twist in zone of yarn formation

Thread guider	Twist for 10 sm						Coefficient of variation for twist,%
	1	2	3	4	5	middle	
Steel	58	62	60	57	55	58.4	4.14
With elastic elements	72	70	73	69	72	71.2	2.67

At the installing of thread guiders with elastic elements, the average twist per 10 cm of yarn in the DB zone was 71.2 twists, i.e. the conditions for the spread of twist are reduced and these thread guiders delay only 14.22% of twist. Thus, we see that the increase in the twist in the thread guiders – the exhausted roller at the installing of the thread guiders of new design is 15.42%. The spread of twist in this area has become more uniform: the coefficient of variation in the twist is 2.67%, which significantly stabilizes the vibrations of the thread. At the working on steel thread guiders, the coefficient of variation of twist on the DB section is 1.47 times greater and amounts to 4.14%.

To assess the degree of influence of the design of the thread guiders on the quality and the process of forming the yarn successively (changing the thread guiders) on the G 35 ring spinning machine, a yarn with linear density of 20 tex was produced.

The main indicators of the physic-mechanical properties of the yarns of both variants were determined by testing of the yarns on the USTER TENSORAPID4 instrument. Average test results are shown in (Table 2 and in Fig. 2).

The yarn of both options meets the requirements of regulatory technical documentation.

Table 2.– Indicators of physical and mechanical properties of yarn

№	The name of indicators	Steel Thread Guider				Elastic Thread Guider			
		1	2	3	Mid.	1	2	3	Mid.
1.	Linear density tex	20.1	20.2	20.0	20.1	20.2	19.9	20.1	20.0
2.	Coefficient of liner density variation,%	0.9	0.92	1.0	0.94	0,89	1,01	0,93	0.94
3.	Breaking load, sN	242.8	240.0	240.2	241.0	252.2	251.2	249.8	251.0
4.	Coefficient of variation for breaking load,%	10.1	9.7	9.6	9.8	8.9	8.6	8.3	8.6
5.	Specific breaking load, sN/tex	12.28	11.88	12.01	11.99	12.5	12.62	12.43	12.52
6.	Lengthening,%	3.98	3.92	3.9	3.93	4.24	4.18	4.27	4.23
7.	Breakage at 1000 tw/h for 100 km of yarn	56	62	58	58.7	48	43	45	45.3

In the study of flexible thread guiders, the specific tensile load of the yarn was 12.52 sN/tex, which is 0.53 sN/tex higher than at working with a steel thread guider (11.99 sN/tex), i.e. conditions for the formation of yarn are improved, the fibers are straightened better and at the breaking the slippage of the fibers is decreased. The quadratic unevenness of the cross-section and the breaking load decreases from 9.8% to 8.6%, the elongation of the yarn increases by 0.3%, i.e. we get more sound yarn.

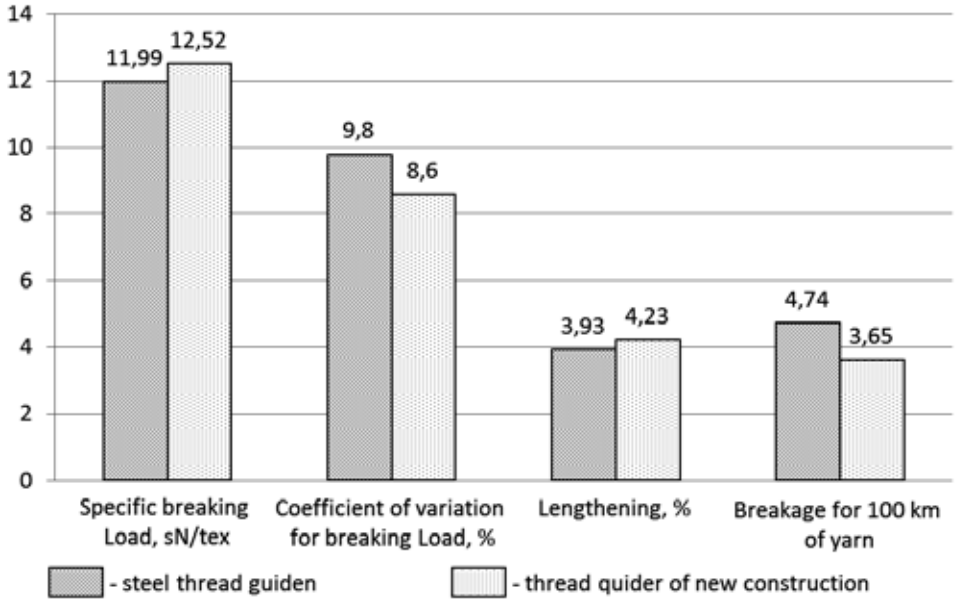

Figure 2. The main indicators of physical and mechanical properties of yarn

In the study of flexible thread guiders, the specific tensile load of the yarn was 12.52 sN/tex, which is 0.53 sN/tex higher than at working with a steel thread guider (11.99 sN/tex), i.e. conditions for the formation of yarn are improved, the fibers are straightened better and at the breaking the slippage of the fibers is decreased. The quadratic unevenness of the cross-section and the breaking load decreases from 9.8% to 8.6%, the elongation of the yarn increases by 0.3%, i.e. we get more sound yarn.

Observation of a break during the removal period showed its decrease from an average of 58.7 breakings per 1000 spindles per hour to 45.3 breakings per 1000 tw. hour, i.e. by 22.8%.

Conclusions:

1. At the installing of thread guiders of a new design with elastic elements, the conditions for spreading twist to the yarn formation zone are improved: the twist increase was 15.42%, while the uniformity of twist spread was increased for 1.47 times, which significantly stabilizes the amount of thread oscillation.

2. At the result of thread uniform tension increasing and a better straightening of the fibers, the breaking load of the yarn was increased; the elongation and unevenness in the cross-section and the breaking load were decreased as well.

3. New design of thread guiders helps to reduce thread breakage on spinning machines to 20.

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ABOUT CALCULATION OF A HYDRAULIC HITTING ABSORBER – AIR-HYDRAULIC CAP WITH DIAPHRAGM

Abstract: The article presents the results of the calculation of theoretical studies of a hydraulic shock absorber – an air-hydraulic cap with a diaphragm by numerical methods – by the finite difference method. Calculations are implemented on a computer.

Keywords: hydraulic shock, pressure pipe, air-hydraulic cap, diaphragm, pump station, pump unit, pump fixing, return valve.

Various measures and means are used to protect pressure pipelines of pumping stations from water hammer [1–4]. The most economical and simple means of a hydraulic shock (HS) absorber in pressure pipelines of pumping stations (PS) are air-hydraulic caps (AHC).

The main dimensions of the AHC installed on the pressure pipelines (PP) are determined by the conditions of starting and stopping pumping units [1–4].

Figure 1 shows the pressure system, which consists of a pumping unit 1, a check valve 2, AHC with a Figure 1, and a pressure pipe 4 and a pressure pool 5.

When the power supply is suddenly disconnected, the pump installation 1 stops working, the check valve 2 closes and the water from the AHC3 goes through the connecting pipe 6 and starts to flow into the pressure pipe 4. A pressure shock occurs in the pressure pipe 4, accompanied by a change in hydrodynamic pressure and speeds.

The hydrodynamic pressure H in the pipeline 4 and AHC3 first decreases, then increases. This oscillatory process is repeated, with a gradual attenuation due to hydraulic resistances. The greatest decrease and increase in the hydrodynamic pressure is observed in the first period of oscillations.

In this paper, the order and method of calculating the AHC with the diaphragm are given with an instantaneous stopping of the pumping unit.When HS water from the cap enters the center of HS, while there is a significant extinction of the increase in pressure.The idea of using the AHC with a diaphragm on the pressure pipe of the pumping station is not a new means of protection from HS; similar thoughts were expressed by a number of authors [1; 4]. However, there is no detailed methodology for calculating the above construction in a wide range, which is one of the reasons for performing this work.

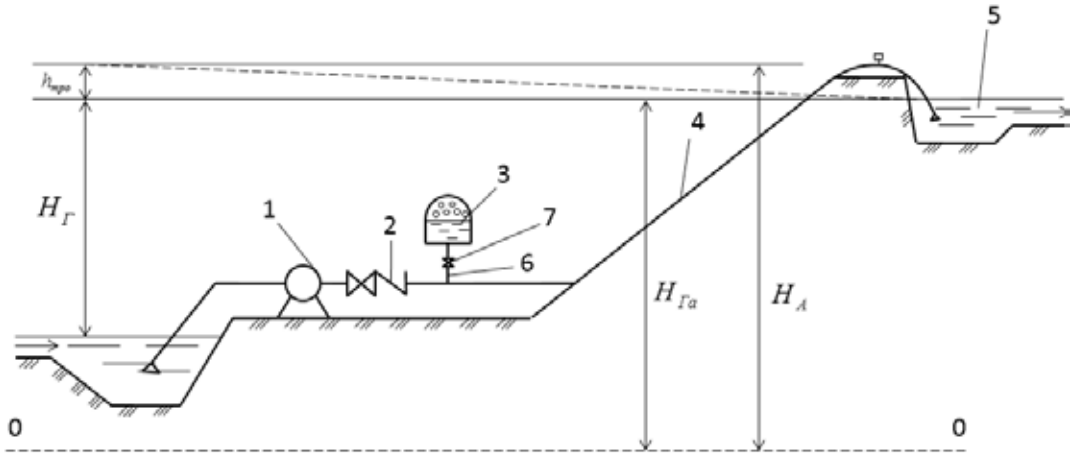

Figure 1. Scheme of the pressure system: 1 – pump; 2 – check valve; 3 – AHC; 4 – pressure pipeline; 5 – pool; 6 – pressure pipe; 7 – aperture

For the AHC system – pressure pipeline-pressure pool, the solution of the problem of hydraulic impact uses the following equations [1; 4; 7] (the accepted notation is the same as in [4; 7]):

$$h-1=\frac{1}{2\pi}\sqrt{2\pi\sigma}\,\frac{d\overline{V}}{d\bar{t}}+\left(\bar{h}_{mpo}+\bar{h}_{\partial o}\right)\overline{V}\left|\overline{V}\right| \quad (1)$$

$$\frac{dh}{d\bar{t}}=-2nh^{\frac{1+n}{n}}\cdot\pi\sqrt{\frac{2\sigma}{n}}\overline{V} \quad (2)$$

The characteristic parameter is determined by the formula:

$$\sigma=\frac{\omega\phi V_0^2}{2gH_{\Gamma a}W_0} \quad (3)$$

The period of pressure fluctuations in the cap without taking into account the pressure loss is equal to:

$$T=2\pi\sqrt{\frac{2\sigma}{n}}\,\frac{W_0}{\omega V_0} \quad (4)$$

The exponent of polytropes is taken with the isothermal process $n = 1$, and with the adiabatic – $n = 1.41$.

When solving equations (1) and (2), it is assumed that the pumping unit shuts down instantly, and the check valve closes instantly.

Equations (1) and (2) are solved under the following initial conditions.

$$\left.\begin{array}{l} h_0=1+\bar{h}_{mpo} \\ \overline{V}_{\,0}=1 \end{array}\right\} \text{ при } \bar{t}=0 \quad (5)$$

The system of equations (1) and (2) can be solved by the finite difference method [1; 3; 4].

By analogy with Evangelisti [1; 5; 6], we will solve the system of equations (1) – (3) using the finite difference method.

In accordance with equation (3) we have

$$\overline{W}_{\bar{t}}=\frac{1}{h_{\bar{t}}^{1/n}} \text{ и } \overline{W}_{\bar{t}+\triangle\bar{t}}=\frac{1}{h_{\bar{t}+\triangle\bar{t}}^{1/n}}, \quad (6)$$

Where $\overline{W}_{\bar{t}}$ and $\bar{h}_{\bar{t}}$ – are the values $\overline{W}$ and h at the moment of time; $\bar{t}$; $\overline{W}_{\bar{t}+\triangle\bar{t}}$ and $\bar{h}_{\bar{t}+\triangle\bar{t}}$ – are the values $\overline{W}$ and h at the moment of time; $\bar{t}+\triangle\bar{t}$; $\triangle\bar{t}$ – are calculated interval (step) of time.

Then we get

$$\triangle\overline{W}=\overline{W}_{\bar{t}+\triangle\bar{t}}-\overline{W}_{\bar{t}}=\frac{h_{\bar{t}}^{1/n}-h_{\bar{t}+\triangle\bar{t}}^{1/n}}{h_{\bar{t}+\triangle\bar{t}}^{1/n}\cdot h_{\bar{t}}^{1/n}}. \quad (7)$$

In accordance with equation (2) we have

$$\triangle\overline{W}=2\pi\sqrt{\frac{2\sigma}{n}}\,\bar{\vartheta}_{\bar{t}}\triangle\bar{t}, \quad (8)$$

Where $\bar{\vartheta}_{\bar{t}}$ – value $\bar{\vartheta}$ at the moment of time t.

Since $\triangle\overline{W}$ by (7) and $\triangle\overline{W}$ by (8) are equal, we get

$$\frac{h_{\bar{t}}^{1/n}-h_{\bar{t}+\triangle\bar{t}}^{1/n}}{h_{\bar{t}+\triangle\bar{t}}^{1/n}\cdot h_{\bar{t}}^{1/n}}=2\pi\sqrt{\frac{2\sigma}{n}}\,\bar{\vartheta}_{\bar{t}}\triangle\bar{t},$$

Where it comes from

$$h_{\bar{t}+\triangle\bar{t}}=\frac{h_{\bar{t}}}{\left(1+2\pi\ h_{\bar{t}}^{1/n}\sqrt{2\sigma}\ \bar{\vartheta}_{\bar{t}}\ \triangle\bar{t}\right)^n}, \quad (9)$$

Or when $n = 1$ (isotherm)

$$h_{\bar{t}+\triangle\bar{t}}=\frac{h_{\bar{t}}}{1+2\pi\ h_{\bar{t}}\sqrt{2\sigma}\ \bar{\vartheta}_{\bar{t}}\ \triangle\bar{t}} \quad (10)$$

From equation (1) we have

$$d\bar{\vartheta}=\frac{2\pi}{\sqrt{2n\sigma}}hd\bar{t}-\frac{2\pi}{\sqrt{2n\sigma}}d\bar{t}-\frac{2\pi}{\sqrt{2n\sigma}}\left(\bar{h}_{\text{тро}}+\bar{h}_{\partial o}\right)\bar{\vartheta}\left|\bar{\vartheta}\right|dt, \quad (11)$$

Where do we get

$$\bar{\vartheta}_{\bar{t}+\triangle\bar{t}}=\bar{\vartheta}_{\bar{t}}+\frac{2\pi\triangle\bar{t}}{\sqrt{2n\sigma}}\cdot\left[h_{\bar{t}+\triangle\bar{t}}-1-\left(\bar{h}_{\text{тро}}+\bar{h}_{\partial o}\right)\bar{\vartheta}_{\bar{t}}\left|\bar{\vartheta}_{\bar{t}}\right|\right], \quad (12)$$

Or when n = 1 (isotherm)

$$\bar{\vartheta}_{\bar{t}+\triangle\bar{t}}=\bar{\vartheta}_{\bar{t}}+\frac{2\pi\triangle\bar{t}}{\sqrt{2\sigma}}\cdot\left[h_{\bar{t}+\triangle\bar{t}}-1-\left(\bar{h}_{\text{тро}}+\bar{h}_{\partial o}\right)\bar{\vartheta}_{\bar{t}}\left|\bar{\vartheta}_{\bar{t}}\right|\right]. \quad (13)$$

In deriving the calculated dependencies (9) and (12), by analogy with Evangelisti [1; 5; and 6], the following assumptions were made:

1. When determining according to (8) it is accepted1. When determining according $\triangle\overline{W}$ by (8) it is accepted $\bar{\vartheta}=\bar{\vartheta}_t$

2. In determining $\vartheta_{\bar{t}+\triangle\bar{t}}$ it is accepted $h=h_{\bar{t}+\triangle\bar{t}}$ and $\bar{\vartheta}\left|\bar{\vartheta}\right|=\bar{\vartheta}_{\bar{t}}\left|\bar{\vartheta}_t\right|$.

The dimensionless pressure h' in the pipeline at the place of installation of the cap differs from the dimensionless pressure h in the cap by the amount of pressure loss in the "diaphragm", namely

$$h'=h-\bar{h}_{\partial o}\ \bar{\vartheta}\left|\vartheta\right|. \quad (14)$$

Using dependencies (9), (10), (11) and (12), it is possible to calculate the process of pressure fluctuations in the cap and pipeline at the time σ, $\bar{h}_{\text{тро}}$, $\bar{h}_{\partial o}$, n and given initial conditions (5) and determine the minimum h_{min} and maximum h_{max} dimensionless pressures in the cap in the first period of oscillation.

Conclusion:

1. The obtained dependences (9), (10), (11) and (12) are used to calculate the process of oscillation of hydrodynamic pressures in a cap with a diaphragm in time given σ, $\bar{h}_{mpo}$, $\bar{h}_{\partial o}$, n, and initial conditions (5).

2. It is possible to determine the minimum $h_{\min}$ and maximum $h_{\max}$ dimensionless hydrodynamic pressure in an air-hydraulic cap with a diaphragm in the first period of pressure oscillations during a hydraulic hitting with a decrease in pressure.

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STUDY OF HYDRAULIC RESISTANCE IN HEAT EXCHANGER TUBES WITH LOCAL TURBULATORS

Abstract: This article presents the main results of an experimental study in the tubes of a heat exchanger with localized tourists.

Keywords: intensification, turbulizer, local turbulator, hollow, hydraulic resistance.

In order to intensify heat transfer and drastically reduce the formation of deposits on heat-exchanging surfaces, the authors of this article propose to install local turbulators (LT) in heat exchanger tubes (Fig. 1) [1]. The use of these types of turbulizers not only intensifies the process of heat exchange and reduces the rate of sediment, but also leads to an increase in the hydraulic resistance of the apparatus.

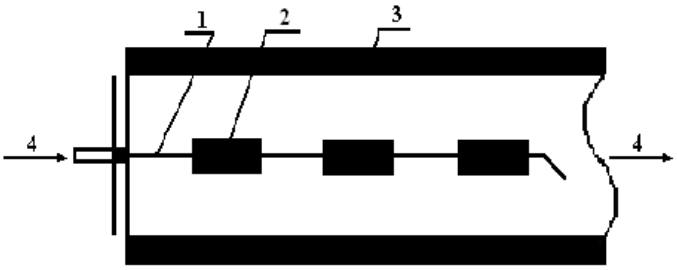

Figure 1. Scheme and general view of the experimental tube with local turbulators: 1 – elastic stainless wire; 2 – turbulators made of hollow; 3 – tube heat exchanger; 4 – direction of movement of raw water

The main elements are thin elastic stainless wire 1 of a free configuration (Fig. 1) and turbulators made of hollow with different geometric configurations 2, and fixed at a certain distance in the wire. One end of the wire 1 is attached to the input of the tube 3, and the other end of the wire remains free. The diameter of the wire is 0.2 … 0.8 mm. The flow of water 4, washing the uneven surfaces of the hollow, pushes the wire away, and the wire vibrates. Due to vibration, the entire flow is turbulent.

Elements of local turbulizers – polymer hollow, the wire passes through the center of these bodies. Hollow cores can be installed in various combinations. Depending on the density of the coolant, various materials with an appropriate specific weight can be used as wires, for example, steel, polymer, etc.

The geometric shape of the hollow (element LT) can be made of various configurations. The criteria for the optimal choice of the shape of the elements are the Reynolds number and the hydraulic resistance coefficient of the apparatus channel. It follows that it is necessary to strive to obtain good turbulization of the water flow with the smallest relative increment of the hydraulic resistance of the channel. Developed seven typical designs of local turbulizers [2, p. 229–231].

An experimental stand was developed for laboratory research [3, p. 79–80], where hydrodynamics of water flow was studied at different flow conditions.

The main element of the experimental stand is an experimental tube made of transparent glass. Its internal diameter and length were respectively D = 20 mm, l = 1200 mm. LT is a wire free configuration. The hollow can be installed in various combinations. In this case, one end of the wire was attached at the entrance to the tube, and the other end remained free.

The installation works in the following order: water enters the installation through a pipeline from the tank. To regulate

the flow of water installed valve. The flow rate itself is determined by the indication of a calibrated rotameter.

For a visual study of fluid flow regimes and the behavior of local turbulizers, the main part of the installation, the tube was made of glass. To supply the dye from the tank and measure the pressure loss in the tube were provided fittings. Head losses were measured using a *U* – shaped pressure gauge. To ensure the flow of fluid over the entire cross section of the glass tube, a hydraulic shutter was installed at the exit of the stand.

The results of studies of the hydrodynamics of water flow in a tube using the developed LTs have shown that the main factor influencing the process is the geometric shape, the type of material of the core, the attachment step. A visual observation showed that the energy of the oncoming flow of water imparts an oscillatory motion to all elements of the LT, at $1000 \le Re$ [4, p. 56–58].

Based on the conducted experiment on the hydraulic resistance in the tubes of the heat exchanger with the local turbulators, generalized dependences were obtained. Generalizing dependencies are obtained on the basis of the D'Arcy formula and are valid within $1000 \le Re \le 10000$. The results obtained by the empirical dependences are presented in Table 1. The data on the coefficients of hydraulic resistance are summarized with an accuracy of ± 3% in the range $Re = 1000–10000$. Depending on the design of local turbulators, the hydraulic resistance coefficient increases from 2 to 3 times [5; p. 144–146].

Table 1.– The values of the coefficients of hydraulic resistance

№	View of the turbulizer	The equation
1.	Smooth tube	$\xi = 136{,}25 / \mathrm{Re}^{1,15}$
2.	Disk	$\xi = 9{,}07 / \mathrm{Re}^{0,73}$
3.	Square	$\xi = 44{,}38 / \mathrm{Re}^{0,87}$
4.	Rectangular	$\xi = 108{,}64 / \mathrm{Re}^{0,98}$
5.	Oval	$\xi = 58{,}02 / \mathrm{Re}^{0,93}$
6.	Taper	$\xi = 43{,}08 / \mathrm{Re}^{0,88}$
7.	Rhombic	$\xi = 1045 / \mathrm{Re}^{1,23}$

Based on the obtained empirical dependencies for oval turbulizers, a hydraulic calculation of heat exchangers with local turbulators was performed. The results of the hydraulic calculation of heat exchangers with oval turbulators show that the required power of the pump for pumping the heating coolant increases and is 417 W.

The use of oval turbulizers in the tubes of a heat exchanger increases the hydraulic resistance (due to the increase in internal local resistances) by almost 8–10%.

To study the influence of the geometric shape and configuration on the hydraulic resistance inside the pipes, an experimental study of the hydrodynamics of pipes with local turbulators was carried out. Experimental studies were carried out on an experimental installation IT-84. Experimental studies were conducted in the following range of basic parameters: water flow, $G = 15 \div 210$ kg / hour; coolant inlet temperature $t_1^{'} = 23^0 C$; internal diameter of heat exchange tubes, $d_в$=0,016 мм. According to the results of the experiments, tables of experimental data were formed and graphs of hydraulic resistance and Reynolds numbers along the length of the tube with local turbulators were plotted. During the experiment in the first series, the geometrical parameters and configuration of the turbulator are assumed to be constant and only the pitch and design of the local turbulator change. Experimental results obtained on the basis of experimental studies are valid within $1000 \le \mathrm{Re} \le 10000$.

The effect of the geometric shape of local disk turbulizers on the hydraulic resistance in pipes with the same ranges of the main parameters was also experimentally investigated. Geometrical parameters of a local disk turbulizer: disc diameter, $d = 8 \div 12$ mm; disk width, $b = 2 \div 10$ mm; turbulent step, $s = 40 \div 100$ mm. Experimental results obtained on the basis of experimental studies are valid within $1000 \le \mathrm{Re} \le 10000$. [6, 156–158].

The authors concluded that using the developed design of local turbulizers under certain conditions, it is possible to achieve an increase in the turbulence of the fluid flow in the tubes of heat exchangers with a relatively small increase in the hydraulic resistance of the channel by about 25–40%.

Analysis of the published works shows that there is a prospect of using this design of local turbulizers in order to intensify the heat exchange process and reduce the rate of formation of deposits, because the oscillatory motion of local turbulizers creates in the tube volume moving vortex flows. In addition, this design of local turbulators is simple to manufacture, low-cost and does not require replacement of existing equipment.

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PARAMETERS OF ARTIFICIAL PIPE FORMING WORKING APPARATUS

Abstract: The article outlines results of theoretical research on parameters of working apparatus, which makes artificial pipe in the bottom of the cotton rows furrow.

Keywords: cotton, artificial pipe, pipe generator, conical angle of pipe generator, length of cylindrical part, column, distance between column and pipe generator.

Agriculture is the main consumer of existing water resources. Because of most of the crops grown in farming are grown in irrigated farming system. Rational use of existing water resources in our republic by using water-saving technologies and technologies that improve the quality of irrigation providing straight-water irrigation of crops along the furrow as well as application and implementation of modern water-saving technologies that reduce the flow of irrigation water to the river has a crucial importance. Nowadays, in our institute are lead scientific researches on justification of parameters of working apparatus, which generates artificial pipe for the irrigation of the cotton with the rows of 60 cm.

The parameters of working apparatus. In accordance with the requirements of agricultural techniques in order to achieve energy saving in formation of artificial pipe from the bottom of the cotton furrow line should be ensured flow of the water through the made pipe to the long distances.

The soil moisture content should be 17–18 percent for the formation of high quality pipes in the furrows of typical irrigated sierozem soil.

The pipe is located at a depth of 22–25 cm at the bottom of the furrow, and the flow of water through pipe should not be less than 65 m [1].

Artificial pipe generating apparatus (Fig. 1) is composed of front edge sharpened column, chisel, pulling metal rope and pipe generator. The following are key parameters that affect the quality and performance of the energy:

a – detaching angle of the chisel; l_u – length of the working surface of the chisel; b – width of the chisel; 2γ – sharpening angle of the front side of the column; d – diameter of the pipe generator; $2\gamma_к$ – conical angle of the pipe maker; $l_к$ – length of cylinder part of the pipe generator; $l_б$ – the distance between column and pipe generator.

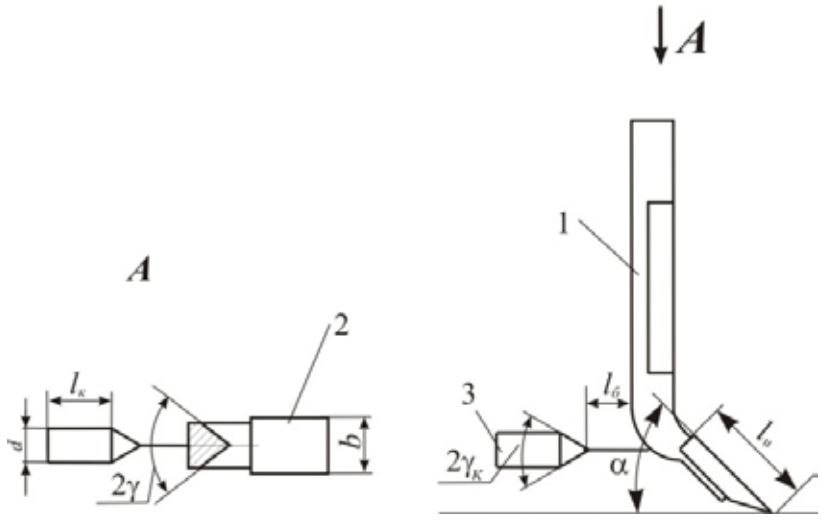

Figure –1. Diagram and basic parameters of artificial pipe generator working apparatus: 1 – column; 2 – chisel; 3 – pipe generator

The pipe generator of working apparatus is located at the back of the column moves, compresses the soil along the diameter during its work and forms the pipe which compacted from the sides. Based on the agricultural techniques the diameter of artificial pipe should be 5 sm, according to that diameter of the pipe maker will be determined as following

$$d = \frac{d_к}{k}, \qquad (1)$$

Here, $d_к$ – pipe diameter according to agro-technical requirements, *m*;

k – coefficient equal to 1.06–1.1 for pipe forming working apparatus [2].

The conical angle of the pipe making working apparatus $\gamma_к$ is determined that soil should not be in the working surface of that and compressing requirement of the soil in the diameter 27–33 ° or between $2\gamma_к$ = 54–66 °.

The length of the cylinder part of the pipe generator is dependent on the diameter of artificial pipe being formed, which can be determined by the following empirical expression [3]

$$l_к = (1,5-2,0)d_к. \quad (2)$$

By putting the above mentioned amount of the expression $d_к$ we will determine that length of the cylindrical part of the pipe generator should be 75–100 mm.

The column of the working apparatus and the distance between the pipe generator is determined from the condition that, by the time of going through the pipe generator the thickness of the walls formed by the chisel should be filled with slot soil, only after that complete pipe will be formed.

For this based on the diagram in the Figure 1

$$l_б \geq l_1 \quad (3)$$

here l_1 –the distance covered by the working apparatus by the time the walls are filled with slot soil, *m*.

The distance covered by the working apparatus while walls filled with the compressed slot soil can be determined by the following expression

$$l_1 = V_м\sqrt{2d_к / g} \quad (4)$$

here $V_м$ – speed of the aggregate m/s;

g – free fall speed m/s^2.

(4) by taking into consideration expression (4) the expression would be as following

$$l_б \geq V_м\sqrt{2d_к / g} \quad (5)$$

It is obvious from the analysis of this expression that distance between working apparatus is dependent to the speed of the aggregate and the diameter of the pipe.

If $V_м$ = 1.7 m/s and $d_к$ = 0.05 m (5) calculations based on the expression show that distance between the working apparatus column and pipe generator should not be less than 17.16 sm.

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DEVELOPMENT AND RESEARCH OF HETEROSTRUCTURES WITH AN INTERNAL THIN LAYER BASED ON P-TYPE SILICON

Abstract: The article presents the manufacturing technology of a heterojunction solar cell and the results of the study of its current-voltage characteristics.

Keywords: solar cells, heterojunction, technology, efficiency, characteristics.

The development of research on the development of high-efficiency solar elements based on silicon, is still gaining temp. The main goal of such research is to obtain a cost-effective and highly efficient solar cell. Among them, silicon solar cells with a more perfect heterostructure are distinguished. The best values for the conversion factor are given in [1] and [2]. In [1], analyzing the low rate of the recombination process of heterojunction solar cells made of silicon compared to direct-gap semiconductors, it was shown that at relatively low concentrations of main charge carriers (N_d~ 10^{15}см$^{-3}$), the excess charge carriers can be comparable or higher N_d. In this case, the magnitude of the efficiency η (efficiency factor) does not depend on N_d. At higher N_d values, the $\eta(N_d)$ dependence defines two opposing trends. One of them contributes to an increase in η with increasing N_d, and the other, associated with Auger recombination, leads to the decreasing η. The authors of this work determined the optimal value $N_d = 2*10^{16}$ см$^{-3}$, at which the value η of such an element is maximum. It is shown that the maximum value of η on 1.5–2% higher than the value of η at 10^{15}см$^{-3}$.

In the work [2] we can see that the creation of HIT elements (heterojunction with intrinsic then-layer solar cells) with an efficiency of 25.6% in the terms AM1.5. If we take into account the opinions of the authors [3], then the maximum theoretical value of the conversion efficiency of silicon solar cells at concentrated solar radiation can reach up to 30%. However, in practice, there are opportunities for the successful conversion of light by concentrating and achieving the highest efficiency values. In addition, research is still continuing on methods for improving the technology of manufacturing silicon solar cells by changing its structural state and production methods. This article is devoted to finding the most efficient heterostructural solar cells made of silicon.

Formulation of the task

In connection with the presence of some unexplored sides of silicon photoconverters, it is considered effectually to investigate the possibilities of creating highly efficient solar cells based on it. The study of foreign literature shows the absence of highly efficient silicon solar cells with a base layer of p-type. This is of interest to the study of methods of manufacturing technology and the creation of a new construction of the latter. In our opinion, the most optimal methods for producing a highly efficient photoelectric converter with a base type of p-type is, firstly, the selection of the sputtering method on a vacuum-magnetron machine and, secondly, the application of fast heat treatment (RTR-Rapid Thermal Processing). In addition, we were faced with the task of finding the reasons for contesting the possibilities of obtaining highly efficient conversion of the energy of sunlight using silicon heterojunction solar cells with a base p-layer.

Production process of solar elements

A silicon semiconductor, which was packed inside a sealed foil, was taken as the starting material. Before cutting, the starting material was thoroughly washed in ethanol solution of ethanol CH_3CH_2OH.

Cutting the silicon wafers is made by the glass cutter without allowing the formation of any damage: cracks, lines and scratches.

The sample from which it intended to produce an effective heterojunction solar cell, after cutting, had the following geometrical dimensions: $S = 4 \pm 0.3$ cm^2 and a thickness of 420 ± 10 μm. After the sample was prepared for sputtering, the sputtering process was carried out in a vacuum-magnetron machine (Fig. 1).

Figure 1. General view of the vacuum-magnetron machine

This operation had a duration of 3 hours. At the moment of spraying, the angle of contact of the dust-like layer with the plate surface is changed continuously. This was carried out with the help of rotating the rotary mechanism of the valve. At the end of the spraying process, after closing the target cover and turning off the heater, a break is taken to cool the sample to a temperature of ~ 250 °C. The heat treatment of the plates was carried out in a fast way. This stage involves heating the plate to 10000C for a few seconds. Heat treatment is performed parallel to the diffusion process. Moreover, in this case artificial oxidation of silicon is performed. The sequence of the method of obtaining silicon films oxide was as follows. Firstly, artificial oxidation of silicon was carried out in oxidizing stove, similar to those used for diffusion in a flow of carrier gas at a high temperature (1000–12000 °C).

The basis of such stoves is, as in diffusion, a quartz tube with silicon plates heated either by high-frequency currents or by other means. An oxidizing agent was used for oxygen, and sometimes water vapor at atmospheric pressure. The working temperature in our technologies did not exceed 8000 °C. In the process of heat treatment, solid planar phosphorus sources at heating, release phosphorus pentoxide (P_2O_5) into the gas phase, the molecules of which diffuse to the surface of the silicon wafers and as a result of reaction

$$2P_2O_5 + 5Si \rightarrow 5SiO_2 + 4P$$

form a layer of phosphorus silicate glass (FSS), from which phosphorus diffuses into the bulk of silicon. Phosphorus nitride, silicon phosphide or materials containing P_2O_5 in a bound form, which is released during thermal decomposition (aluminum metaphosphate, silicon pyrophosphate), is used as TPI of phosphorus. Table 1 shows the heat treatment time and the maximum operating temperatures.

Then, thick silver solutions were deposited on the surface of the sample and the sample was exposed to drying in the oven. It should be noted that the necessary action to verify the results of sputtering and diffusion is to prepare samples for grinding. For this, silicon carbide (SiC) was used. Silicon carbide is a popular abrasive because of its durability and low cost. In the manufacturing industry, due to its high hardness, it is used in abrasive processing in processes such as grinding and honing.

For grinding work, a cylindrical metal Ø 50 mm and a metal sleeve for this diameter were taken. It also used heavy-duty glass with a smooth surface. The grinding process begins with the preparation of a solution of silicon carbide using water on the surface of the glass. About 50 grams of silicon carbide is taken and spilled onto the glass surface to the desired thick mass. After this, a prepared sample of 1.0 cm^2 in size is placed on the inside of the cylindrical metal with the aid of a sleeve. Grinding was performed by slow rotation in the style of the eight or by the zigzag method.

Table 1.

	Step-1	**Step-2**	**Step-3**	**Step-4**	**Step-5**	**Step-6**
	Time/temp.	**Time/temp.**	**Time/temp.**	**Time/temp.**	**Time/temp.**	**Time/temp.**
Example-1	20s-350	30s-400	45s-450	20s-700	45s-750	15s-800
Example-2	30s-300	30s-350	45s-450	20s-600	45s-700	15s-800
Example-3	20s-250	30s-350	45s-450	20s-650	45s-750	15s-800
Example-4	20s-200	30s-300	45s-400	20s-500	45s-700	15s-800

The Results of the research

The resulting samples were consistently exposed to testing parameters. Parameters of the p and n-junction, current-voltage characteristics and finally the efficiency of the element were checked. Our results differ from the data given in foreign literature.

A general view of the volt-ampere characteristics of the measured sample is shown in Figure 4, which clearly shows the main trends in the output parameters of the current-voltage characteristic with temperature. With the increasing of the temperature, the open-circuit voltage monotonously is decreas-

ing, the short-circuit current slightly is increasing. Processing current-voltage characteristics allows to determine the nature of the changes in the main energy parameters of solar cells with temperature. The voltage of no-load stroke varies almost linearly with temperature in a wide temperature range and is characterized by a slope from –1.84 mV / ˚C at low temperatures to –2.11 mV / ˚C at temperatures from +20 to + 60 °C. The temperature dependence of the no-load voltage for the measured samples shows that Uxx is well reproduced and at this temperature is the same for all samples with an accuracy of up to ± 5 mV.

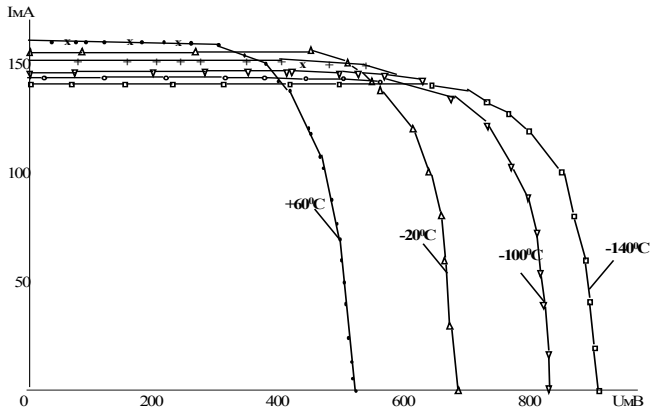

Figure 4. Volt – ampere characteristics of a silicon photoconverter at $\overline{P}_{-p} = 0{,}139$ V/sm²

The same can be said about the temperature coefficient of voltage, which is –1.81 ± 0.08 mV / ˚C in the region of negative temperatures, and –1.9 ± 0.05 mV / ˚C in the area near zero with a zone of 20 °C It is interesting to note that the value of the no-load voltage is somewhat higher, and the absolute value of the temperature coefficient is somewhat lower than the values given in the literature [5]. This difference, apparently, can be explained by the presence of a wide-band layer.

The voltage at which the maximum power is reached under load is 120–150 mV lower than the no-load voltage at all temperatures at which the measurements were made, and the absolute value of the temperature coefficient is approximately –2 ± 0.2 mV / ˚C. The larger variation of this value is due to the fact that the optimal voltage is determined with a large error than $U_{n\text{-}lv}$. The difference $U_{n\text{-}lv} - U_{opt}$ for this sample is almost independent of temperature and varies from sample to sample, depending on the shape of the current-voltage characteristic of a given solar cell. A weak temperature dependence is observed in the short circuit current and the temperature coefficient of this parameter varies from sample to sample in the range of 0.02 ± 0.2 mA / ˚C with an average value of 0.08 mA / ˚C, which corresponds to ~ 0.05% / ˚C. It should be noted here that this value is somewhat underestimated (by 10–20%) compared to the value of the temperature coefficient of the short-circuit current, which is obtained when the PC sample is illuminated by the atmospheric Sun, due to differences in the spectral composition illuminating the light sample. Due to the scatter of the values of the optimal current within a small area, it is not possible to show the unambiguous values of the temperature coefficient of this parameter within the specified area. The maximum power obtained from the PC sample strongly depends on temperature and the shape of this dependence is close to linear. With an accuracy of the power measurement error (± 2 ± 3%), the temperature dependence of the maximum power on the five studied samples over the entire temperature range can be approximated by a straight line with a slope of δ_W = 0.3 ± 0.02% / ˚C. Experience shows that for samples whose frontal contact is made by photolithography, this coefficient has a negative sign ($\delta_W W$ = –0.25% / ˚C).

Most samples have a tendency to increase the absolute value of δ_W with increasing temperature, so that in the low-temperature region (T <–20 °C) δ_W –0.25% / ˚C, and at higher temperatures δ_w = –0.39% / ˚C. However, due to the impossibility of stabilization of light on our experimental installation with an accuracy substantially better than $\sqrt{2}$%, we can only speak of a trend of this kind, until the accuracy of measurements is increased and the temperature interval is not increased. We note that the maximum power temperature coefficient obtained by us at a temperature of –20 + 60 °C is significantly lower $(\sim 20 \div 25\%)$ given in [5]. At low temperatures (T < 20 °C) the growth of Wmax and efficiency with decreasing temperature is stronger than described in [5]. It is important that at low temperatures at the **PC** research we can not observe no voltage or efficiency factor and maximum power. This is apparently due to the high quality of the p-n-junction, in which even at temperatures of $100 \div -140$ ˚C we could not notice leaks.

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DEVELOPMENT OF EFFECTIVE TECHNOLOGY OF FIBER CLEANING

Abstract: The article presents an efficient technology of fiber cleaning on a two-drum fiber cleaner with working bodies of a new design. The influence of the aerodynamic regime on the efficiency of the machine operation, the cleaning effect, the quality and yield of the fiber, and the degree of fibrous waste in the processing of raw cotton of hard-to-clean varieties were studied.

Keywords: Fiber cleaner, grate, guide, cleaning effect, selection, hard-to-clean grade of raw cotton, fiber, weed, quality.

Introduction: The technological operation of fiber cleaning is currently an actual problem, as in the textile industry, in the production of yarn, high quality cotton fibers are required.

The contamination of the fiber depends on the way the raw cotton is harvested, the type and amount of the technological equipment during its cleaning and processing.

Currently, in the cotton-processing industry of the Republic of Uzbekistan, a fiber cleaner of the 1VPU type is used in sawing technology (Fig. 1), in which, when processing high and low grades of raw cotton, the declared cleaning effect is 30–35%, and the fiber content of waste to 20–25% [1, 416–417]. The obtained statistical and experimental data show that the actual cleaning effect of the fiber cleaner 1VPU is 22–25%, which is 8–10% lower than the passport one [1, 416–417], and the content of impurities in the composition of the purified fiber during the processing of I–II grades of grade 1 of raw cotton is on average 0.5–1.5% higher than the permissible norm, which does not allow to receive fiber of the "Oliy" class according to the state standard O'zDst 604–2016 "Cotton fiber, Technical conditions" [2, 10–11]. The increase in the volume of procurement of raw cotton raw cotton, poses the task of obtaining high-quality fibers in front of the cotton ginning industry. Single-drum fiber wipers, due to design deficiencies, do not provide intensive separation of hard-to-remove weeds from the fiber, reduce the potential cleaning ability of machines and do not meet technological requirements.

Experimental part: To eliminate these shortcomings, a two-drum fiber cleaner of grade 2VPM with improved grate bars and guides was created in JSC "Pakhtasanoat ilmiy Markazi" (Fig. 1). The work of a two-drum fiber cleaner at the Zarbdor cotton gin plant of the Djizak region was studied (Fig. 2).

In previous studies [3, 115–120] it was established that the efficiency of the straight-through wipers depends on the aerodynamic mode of the machine. In this connection, studies were conducted to determine the optimum aerodynamic behavior of the new fiber cleaner.

To determine the optimum aerodynamic mode of the fiber cleaner, during the tests, the effect of the fiber's waste on the cleaning effect was studied, according to the approved procedure [4, 340]. Experiments were carried out, during which the rarefaction at the output of the fiber cleaner changed, and fiber samples were taken before and after cleaning, as well as isolated wastes. The results of the experiments are given in (Table 1).

According to the data in (table 1), a graph of the dependence of the cleaning effect (Figure 3) and the fibrousness of the waste (Figure 4), on the degree of rarefaction at the output of the fiber cleaner.

Analysis of the graphs shows that with increasing dilution, the cleaning effect and the fibrousness of the waste falls. This is typical for all types of straight-cutting saw wipers. To obtain the maximum effect, it is necessary to set the minimum discharge. In this case it is necessary to take into account that with a decrease in the discharge at the output of the fiber cleaner, the pressure in the connecting pipe increases, which prevents the normal operation of the gin.

Table 1.– The results of studying the influence of the aerodynamic mode of operation of a fiber cleaner on its technological parameters

№	Discharge at the output of the fiber-izer, kg/m²	Fibrous waste, %	The content of defects and impurities in the fiber before cleaning,%	The content of defects and impurities in the fiber after cleaning,%	Cleansing effect of fiber-cleaner,%
1.	–1	45.8	7.1	2.51	40.1
2.	–5.5	33.3	6.8	2.6	31.2
3.	–8	21.4	3.65	2.4	37.6
4.	–12	16.3	3.72	2.91	24.5

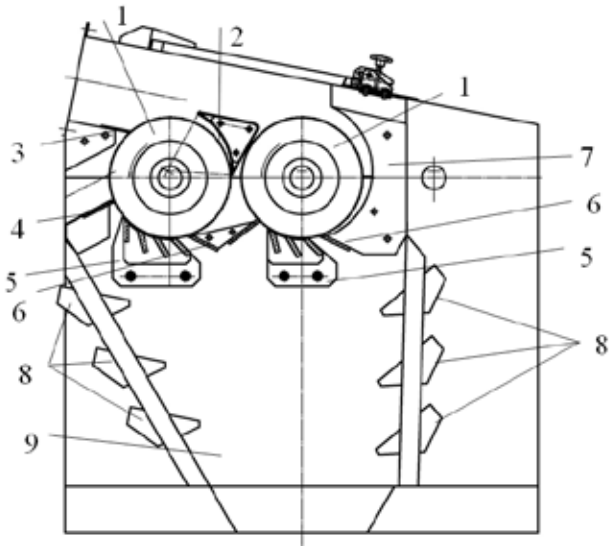

Figure 1. Scheme of the modernized two-bar-fiber wiper with new grate bars and guide. 1 – saw cylinder; 2 – guide; 3 – cutter knife; 4 – Lapping device; 5 – grate; 6 – grate; 7 – shit; 8 – a louvered grating; 9 – weed chamber

Figure 2. Upgraded double-drum fiber cleaner in production conditions

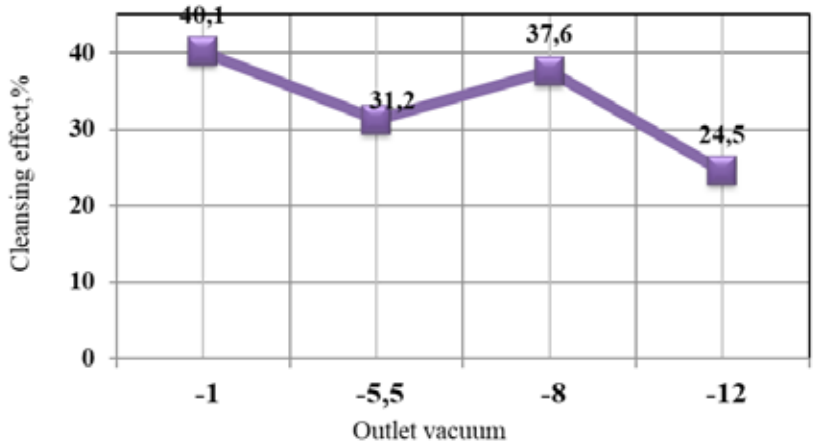

Figure 3. Graph of the dependence of the cleaning effect on the vacuum at the output of a two-drum fiber cleaner

In this series of experiments, the optimal ratio of aerodynamic and technological indicators was observed with a discharge at the fiber cleaner output of the order of 8 kg / m^2. In this case, the pressure gradient in the connecting pipe was at the permissible limit. Experiments were carried out during the operation of the fiber cleaner at full load. Therefore, the data given in table 1 should be considered as orienting indicators that do not fully characterize the technological characteristics of the fiber cleaner. In the course of the experiments, an aerodynamic regime was determined in which the fiber content of the waste was 15% –25%.

As a result of the tests, technological characteristics of a pilot-industrial sample of a two-drum fiber cleaner are determined. The experiments were carried out on hand-picked cotton of grade I, grade 2, selection varieties C-6541 and Porlock-1.

The results of the tests showed that when processing raw cotton 1-grade, 2-grade, selection grade C-6541, the content of defects and impurities in the fiber after gin is 3.10%–3.5%, and after the fiber cleaner it decreased to 2, 0–2.2%. At the same time, the cleaning effect of the new fiber cleaner averages 34%–35%.

When processing raw cotton 1-grade, 2-grade, selection grade Porlock-1, the content of defects and weed after gin was 3.8%–4.0%, and after the fiber was reduced to 2.4%–2.5% [5, 7–11].

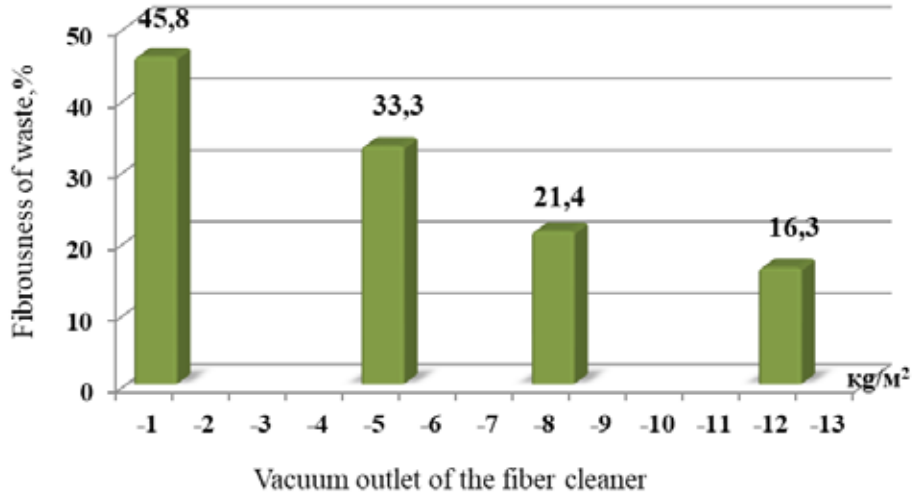

Figure 4. Graph of the dependence of the fibrousness of the waste from the vacuum at the outlet, kg/m^2

The cleaning effect of the new fiber cleaner increased to 36.0% –37.0%. The average cleaning effect of the new fiber cleaner was 35.7%, which is twice as much compared to the used 1VPU wipers [5, 7–11].

Conclusions: The proposed fiber cleaner effectively cleans the fiber of hard-to-clean selections of raw cotton and manual harvesting, its design allows to provide high quality of fiber during cleaning. Reduction of the fibrous part in the waste makes it possible to increase the fiber yield.

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CONTROLLING THE ACCURACY OF PROCESSING THE INVOLUTE PROFILE OF THE HEIGHT OF THE GEAR TOOTH WHEELS

Abstract: This article describes the possibilities controlling technological factors and increasing the reliability of the technological process of tooth processing through integrated management accuracy processing based on the functional dependencies of systematic technological factors and deviations of the parameters of gears, where the argument of functional dependencies is the deviation of a single parameter of the gears deviation of the radius of the involute profiles.

Keywords: Toothed wheels, involute tooth surface, roughness, hardness, positioning of allowances, control of the accuracy of processing, management of technological factors.

Introduction

Tooth profile error of the wheel can be estimated not only by the magnitude of deviation from the involute, but also by the nature of the variation in the magnitude of the deviation along the height of the tooth. We have established that every systematic technological factor leads to the formation of a profile error with a certain character of the variation in the profile of the tooth of the wheel [1].

The basis for the search for the dominant technological factor according to the structural scheme shown in Fig. a regression analysis of the study of the relationship between the error values of the profile f_{fr} in each angular position along the height of the tooth with fully defined values f_f, to be formed from the action of one of the dominant technological factors. This approach to the search for technological factors made it possible to identify systematic technological factors and to control the influence of individual of them on the magnitude and nature of changes f_{fr} in tooth height.

At a tooth processing with a rolling tool (with shaver) with dominant technological factor, causing an error in the involute profile, it is often a radial runout j. The radial runout of the shaver-drawer leads to the formation of errors in the profiles with a sinusoidal law of variation. The nature of the location of the profile error in tooth height depends on the mutual phase position of the direction of geometric eccentricity relative to the cutting comb located in the calibration plane.

When studying the factors causing the errors in profiles, scientists and production workers, the main attention was paid to the calculation and determination of absolute values f_{fr}, characterized by (Mandatory standard industrial) as the distance between the two closest nominal end profiles of the tooth, between which the actual active tooth profile cogwheel. Investigations of the values and character of the location of tooth profile errors in the profile of tooth height, depending on the phase of the action of various systematic technological factors.

To solve the problem of controlling the accuracy of the processing tooth, there is a necessity to solve the problems associated with controlling the size and nature of the location of the errors in profiles.

The results of the studies on the accuracy control of gear tooth profiles are described below.

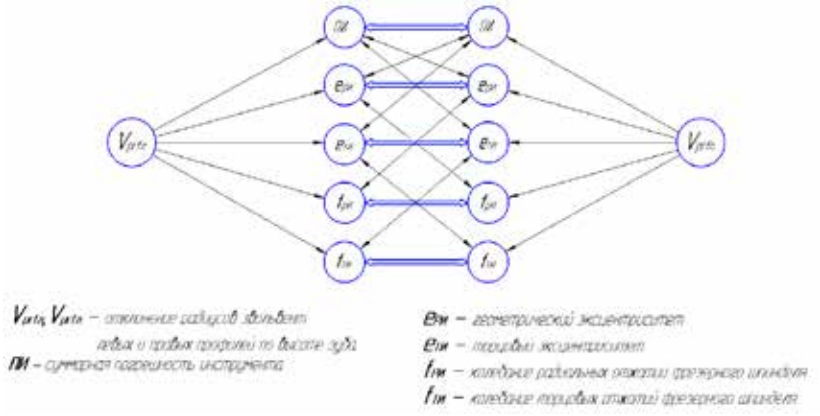

Figure 1. Structural scheme for searching for dominant technological factors causing deviations in the radius of the involute by the height of the tooth profile of the wheel

Control over the nature of the location of profile errors was carried out at tooth processing straight-toothed cylindrical wheels with rolling tools.

The Control was carried out by changing the phase position of the direction of geometric eccentricity relative to the cutting comb. Table 1 shows the values of the process settings at tooth processing straight-toothed cylindrical gears. The values of radial beats were tuned by means of special eccentric sleeves. Table 1 shows the theoretical values of the profile error, the angle between min and max, as well as the theoretical values of the angular positions of the profile points with the deviations min and max for each of the axial settings of the rolling tool.

Table 1.

Batch number	Wheel parameters		Specified radial runout of the tool	Theoretical values	Angle of deployment between	Installation number	Axial movements of the tool	Side of tooth profile	The theoretical values of the angular positions of the points	
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
I	4	17	0,20	73	10 °36	1		Left	15 ° 33	26 °9
								Right	15 ° 33	26 °9
						2		Left	26 °9	15 ° 33
								Right	26 °9	15 ° 33
						3		Left	20 °51	31 °27
								Right	20 °51	31 °27
						4		Left	15 ° 33	26 °9
								Right	15 ° 33	26 °9
II	4	23	0,24	87	7 °30	1		Left	16 °56	24 °46
								Right	16 °56	24 °46
						2		Left	13 °1	20 °41
								Right	13 °1	20 °41
						3		Left	24 °46	16 °56
								Right	24 °46	16 °56
III	3	45	0,10	36	4 °	1		Left	18 °	22 °
								Right	18 °	22 °
						2		Left	16 °	20 °
								Right	16 °	20 °
						3		Left	18 °	22 °
								Right	18 °	22 °
IV	4	23	0,06	22	7 °50	1		Left	16 °56	24 °46
								Right	16 °56	24 °46
						2		Left	13 °1	20 °41
								Right	13 °1	20 °41
						3		Left	24 °46	16 °56
								Right	24 °46	16 °56

Table 2 shows the results of experimental studies on the management of the location of the errors in the profile of the teeth of gears. The table shows the actual values of the angular positions of the points of the profiles with the deviations of min and max, the values of the errors in the profiles, and also the comparative data between the given theoretical and actual angular positions of the extremely points and the error values of the profiles.

Table 2.

Batch number	Installation number	Side of tooth profile	The actual values of the angular position of points in degrees		Deviations of angular position from theoretical values		Value	Deviations from theoretical values in%
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
I	1	Left	16	25	0 °27	1 °9	73	0
		Right	15	26	0 °33	0 °9	64	12.3

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
I	2	Left	15	26	0°33	0°9	74	1.3
		Right	15	26	0°33	0°9	65	10.9
	3	Left	21	31	0°51	0°27	63	13.7
		Right	31	21	0°27	0°51	55	24.4
	4	Left	31	21	0°27	0°51	75	2.6
		Right	21	31	0°51	0°33	70	3.9
II	1	Left	15	22	1°56	2°46	83	4.6
		Right	17	25	0°04	0°14	84	3.4
	2	Left	11	19	2°1	1°41	87	0
		Right	21	12	0°19	1°1	80	8.0
	3	Left	13	16	1°46	1°56	68	24.1
		Right	24	15	0°46	1°56	68	25.2
III	1	Left	16	24	1°	2°	23	36.1
		Right	18	24	0°	2°	17	52.8
	2	Left	20	14	0°	2°	31	13.3
		Right	14	22	2°	2°	23	36.1
	3	Left	24	16	2°	2°	21	41.7
		Right	24	18	2°	0°	24	33.3
IV	1	Left	19	26	2°4	1°14	24	9.1
		Right	19	26	2°4	1°14	19	13.6
	2	Left	14	22	0°59	1°19	21	4.5
		Right	22	16	1°19	2°59	37	68.7
	3	Left	26	19	1°14	2°14	16	27.2
		Right	225	19	0°14	2°14	24	18.2

From the comparative data in (Table 2) it can be seen that the angular positions of the points with the extreme deviations in the errors of the profiles obtained by experimental studies practically coincide with the calculated theoretical values. It can also be seen from the Table 2 that the error values of the profiles obtained experimentally for a given radial runout of the gear-cutting tool are almost close to the theoretical values of the profile errors for the same values of the radial beating of the tool for most cases.

The observed difference in the magnitude of the errors in the profiles, which occurred in individual cases, is apparently due to the instability of the cutting process during tooth machining.

The results of experimental studies have shown that with tooth processing with rolling tools, it is possible to obtain a predetermined character of the location of the profile error by controlling the magnitude and phase position of the running-out of the rolling tool.

Conclusion

Experimental studies have also established that it is possible to solve the inverse problem by the nature of the change in the profile error, the height of the tooth by regression analysis determine the dominant systematic technological factor.

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SLAG-ALKALINE FOAM CONCRETE BASED ON GRANULATED ELECTROTHERMOPHOSPHOR SLAG

Abstract: The article presents the results of research of grinding, physical and mechanical properties and the possibility of obtaining a slag-alkaline foam concrete on the basis of electrothermophosphor slag.

Keywords: slag-alkali binder, physical and mechanical characteristics, sodium disilicate, foaming agent, foam concrete.

Introduction

World consumption of fuel and energy resources is increasing at a rapid pace. This is due to several reasons, such as anincreasing of population, the need for comfortable housing, an increase in the amount and capacity of production, the development of transport logistics, etc. In parallel, the prices for these fuel and energy resources are also growing, which is included in the main expenditure side of the majority of production and the family budget.

The construction of new public and residential buildings using modern building materials and products is requirement of nowadays. More and more attention is paid to the use of insulation materials during construction.

It is generally known that thermal insulation materials are mineral wool, porous materials and other such kind of building structures. One of these artificially porous materials is foam concrete. At the moment, foam concrete is prepared and produced on the basis of a cement binder. Also, methods and technologies for manufacturing of foam concrete are well developed [1].

Analysis of modern scientific – technical and patent literatures (are) [2–5] showed that the issues of obtaining and studying the properties of foam concrete are developed mainly in the following areas:

– development and discovery of new types of foaming agents;

– development of new compositions of foam concrete;

– development of new methods and technologies for obtaining foam concrete;

– improvement of existing and development of new designs of technological equipment;

– development of new technological lines for foam concrete production;

– development of new methods for assessing technological parameters;

– etc.

All of the above listed works are conducted to obtain foam concrete on the basis of an ordinary cement binder [1–5]. To questions of reception of foam concretes on the basis of slag-alkaline binder are devoted a small amount of works [6; 7]. The reason for this is the high alkalinity value of the pH medium in comparison with the cement binder. High alkalinity of the pH medium interferes with obtaining stable foam, which after bursting the foam concrete solution into molds bursts and the porous structure breaks down.

The purpose of the work

In connection with this, the purpose of this paper is to investigate the possibility of obtaining slag-alkaline foam concrete.

Methods of research and characteristics of raw materials

As a solid constituent, granulated electrothermophosphor (ETP) slag and sand were used. The alkaline solution of sodium disilicate (SDS) with a density of 1.3 g/cm^3 was used as a quench liquid. As a foaming agent, "PB-2000" was chosen. Elemental composition of ETP slag is given in (Table 1).

Table 1.– composition of the ETP slag

Chemical elements,%													
Si	***Al***	***Ca***	***Na***	***K***	***Fe***	***Mg***	***P***	***Sr***	***Mn***	***Ti***	***Cr***	***Cu***	***Zr***
20	4	20	0.6	0.3	1	3	2	0.03	0.4	0.02	0.002	0.001	0.002

As can be seen from (Table 1), the ETP slag consists mainly of silicate calcium compounds.

In studies, we used well-known physical and mechanical methods of research, such as fineness of grinding, density, strength and electron microscopy.

The results of the research and their discussion

ETP slag was ground in a laboratory ball mill MBL-1. The results of grinding showed (Fig. 1) that the minimum required satisfactory degree of specific surface is achieved with a duration of at least 60 minutes [8]. It can be seen from the graph that in the interval 60–90 minutes there is a turning point in the grinding process.

Then coarsely and finely ground powders of ETP slag were closed with a solution of SDS with a density of 1,3 g/cm^3. Samples were formed in the form of cubes with a face size of 2 cm. The samples were hardened under air conditions up to 28 days old. The compressive strength of the samples was determined on a hydraulic press.

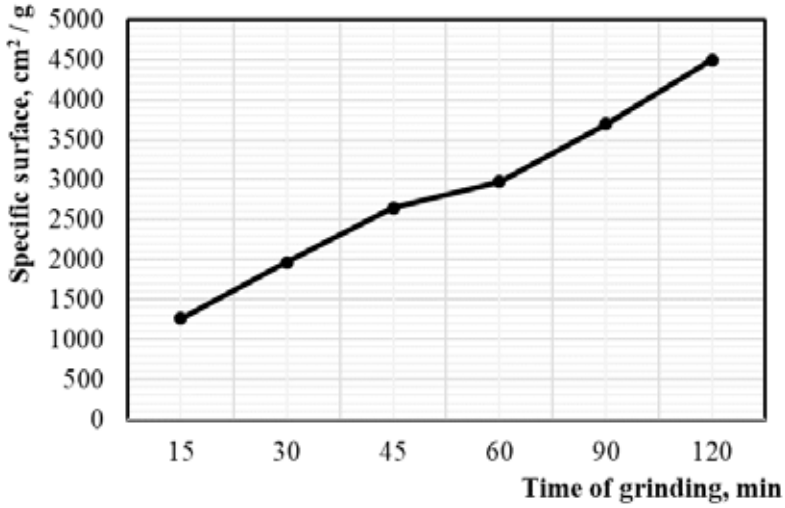


Figure 1. Change in specific surface area depending on the length of grinding

The results of compressive strength tests showed (Fig.2) that the best results are obtained for fine-grained powders of ETP slag with a grinding time of 60–90 minutes (specific surface 2972–3698 cm^2/g) [9]. Grinding with duration of more than 90 minutes does not give a positive effect in terms of increasing strength. As can be seen from the graph, the most intensive rate of compression strength is observed from 15 to 30 minutes of grinding in a ball mill (17.0–42.1 MPa), which is due to the broader granulometric composition of the binder leading to a denser packing of grains.

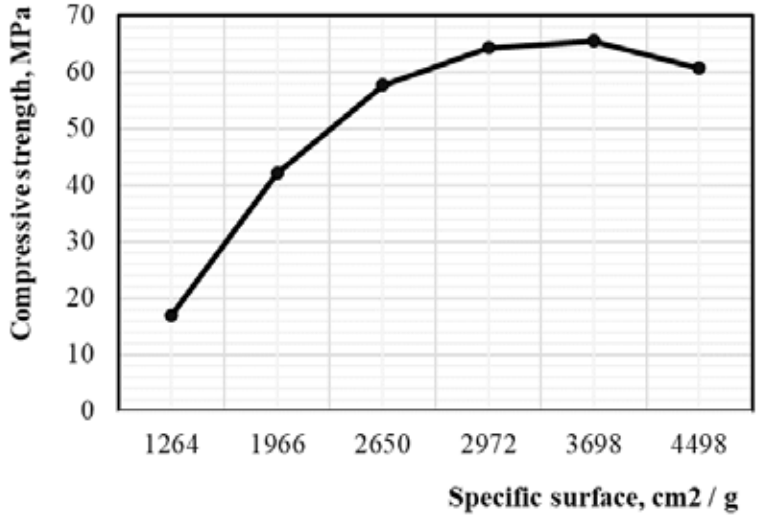


Figure 2. Strength of slag-alkaline binder at 28-day age depending on the specific surface area

Previously, we conducted research on the effect of 4 foaming agents on the physical and mechanical properties of the slag-alkaline binder [10]. At the entrance to the research work, additional studies were also carried out to determine the influence of the "PB-2000" foaming agent on the physico-mechanical properties of the slag-alkaline binder. The results of the study are given in (Table 2).

Table 2. – Effect of foaming agent on physico-mechanical properties of slag-alkaline binder

№	«PB-2000», (%) of the mass of ETF slag	Storage conditions	Compressive strength, MPa		Density of samples, g/cm^3
			7 days	28 days	
1.	–	normally-moist	37.75	74.66	2.17
2.	0.4		23.08	41.00	1.98
3.	0.8		18.50	42.33	1.90

The results obtained determine the effect of the amount of foaming agent on the strength and density of the samples. It turned out that the foaming agent not only slows down the hardening processes, but also pores the structure of the slag-alkaline solution during the preparation process.

In the subsequent studies were carried out on the production of slag-alkaline foam concrete. For this, sand was used as filler. Samples were formed in the form of cubes with the dimensions of the face of 7 cm. The results of the investigations are given in (Table 3).

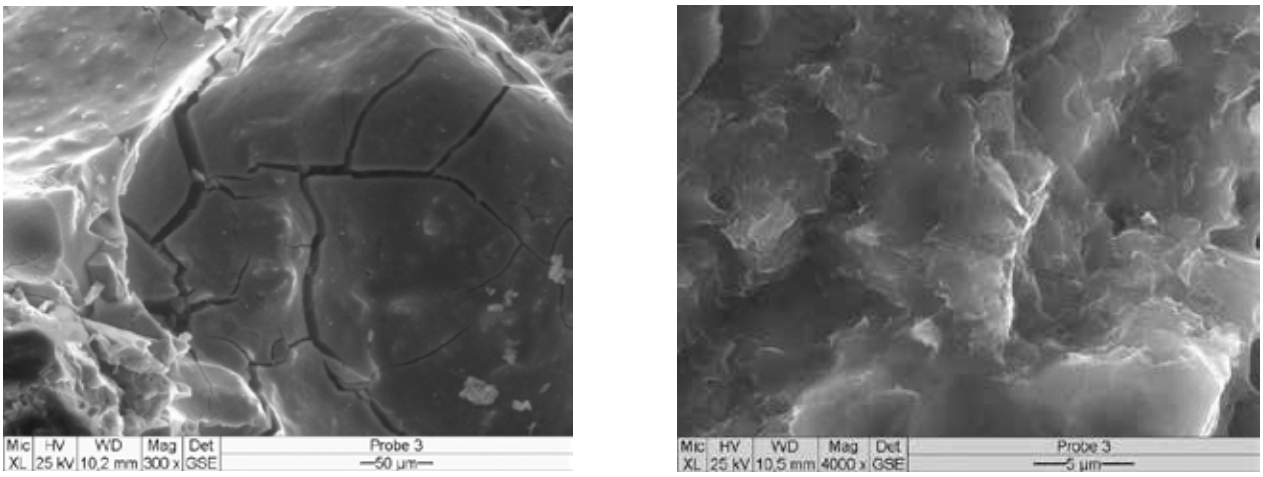
The results of the studies showed the possibility of obtaining a slag-alkali foam concrete on the basis of ETP slag. During the experiments, a more rapid destruction of the foam bubbles was found, leading to compaction of the foamed slag-alkaline solution. As a result, the density of the samples was high (1,03–1,17 g/cm^3). To explain, it is possible with high alkalinity of the chosen system, leading to a rapid destruction of freshly molded bubbles of the entrained air.

Table 3. Physical and mechanical properties of slag alkaline foam concrete

№	Ratio of components, gr.		SDS, ml	PB-2000, ml	Curing conditions	Compression strength after28 days, MPa	Density of the samples after 28 days, g / cm^3
	ETP slag	Sand					
1.	300	250	160	0.9	normally-moist	4.11	1.03
2.				1.8		5.55	1.17

Note: from 160 ml of SDS, 120 ml was used to prepare the solution and 40 ml of foaming foam

The microstructure of the slag-alkaline foam concrete was examined using an electronic optical microscope. On microphotographs of samples of slag-alkaline foam concrete (Fig. 3), clearly formed pores, cracks on the walls of pores and partitions are visible. The resulting cracks in the form of a grid may have formed as a result of internal stresses during hardening. Perhaps for these reasons, the strength of the samples was 4.11–5.55 MPa.



a) with an increase of × 300 times b) with an increase of × 4000 times

Figure 3. Microphotographs of pore structure of slag alkaline foam concrete

Conclusions

During the research it was found that the minimum required time for grinding ETP slag is not less than 60 minutes. The best strengths of fine-grained powders were achieved in fine-grained powders, by grinding for 60–90 minutes. It has been established that the amount of foaming agent "PB-2000"

has a negative influence on the physical and mechanical properties of the slag-alkaline binder. It was also possible to obtain a slag-alkali foam concrete with a strength of 4.11–5.55 MPa and a density of 1.03–1.17 g/cm^3.

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ENERGY RESOURCE-SAVING IN A THERMAL POWER PLANT AUXILIARY

Abstract: The paper presents the main reasons of electric drives wasteful modes in the system of Thermal Power Plant auxiliaries. As example, the way for improvement of the modes of work of electrical drives on the Takhiatash Thermal Power Plant in Uzbekistan, the use of frequency-controlled drive for feeding electric pump with the power of 4000 kW is suggested.

Keywords: Thermal Power Plant, auxiliaries, electric motor, operating mode, frequency regulated electric drive, power block.

Introduction

The growth of electricity consumption in all countries of the world, as well as in the Republic of Uzbekistan over the past decade, significantly exceeded the rate of commissioning of generating capacity, which led to the formation of a deficit of free capacity reserve.

The problem of power shortage can be solved in two ways: either by increasing the pace of construction and commissioning of generating capacity, or by rational consumption of energy produced and the introduction of the latest energy-saving technologies. It must be borne in mind that the cost of creating 1 kW of generating capacity amounts to a huge amount of investment, while the cost of introducing modern energy-saving technologies is no more than 10 percent of the invested amount, respectively. In addition, the construction and commissioning periods of thermal power plants range from 3 to 5 years and require significant investments, while the results of energy savings in the implementation of energy-saving technologies can be obtained in the next one to two years [1–5].

One of the largest consumers of electricity are blade pumping units, fans, compressors, which are used in industry, agriculture, and also in the ON system of a thermal power plant.

The system of own needs (ON) of a power plant is a complex of auxiliary electrical equipment of a power plant, ensuring the uninterrupted operation of its main units (steam boilers, turbine generators). The power plant's own needs include: power and lighting power stations, battery systems, emergency power sources, electric motors of all mechanisms – pumps (water, oil, oil, etc.), fans, smoke exhausters and the most common in thermal power plants – unloading mechanisms railway cars, fuel supply, coal preparation and dust preparation.

Energy saving in the ON system is considered on the example of a 4000 kW feed pump at the Takhiatash thermal power plant of the Republic of Uzbekistan. Asynchronous electric motors with a squirrel-cage rotor are installed on electric motors in the own needs system of the Takhiatash Thermal Power Plant (TPP), the electric motors are powered from 6 and 0.4 kV. Monthly electricity generation is 281875975 kW · h, and electricity consumption for own needs is 29033225.4 kW · h [according to the data of the technical and technical equipment of the Takhiatash TPP]. The quality of energy-saving technology of the pumping unit uses a variable frequency drive.

Experimental Part

Today, the consumption of electricity for own needs exceeds 10%, although it should not exceed 5–7% of the total generated electricity.

The main reason for the uneconomical modes of operation of the mechanisms of their own needs and the loss of fuel and electricity are variable loads of thermal power plants. Due to the variable modes of most of the power units, the operational reliability and efficiency of both the main heating and mechanical equipment and the mechanisms of the system's own needs – numerous pump and fan installations and their drive asynchronous motors – are deteriorating. Frequent start-ups and shutdowns of power units, changes in their loads are accompanied by losses due to non-optimal operating modes of the main equipment and mechanisms of the own needs system, due to the need for throttling of heat carriers (steam, water, air, gases).

Frequency-controlled electric drive is one of the most effective tools for improving energy consumption and reducing costs in the production and distribution of electrical and thermal energy, and to increase the reliability of operation.

The composition of the frequency – controlled electric drive includes a standard or special asynchronous or synchronous electric motor, a transistor or thyristor frequency converter, a matching transformer or reactor, a starting control and switching equipment [2].

Consider the case when the motor with a constant moment of resistance on the shaft is powered at rated voltage from the mains with a frequency less than nominal. Reducing the frequency will cause an increase in magnetic flux and an increase in torque. Since the moment of resistance remains constant, the slip will be reduced to such an extent that the balance between the engine torque at a reduced frequency and the moment of resistance is maintained.

Due to an increase in the magnetic flux, the rotor current decreases, and the no-load current increases. The stator current may increase or decrease, as well as for the case of increasing voltage.

Thus, lowering the frequency is almost equivalent to increasing the voltage. Therefore, if, as the frequency decreases, the voltage decreases accordingly, the magnetic flux, and hence the no-load current, rotor current, and stator current, will remain the same as during normal operation. In this case, there will be some change in the losses in the steel and, consequently, the active component of the no-load current. These changes will practically not affect the magnitude of the stator current [1–2].

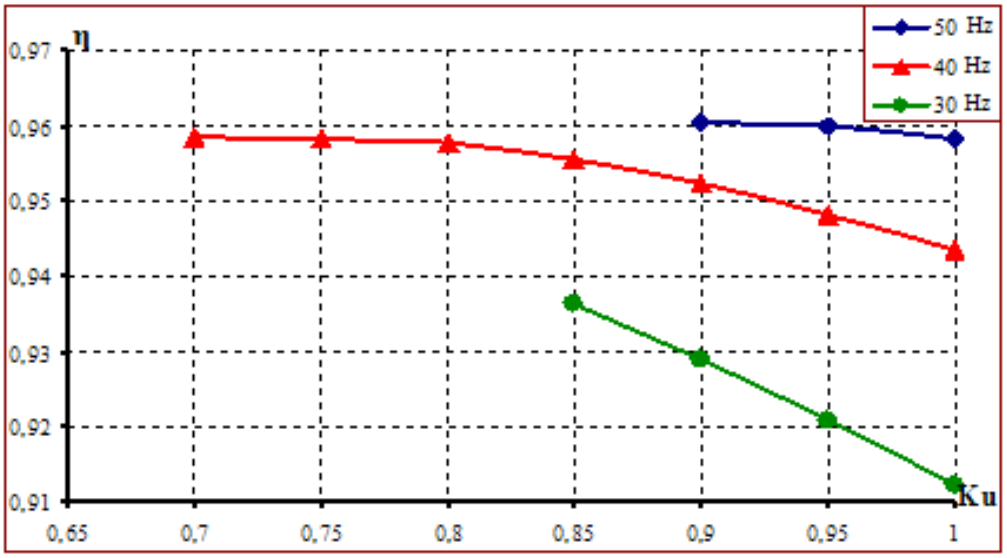

Figure 1. Efficiency change with frequency and voltage Ms = 0.87

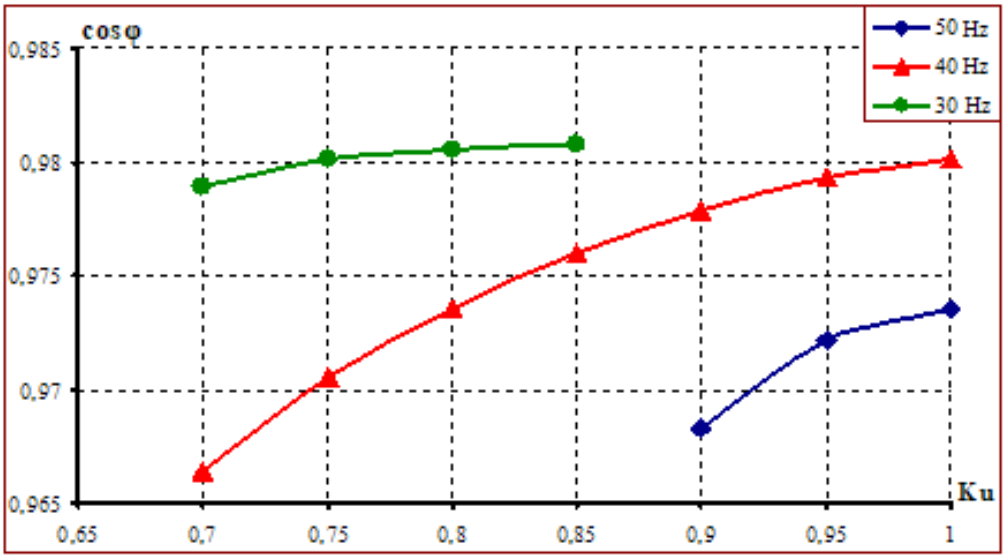

Figure 2. Power factor change with frequency and voltage Ms = 0.87

Based on the foregoing, the calculation of the frequency-controlled electric drive of the feeding electric pump was made. Technical parameters of the electric motor: nominal power 4000 kW (working power 3500 kW), voltage 6 kV, moment of resistance M_S = 0.87, nominal stator current 400 A, power factor cosφ – 0.89, electric motor efficiency – 97.3%. The results of the calculation are shown below in graphical form (Fig. 1. and Fig. 2). The working efficiency of the pump unit at a load of M_S = 0.87, η = 0.947. And the total engine loss was 196 kW. After changing the frequency and voltage, the engine efficiency reaches η = 0.96 with the same load. And the total loss of the engine is 146 kW. It should be noted that the use of a frequency – controlled electric drive makes it possible to save energy by reducing the loss of electric motors in the ON TPP system.

Conclusions

Calculations have shown that when using a frequency – controlled electric drive, it is possible to reduce engine losses, increase efficiency, and also improve the quality of process control.

In addition, the use of a frequency – controlled electric drive leads to the following possibilities:

- high quality regulation;
- large range of regulation;
- high profitability;
- ease of use;
- ease of operation and maintenance.

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FORMATION OF QUANTITATIVE SIGNS WHEN CONSTRUCTING THE ALGORITHMS FOR CLASSIFICATION OF ELECTRONIC EDUCATIONAL RESOURCES

Abstract: The Scientific work considers the problem of formation of quantitative features from the initial set of different types of data when constructing classification algorithms under conditions of high dimensionality of an attribute space. To solve this problem, a new approach has been proposed, based on the Boolean separation of classified electronic educational resources.

Keywords: Electronic educational resources, course elements, complex of features, database, classification.

It is central question nowadays to carry out monitoring over electronic information systems, the quality of electronic resources, their validity and their continual update [1; 5].

The database of information, saving the information existed even before the invention of computers. This was done with the help of notepads, special copybooks for notes and so on. Together with the society information systems are also developing. The state also has taken several measures to develop the sphere and to apply computer technology in different areas of society including the institutions and establishments.

The essence of this approach is as follows. The studied subsets of different types of data are checked for the presence, if they exist in the database of electronic resources, depending on the presence of formed elements in the database are assigned values of 1 or 0, then based on the generated data, an algorithm is proposed for generating quantitative *N* signs by normalizing the elements consisting of valid numbers.

There are various classification features of electronic educational resources (EER), therefore, their characteristic parameters should be identified [1; 2; 5]. Usually, the main object of the LMS (Learning Management System) systems is understood as course elements, in which EER are considered as software products. Therefore, given the many types of e-learning resources, their classification by goal and specific features seems relevant. Electronic educational resources consist of course elements, in turn, course elements include a complex of various signs (in the form of texts, numbers, dates, etc.), for example:

1. Lecture – $x_{pi}^{j_1}\ \left(j_1 = \overline{1,k_1}\right)$, course element consisting of complex j_1-signs – p-class object;
2. Task – $x_{pi}^{j_2}\ \left(j_2 = \overline{k_1+1,k_2}\right)$, in which it has also the complex of text features $\left(j_2 = \overline{k_1+1,k_2}\right)$:
3. Test tasks – $x_{pi}^{j_3}\ \left(j_3 = \overline{k_2+1,k_3}\right)$;
4. Glossary – $x_{pi}^{j_4}\ \left(j_4 = \overline{k_3+1,k_4}\right)$;
5. Seminar – $x_{pi}^{j_5}\ \left(j_5 = \overline{k_4+1,k_5}\right)$;
6. Forum – $x_{pi}^{j_6}\ \left(j_6 = \overline{k_5+1,k_6}\right)$;
7. Chat – $x_{pi}^{j_7}\ \left(j_7 = \overline{k_6+1,k_7}\right)$;
8. Resource – $x_{pi}^{j_8}\ \left(j_8 = \overline{k_7+1,k_8}\right)$;
9. DB – $x_{pi}^{j_9}\ \left(j_9 = \overline{k_8+1,k_9}\right)$;
10. Wiki – $x_{pi}^{j_{10}}\ \left(j_{10} = \overline{k_9+1,k_{10}}\right)$;
11. Questionnaire – $x_{pi}^{j_{11}}\ \left(j_{11} = \overline{k_{10}+1,k_{11}}\right)$ and so on.

In other words, course elements consist of objects that include various sets of features. The numerical representation of these complexes is carried out in 2 stages: at the first stage, depending on the presence of formed elements in the database, 0 or 1 values are assigned, then at the second stage, based on the generated data, the transformation takes the form of normalization of elements consisting of real numbers.

Thus, after the first stage, e-learning courses x are presented as a group of the following course elements.

$$x = \left(\underbrace{x^1, x^2, \ldots, x^{j_1}}_{\text{group 1}}, \underbrace{x^{j_1+1}, x^{j_1+2}, \ldots, x^{j_2}}_{\text{group 2}}, \ldots, \underbrace{x^{j_{N-1}+1}, x^{j_{N-1}+2}, \ldots, x^{N}}_{\text{group } N} \right) \quad (1)$$

For example, the 3rd group of a set of features expressing types of computer testing includes the types of tests, the form of answers, the bank of questions.Now, based on the above data and using (1), we can present electronic educational resources of the class X_p in the context of groups of course elements in the form of the following table.

$$X_p = \begin{bmatrix} x_{p1}^{1}, x_{p1}^{2}, \dots, x_{p1}^{j_1}, x_{p1}^{j_1+1}, \dots, x_{p1}^{j_2}, x_{p1}^{j_2+1}, \dots, x_{p1}^{j_{N-1}+1}, \dots, x_{p1}^{j_N} \\ x_{p2}^{1}, x_{p2}^{2}, \dots, x_{p2}^{j_1}, x_{p2}^{j_1+1}, \dots, x_{p2}^{j_2}, x_{p2}^{j_2+1}, \dots, x_{p2}^{j_{N-1}+1}, \dots, x_{p2}^{j_N} \\ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \\ x_{pm_p}^{1}, x_{pm_p}^{2}, \dots, x_{pm_p}^{j_1}, x_{pm_p}^{j_1+1}, \dots, x_{pm_p}^{j_2}, x_{pm_p}^{j_2+1}, \dots, x_{pm_p}^{j_{N-1}+1}, \dots, x_{pm_p}^{j_N} \end{bmatrix} \quad (2)$$

Here $p = \overline{1,r}$ means the total number of courses taught in an r – educational institution, and m_p – expresses the number of teachers who teach p – discipline.

This table is completed based on the software [4] developed as part of the work. Elements of the table consist of the digits 0 or 1, which are determined using the program. If teachers introduced the parameters of the course element to the system, this element is assigned the value 1, if not – 0. The elements of this table reflect the quality of the training course created by the teachers, in addition, the table allows you to determine the quality and completeness of courses, monitor the training course on an ongoing basis items.

The above EERs are classified based on hidden data relationships using the proposed classification methods [1; 3].

At the second stage, the set of j_3 – tests i – the electronic training course given with respect to (1) has the parameters of extensive tests. Thus, the assessment of the EER is related to the significance indicators of these extensive internal parameters, which are determined by experts in different scales. The simplest indicator is the presence or absence of a parameter. After that, it becomes possible to make special criteria for evaluation.

$$x_{pk}^{1} = \frac{1}{j_1}\sum_{i=1}^{j_1} x_{pk}^{i}, x_{pk}^{2} = \frac{1}{j_2 - j_1}\sum_{i=j_1+1}^{j_2} x_{pk}^{i},$$

$$x_{pk}^{3} = \frac{1}{j_3 - j_2}\sum_{i=j_2+1}^{j_3} x_{pk}^{i}, \dots, x_{pk}^{N} = \frac{1}{j_N - j_{N-1}}\sum_{i=j_{N-1}+1}^{N} x_{pk}^{i}$$

Here x_{pk}^{i} – parameters of course elements $k = \overline{1,m_p}$. As a result, a table is formed, the normalized elements of which consist of real numbers.

$$X_p = \begin{bmatrix} x_{p1}^{1}, x_{p1}^{2}, \dots, x_{p1}^{N} \\ x_{p2}^{1}, x_{p2}^{2}, \dots, x_{p2}^{N} \\ \dots\dots\dots\dots \\ x_{pm_p}^{1}, x_{pm_p}^{2}, \dots, x_{pm_p}^{N} \end{bmatrix} \quad (3)$$

The mathematical expression of the classification of the components of electronic educational resources, course elements is formed in the context of signs. Training courses created by teachers are presented in tabular form using course elements. It is justified the assignment of the elements of the table (2) values of 0 or 1 using the software. An algorithm for generating a standardized quality table (3) using course elements has been developed.

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STUDYING THE TECHNOLOGIC PROCESS OF THE OPERATING ELEMENT FOR ASSEMBLY OF PAWLS FORMATION

Abstract: The article presents the results and method of study the process of formation of longitudinal ridges in the rows of cotton. A schematic diagram on installation of the formation of longitudinal ridges in cotton rows pacings is developed.

Keywords: Pawl, coil conveyor, slope angle of soil, number of coil conveyor rotation, soil volume.

Introduction

Decree of the President of the Republic of Uzbekistan #PF-4947 dated 7th February 2017 "Actions strategies on further development of the Republic of Uzbekistan" and Resolution of the President of the Republic of Uzbekistan #PK-3459 dated 4th January 2018 "Supplementary measures to increase agricultural equipment" [1; 2] shows its valuable importance in mechanization of this sphere.

Lessening energy and resources in economy, the use of energy saving technologies for production, wide use of being restored energy sources, increasing labor productivity in economy sphere are set up in the 3rd chapter 3.2 part, 7 item in the Strategy of Actions of development the Republic of Uzbekistan in the period of 2017–2021 years, and 3 chapter 3.3 part is indicated works which are being performed in the sphere of agriculture "Modernization the agriculture and develop it intensively" [1].

Nowadays the most part of cotton growing appropriates to irrigated farming. Nevertheless cotton growing in irrigating agriculture demands more labor forces, it is considered preferable for high yields productivity. Because of crops' area relf and uneven fields related with the cotton irrigating process will be implemented better by means of dividing pawls on the small fields. In this process along and across cotton pawls should be implemented before irrigating and use it till the end of crops period. Taking into consideration and making it quantities with all agricultural means is considered the actual problematic issue. Nowadays this process is being carried out by means of manual work at certain farmers. Manually made capsizer creating surface pawls is also being used. This device does not give an opportunity to use widely because of creating across pawl between cotton raw doing aggregate in twice, the height of hurting cotton young growth. As solution of such kind of problems the scientists are doing research work according to create. This by technical means to form two longitudinal aggregating get done among a number of cotton past the threshold, at the same time to injure the cause of the high level of the germination of cotton-wide, there is no allow you to apply. The solution of this problem by scientists as among a number of active cotton Bukhara branch of the Tashkent Institute of Engineers for Mechanization and Agriculture to form a longitudinal threshold screw work conducts scientific research in the

creation of the device. Recommended his new device has many advantages, particularly the lack of negative effects on cotton and energy economical, and other advantages of the threshold implementation as a form i.e. in transition.

Novelty of this recommended assembly which is created along pawl between cotton rows is defended by useful patent model № FAP 00671 by the intellectual property of the Republic of Uzbekistan.

Among the news of the longitudinal threshold as recommended assembly cotton pawls this form of utility model patent at the Intellectual Property Agency of the Republic of Uzbekistan is protected by № FAP 00671. The soil for the purpose of lifting and transport device at a specific angle from the body of work screw were used.

Checking results of theoretical research conducted on the creation of this device working parameters and modes of the body of his work experience program in research in order to study the effects on the productivity of the work of bodies in laboratory conditions of energy section, and provided the basis of the parameters.

A number of longitudinal experimental studies among cotton the threshold in accordance with the program to form the model for conducting experimental research in laboratory conditions of the device prepared (Fig.1).

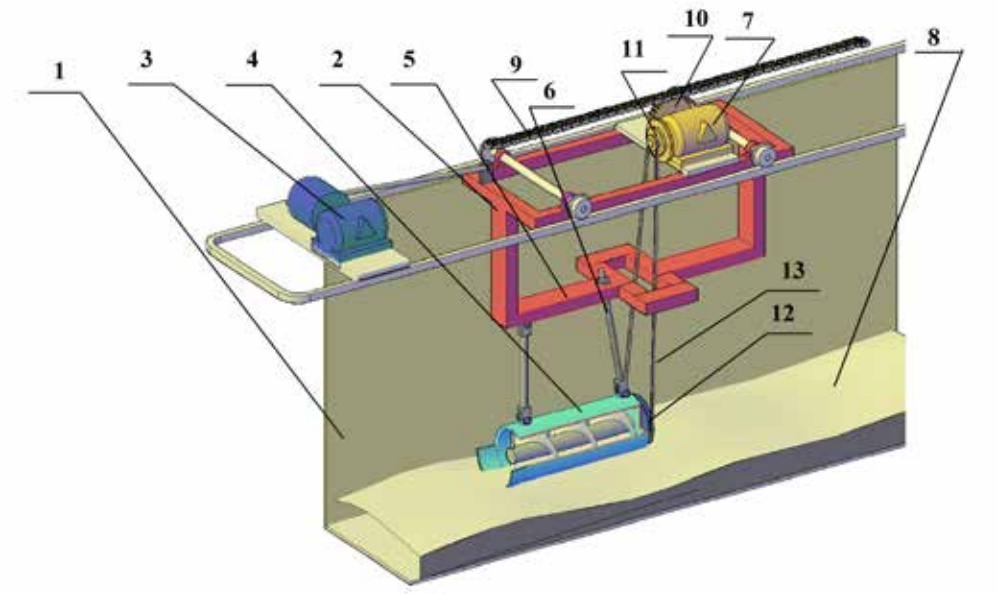

Figure 1. Laboratory assembly to investigate technologic process of creating along pawl device between cotton rows

From the model envisaged for the implementation of this laboratory prepared the following research work:

– work up the soil in relation to the direction of the movement of the body screw to set the angle of rotation of screw of his work due to the speed of movement and the number of studies on the productivity effects.

– blade raised in relation to its axis of screw of the corner to determine the effect on work productivity;

– screw its energy and agronomic performance to determine the effect of step diameter;

– experience using the planning method from which many of the working body to determine the value of parameters and modes of rational use.

A special laboratory to conduct research in the context of the laboratory experience and prepared the design of the device (Fig.1).

The laboratory device consists of the following parts: the soil of the channel 1, the wheelchair can move freely 2, (electric engine) 3, 4 screw the body of work of body work to set up a special device acting the wheelchair 5, the direction of the body in relation to the full settings available work actions a combination of the situation device 6 to transfer the rotary actions in the plane perpendicular to the body of work reducer device 7, become in the process of offering expenses out of the wheelchair due to the number of the chain gear 9, gear star shaped 10, 11 and 12 consists of a gear between the straps 13 forming pulley.

The device works in the following order of laboratory. The soil moving device that can move freely while the wheelchair 2 to channel 1 (electric engine) 3 moves forward. Experience device (screw body work) 4, 5 through a special device mounted to the wheelchair 2. The working action of the straps to the wheelchair body 2 through 13 screw 4 gear mounted cone special from 7 reducer device works out. Laboratory work in relation to the direction of movement of the device 6 is replaced by the slope angle combination of the body 4 screw. I am handling

the removable device in the laboratory experiment the results from the soil's volume 8 will be evaluated through.

To change the angle of inclination relative to the movement of the laboratory device from 0 to 75 degrees on the reverse side of the support, a threaded connection 6 is installed.

The main working element of the device at this angle the soil laboratory work screw carrier body 4, the rotary movement of the wheelchair's forward stationary be tried along with her 2 two-storey chain of 7 to 10 through the gear 9 to come to action from the reducer device in the shape of star cone, committing three gear rotary motion out of it that shaft making in diameter from 11 to 13 by straps 12 divided parts pulley of the screw is transmitted. Pulley that purpose through the change of level of the soil's rotation due to the rotary motion, which removes screw through this change and to determine the optimal number of parameters is designed to achieve. Laboratory model of creating along pawl between cotton rows' assembly is prepared according to working organ size 1/3 and fixed to soil channel cart through special device creating along pawl in soil channel laboratory assembly, gives an opportunity to practice several speed movement in operation modes (Fig.2).

Figure 2. Side view of laboratory assembly which creat along pawl between cotton rows

Requirement of soil and experimenting.

Making laboratory experiments with hard soil, its wetness and granules are the same condition as fields.

Soil's layer wetness 0–15 cm keep the same with hardness of it 10.3–12.1% and 0.16–0.33 MP.

In laboratory assembly is aimed to determine descent corner according to movement direction of coil conveyor working organ, number of coil conveyor step and rotatory number, speed movement and coil conveyor diameter, effect of raising coil conveyor to energetic and agro machine indications, this is assessed by productivity of work.

All indicators are intended to implement in accordance with UzRH.63.07: 2001 and Tst.63.03:2001 "Experiment of agricultural machine. Methods of economic effectiveness of experimental machine." Programs and methods of experiments RD10.5.1–91 [3, 4].

Experiments make an opportunity fixing α=25°, 35°, 45°, 55° and 65° descendat corner according to horizon and speed movement of coil conveyor rotatory movement number ν=30; 42 and 55 RPM.

Version of coil conveyor diameter d_{sh}= 80; 90and 100 мм, raising corner γ = 70°, 80°, 90° and its step q_{sh}= 25, 35 and 45 mm are prepared on the base of theoretic research results.

5 repeated measuring process will be implemented on the base of these parameters the results are taken from 3 point of soil channel and determined average mathematical value in experiments.

Laboratory assembly gives an opportunity to move in V= 0.5, 0.75, 1.2 m/s working organ of soil channel direction. These speeds coincide with II and III step of aggregate.

Special reducer device elector motor fixed in laboratory assembly and it provides rotator number (750, 1000 and 1500 RPM.) and model 4A U128 works to move cart which is in soil channel.

Coil conveyor diameter, steps and raising corner parameters are determined by making 3 version experimental models coincide with laboratory device which is created pawl between cotton rows coincide with its value. So taken results from laboratory coincides with field and land areas.

Conclusion

Using this style will help to do hard and difficult experiments and take the results fast and suitable.

Through taken the use of this style one can easily get the best and fast result during experiments getting results are worked mathematically get the same size and it gives an opportunity to prepare working examples without mistake. So it will bring lessening working expenditure. It will also enable to compare results which are taken from assembly in field and laboratory and through that research work will be assessed.

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INVESTIGATION OF REACTIVITY AND SYNTHESIS OF CLINKERS FROM RAW MATERIALS WITH THE USE OF BASALT ROCKS

Abstract: Raw mixes using basalt rocks have high reactivity, which allows to complete the processes of mineral formation at a temperature of 30–50 °C below with a reduction in heat consumption for clinker burning. When two-component raw mixes were fired using limestone from the Jamansay-2 deposit and basalt rock of the Berkuttau section, the optimum sintering interval of clinker (1400–1420) °C. For raw mixes that include limestone from the Jamansay-2 field, the clay component of the Berkuttau section and iron-containing cinder of the Almalyk Miningand Metallurgical Combine, the optimum firing temperature is 1450 °C, which corresponds to the classic temperature indicator for the production of portland cement clinker.

Keywords: limestone, clay, basalt, aluminosilicate and iron-containing component, roasting, clinker, cement, free calcium oxide.

Introduction: All available information on basalt is related to geological processes of volcanic eruptions. An analysis of literature data on the location of the basalt rock of Uzbekistan's deposits showed that the main occurrence of basalt igneous rock can be observed on the surface of the earth's crust. Such an arrangement of basalts occurred after oceanic volcanic eruptions, with the rapid cooling of magmas, when, along with numerous magmatic rocks, basalt was formed [1–2].

The igneous rocks (basalts, gabbros, diabase-porphyrite, etc.) differ in their crystalline structure from traditional iron-containing additives (with a melting point of 1380–1450 °C) and melt at lower temperatures (1105–1250) °C, which leads to a lower the sintering temperature of the raw material mixtures containing these rocks. Melting temperature range of basaltic rock of the Berkuttau section (1180–1190) °C. Samples of basalt sand and basalt sample of the Berkuttau section are similar in chemical composition and content of regulated oxides fully comply with the requirements imposed by.

O'zDSt 2950: 2015 for igneous rocks used in the production of portland cement clinker, and are recommended for use when conducting technological tests as aluminosilicate and iron-containing components [3].

The formulation of the problem. Studies have been conducted to establish the possibility of clinker synthesis based on local raw materials using basalt rocks for the production of general construction and sulfate-resistant cements of the brand with a strength of at least 400.

Methods of research materials, equipment and tools: Chemical analysis of raw materials, raw mixes and roasting products was performed in accordance with the requirements of GOST 5382–91 "Cements and materials of cement production Chemical analysis methods" [4]; The mineralogical composition of the raw materials and calcination products was determined on an x-ray unit "DRON-4" with a copper anode at a shooting speed of 2 degrees per minute and using ά-quartz as an external standard; the temperature range of melting of the basaltic rock of the Berkuttau section was established according to the method developed at the Research and test center "Strom" Institute of General and inorganic chemistry of the Academy of sciences of the Republic of Uzbekistan using a high-temperature electric heating furnace; Compositions of raw mixes and clinkers for general construction and sulphate-resistant cements are calculated according to a special program using the formulas S.D Okorokova in accordance with the requirements of O'zDSt2801: 2013 "Portland cement clinker. Technical conditions" [5]; firing of raw mixes was carried out in a laboratory silica oven; the temperature during firing was controlled by a TPR thermocouple with a secondary device; Grinding experienced clinkers on cement was carried out in a laboratory ball mill MBL when loading "grinding media: grindable material = 5.5: 1"; assessment of the quality of raw materials for clinker production was carried out in accordance with the requirements of O'zDSt 2950: 2015 "Raw materials for the production of portland cement clinker. Technical conditions".

Results and discussion: On radiographs of a technological sample of basalt from the Berkuttau section (Fig. 1), diffraction reflections of chlorites dominate with d/n = (0.649; 0.466; 0.442; 0.402; 0.384; 0.369; 0.360; 0.352; 0.318; 0.292; 0.272; 0.258 …) nm. In addition, in the sample there are: quartz with d/n = (0.334; 0.222; 0.212; 0.196; 0.181 …)nm.; calcite with d/n = (0.303; 0.248; 0.232; 0.206 …)nm.; dolomite with d/n = (0.285; 0.217; 0.206 …)nm.

The increased background level of diffraction reflections indicates the presence of a glass phase in the basalt sample of the Berkuttau section, which is typical of igneous rocks.

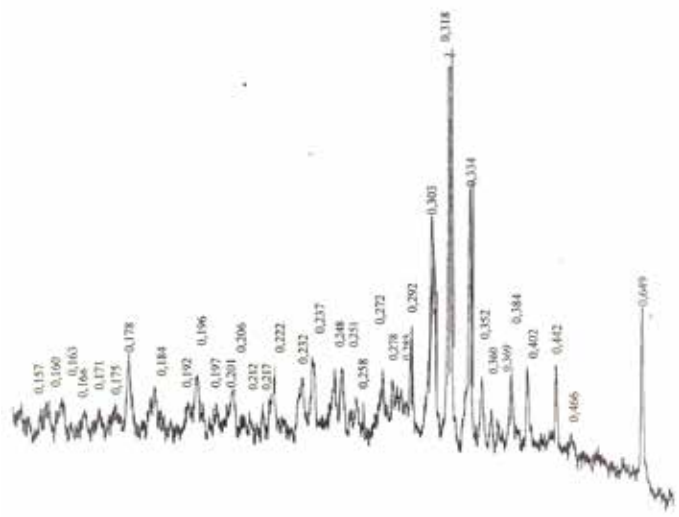

Figure 1. Radiograph of a technological sample of basalt from the Berkuttau section, nm

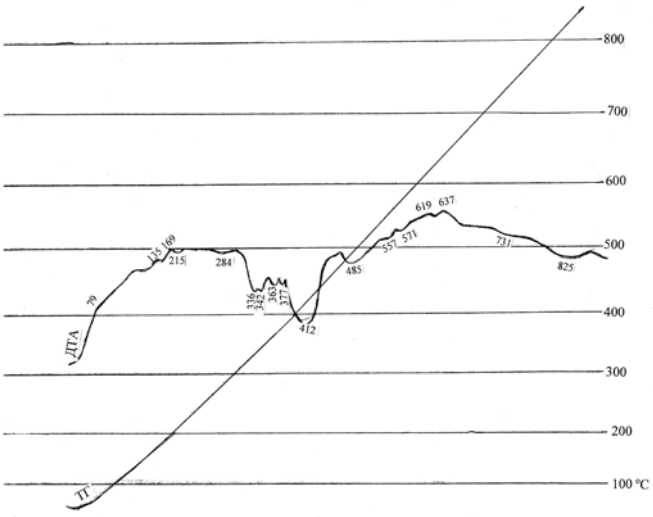

Figure 2. Heating curves of basalt of the Berkuttau section

Differential-thermal analysis established that the process of basalt heating of the Berkuttau section (Fig. 2) is characterized by twelve endothermic effects at (215; 284; 336; 342; 363; 377; 412; 485; 557; 571; 731; 825) °C and five exothermic effects at (79; 135; 169; 619 and 637 °C. Endothermic effects are associated with the phased decomposition of chlorites (aqueous silicates of Al; Mg; Fe3 + of complex and variable composition), dolomites, and calcium carbonate. Exothermic effects correspond to the processes of rearrangement of the crystalline structure of the igneous rock. The total mass loss in the temperature range (60–900) °C along the thermogravimetry curve is 11.85% [6].

It has been established by calculation that on the basis of two-component raw mixes using (82.09–84.22)% limestone of the "Jamansay-2" deposit and (15.78–17.91)% of the basalt rock of the "Berkuttau" section as aluminosilicate and iron-containing component it is possible to obtain clinkers for general construction cements with chemical-mineralogical composition and modular characteristics that meet the requirements of O'zDSt 2801.

In order to reduce the mass fraction of basaltic rock of the Berkuttau section (from 15.9 to 8.09)%, the introduction of (from 0.43 to 6.84)% of the clay component of the North Jamansay deposit is recommended in the composition of two-

component raw mixes. Three-component raw mixes and clinker based on limestone from the Jamansay-2 field, the clay component of the North Jamansay field and basalt rock from the Berkuttau section, in terms of chemical-mineralogical composition and modular characteristics, fully comply with the requirements of O'z DSt 2801.

Raw mixture number 2; 3; 6; 12; 15; 16 studied the reactivity by burning in the temperature range (1000–1450) °C and analysis of the products of burning for residual content of free calcium oxide. The burning of the pellet samples (d = h = =20)mm was performed in a laboratory silica oven with sampling in the temperature range (1000–1450) °C and 1450 °C with an exposure time of 30 minutes. The amount of free calcium oxide in the calcination products was determined by the alcohol-glycerate method according to GOST 5382. The results of the determination saregivenin (Table 1).

Table 1.– The content of free calcium oxide in the burning products

No.	Name and the material composition of the raw mix,%	Content of free calcium oxide,%						
		1000	1100	1200	1300	1400	1450	1450 °C, 30 min shutter speed
1.	Raw mixture number 2 – Technological test of limestone – 83.19 – Technological sample of basalt – 16.81 SC (saturation coefficient) KH = 0.90; *n* = 2.72; *p* = 2.31	30.10	21.15	15.45	5.00	0.95	0.02	–
2.	Raw mixture number 3 – Limestone technology test – 83.61 – Basalt technology test – 16.39 SC = 0.92; *n* = 2.73; *p* = 2.32	31.80	22.10	19.15	5.80	1.00	0.03	–
3.	Raw mix number 6 – Limestone Technology Test – 83.52 – Technological test clay comp.– 2.08 – Basalt technology test – 14.40 SC = 0.90; *n* = 2.80; *p* = 2.47	32.85	22.05	15.70	5.95	1.12	0.08	–
4.	Raw mixture number 12 – Technological test of limestone – 83.83 – Technological test clay comp.– 9.89 – OgarkiAlmalyk Miningand Metallurgical Combine – 6.28; SC = 0.90; *n* = 2.17; *p* = 0.95	30.20	22.00	17.42	6.40	2.65	0.15	–
5.	Raw mixture number 15 – Limestone Technology Test – 84.10 – Technological test clay comp.– 9.32 – OgarkiAlmalyk Miningand Metallurgical Combine – 6.58 *SC* = 0.92; *n* = 2.12; *p* = 0.90	33.40	24.10	20.20	7.35	2.90	0.20	–
6.	Raw mix № 16 SR PTs (sulphate-resistant portlandcement) – Limestone Technology Test – 82.72 – Technological test clay comp.– 8.90 – Ogarki Almalyk Miningand Metallurgical Combine – 8.38; *SC* = 0.87; *n* = 1.94; *p* = 0.75	27.94	21.10	17.35	6.05	1.78	0.15	–

According to the data set out in the (table 1), it can be concluded that the processes of formation and assimilation of free calcium oxide in raw mixtures based on the tested raw materials proceed intensively.

The maximum amount of free calcium oxide is observed at a temperature of 1000 °C. With increasing temperature, CaOs content.decreases sharply due to the onset of mineral formation processes [7].

Roasting products synthesized at a temperature of 1450 °C from 30 min. extract, do not contain free CaO, which indicates its full absorption in the processes of formation of the clinker phases.

The presence of basaltic rock with a melting point in the range (1180–1190) °C intensifies the process of mineral formation and accelerates the absorption of free calcium oxide, which is almost completed at a temperature of (1420–1450) °C, which is relatively lower than in raw mixtures containing cinders of Almalyk Miningand Metallurgical Combine.

Experimental data show that for firing raw mixes the optimum temperature range is (1400–1420) °C. To complete the processes of mineral formation in raw mixtures, the temperature range rises to (1430–1450) °C.

Conclusion: Thus, it was experimentally established that the raw material mixtures based on the tested raw materials have high reactivity. The mineralogical composition of the technological sample of the basalt of the Berkuttau section is characteristic of igneous rocks and is represented by a natural mixture of chlorites, quartz, calcite, dolomite and glass phase.

It was established experimentally that the temperature range of melting of the basalt rock of the Berkuttau section (1180–1190) °C. The chemical composition of the technological sample of basaltic rock of the Berkuttau section according to the content of regulated oxides (SiO_2 = 53.28; Al_2O_3 = = 16.30; MgO = 5.32; SO_3 = 0.43; R_2O = 4.50)% meets the requirements of O'z DSt2950: 2015 to the chemical composition of igneous rocks used in the production of portland cement clinker.

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ANALYSIS OF EXISTING METHODS OF ELECTRIC CONSUMPTION

Abstract: In the article the analysis of existing methods of rationing of power consumption is given as an example of the enterprises of ferrous metallurgy. Based on the analysis of existing methods, shortcomings and main tasks are identified to improve these methods.

Keywords: specific consumption, power consumption, unit production, technological and production factors.

All electricity consumption by the enterprise, both main and auxiliary technological processes, as well as auxiliary production needs, including production of cold, compressed air, lighting, water supply, heating, ventilation and losses in intra-plant networks is subject to normalization.

Under the normalization of electricity consumption the establishment of a plan for the consumption of electricity for the production of a unit of production, the processing of raw materials or the amount of work to be performed is understood.

The value of electricity consumption per unit of production is called the specific consumption of electricity.

In this case, the planned flow rate is called the rate of specific consumption (or simply the specific rate), and the actual consumption of electricity per unit of output by the unit consumption.

The specific consumption rate is understood not as an arbitrarily accepted amount of consumption, but objectively necessary consumption of electric energy for the production of a unit of output or volume of work under given production conditions, conditioned by the organization and technology of the production process; technical level of applied technological and power equipment; technical condition and mode of operation of production equipment.

The norm of the specific consumption of electricity is established on the basis of technical and economic calculation and is the maximum permissible amount of electricity consumption for the production of a unit of production (or volume of work) of a specified quality.

A progressive method for estimating the specific energy consumption makes it possible to use the appropriate norms of unit costs for forecasting energy consumption and determining the energy load in planning and design. At the same time, the specific energy consumption by production processes in shops and enterprises is an important technical and economic indicator of the energy economy of industrial enterprises [1].

However, presently, the calculation and analysis of specific electricity consumption at the iron and steel industry does not yet meet modern requirements, in view of the fact that the energy intensity of the assortment of manufactured products and raw materials coming at different stages of the technological process, the change in the quantitative ratio of the nomenclature of the enterprise's products, features of the aggregates of this industry. At present, the number of finished products produced is 70 titles and more. Moreover, the same type of finished products is produced according to different technological schemes with unequal specific electricity consumption, depending on the composition of technological units and the quality of the processed raw materials [2].

The system of rationing electricity consumption is a factor determining the policy and efficiency of energy saving. A review of existing systems for the normalization of electricity consumption according to the works of foreign scientists, is currently underway in metallurgical production [3].

Usually in the practice of production specific standards of energy resources (fuel, heat and electricity) are developed for each type of raw materials of the final product. The importance of the norms in question is that they allow you to determine the degree of energy consumption per unit of production at a particular time interval. There are more than a hundred in metallurgy existing for a separate technological process. These types of norms are determined for energy-intensive production by using one of these methods.

When using the experimental method of rationing to determine the value of the specific consumption of electricity per unit of output, measurements of electricity costs for each production process required by the regulations are necessary. It should be noted that in determining this value, considerable labor input is required, since more instruments are used. The application of this method in industrial enterprises will be extremely time-consuming, since they are characterized by a large amount of electrical equipment [4].

According to the calculation and analytical method, the determination of the value of the norms for the specific consumption of electricity per unit of output is made by calculation on the basis of the passport data of the electrical equipment used. The calculation takes into account the workload, operating modes and other individual factors affecting SEC. The presence of a multitude of energy components makes this method of element-wise calculation extremely laborious.

The calculation and statistical method of normalizing the specific consumption of electricity is based on the processing of statistical data on the absolute and specific consumption of electricity for the period under consideration and when determining the norms, all influencing factors are taken into account for the amount of specific electricity consumption. Indicators of norms are carried out on the basis of data of devices of the account of consumption of the electric power on resultant values of let out production.

To develop scientifically based forecasts of the norms for the consumption of electrical energy, it is necessary to carry out [5]:

– complex technological and energy research;
– Deep analysis of electrical balances;
– critical use of reporting and statistical materials using mathematical and statistical methods.

The absence of methods for the electric power assessment of the influence of technological factors on electric loads and electric power consumption does not allow to effectively take into account unforeseen and planned deviations from technological conditions, include in reserves of energy savings and a forecast estimate of the direction of improvement of production processes [6].

Analysis of electrical loads and power consumption of enterprises of ferrous metallurgy points to the need to identify the influence of technological factors of power consumption on its individual parameters. This will increase the reliability of analysis and calculation of power consumption of individual production units and the entire industry [7].

In work [8] methods of operative planning and management of large-capacity electric steel-smelting furnaces of metallurgical manufactures are considered. In the work when assessing the determination of the error in calculating the norms for the consumption of electrical energy, existing methods are used that do not take into account the statistical dependence of the specific consumption of electricity on the output of the final product.

In work [9], the issues of normalizing the consumption of electric energy at the enterprises of ferrous metallurgy are considered. The analysis of the above works shows that the authors considered factors influencing the value of specific energy consumption, such as: productivity, installed capacity. Accounting for the limitation of the number of influencing factors leads to a significant discrepancy between the calculated and actual results.

The review and investigation of existing, promising methods of rationing energy resources at enterprises is carried out in [10]. The advantages and disadvantages of these methods of rationing are shown. As a result, it can be concluded that the features of known and applied methods require their improvement.

In work [11], a method of energy consumption rationing for ferrous metallurgy enterprises, in particular rolling production, was proposed. The technique makes it possible to determine the value of norms using the energy characteristics of the dependence of energy consumption on the volumes of products produced, as well as the specific consumption formed by the mathematical processing of the actual indicators of specific energy consumption. But the method does not ensure the construction of energy characteristics taking into account the classification of statistical data on the range of rolling products.

Significant studies have been conducted by scientists A. Ya. Dzevensky and F. A. Khoshimov. The authors in their writings investigated the modes of consumption of industrial enterprises of heavy and light industries. The process of power consumption at these enterprises is considered for studies as a random process at different time levels (hourly, shift, monthly, annual). To analyze the influence of factors on electricity consumption, it was proposed to use multidimensional analysis methods, pattern recognition theory methods in calculating power consumption parameters, which, under conditions of weak informativeness of factors determining power consumption mode, most fully use statistical information to obtain mathematical models that accurately describe the real power consumption process. In these studies, a methodology has been developed and an analysis has been conducted to assess the states and to simulate statically inhomogeneous modes of electrical loads of electrical receivers of enterprises; energy consumption studies were performed and the energy characteristics of the main power consumers were established; recommendations were developed for improving the methods for determining the design loads of electrical receivers with

statically inhomogeneous electrical modes, for estimating energy consumption, for synthesizing mathematical models to determine promising levels of electrical consumption, under conditions of uncertainty and incompleteness of information.

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THE PROBLEM OF REMOVAL OF DEPOSITS FROM HEAT EXCHANGE SURFACES AND THEIR GRINDING

Abstract: Data on the character of formation of deposits on heat exchange surfaces are presented. The main methods of cleaning contaminated surfaces are shown. Methods of waste treatment and utilization are presented.

Keywords: heat exchange, surfaces, methods, waste treatment, utilization.

In the process of ethyl alcohol production the main waste is liquid after-alcohol bard. The yield of the bard can reach 390 tons per day with the capacity of the distillery in 3000 dal of alcohol per day. In the technological process of utilization of liquid bard, on the walls of the heat exchange equipment, solid deposits are formed, which are difficult to separate from the surface. The rate of growth of these deposits strongly affects the efficiency of the devices and generally limits the performance of the entire distillery as a whole.

To date, the most common method of disposal of bards is a technology that includes the use of centrifuges, evaporators and dryers. The main problem of this technology is the rapid formation of deposits of the processed bard on the walls of the heat exchange equipment.

In order to develop recommendations for the operation of existing technological equipment and the possible use of new designs, we have set the following tasks:

1. Creation of new experimental facilities that simulate the formation of deposits on different heat exchange surfaces under different operating conditions;

2. Development of recommendations to reduce the rate of growth of deposits on the walls of technological equipment.

As our studies of drying kinetics on liquid bard substrates have shown, the formation of certain structures is observed. At all investigated modes of drying of a surface of the dried-up bard the thin film is formed.

The structuring of the solid phase in the film continues throughout the drying process. A similar phenomenon is observed on the walls of heat exchange equipment, for example, in evaporators [1].

To determine the effect of the process modes, methods of mechanical and thermal treatment of liquid bard on the experimental setup developed by us, simulating the operation of typical shell-and-tube heat exchangers and tubular film evaporators, studies were conducted that simulate the process of occurrence and development of deposits of dried bard on the walls of the heat exchange equipment [2].

The analysis of the obtained values showed that the adhesion value for the corn bard is less than that of the grain bard by 4–10 times.

An increase in the temperature of the heat exchange surface leads to an increase in the adhesion value by 1.5–3 times [3].

The main mechanical processes of chemical technology include grinding of solid materials and classification (sieving) of bulk materials.

There are: crushing (final particle size about 20 mm) and grinding (smaller particles). There are also: large, medium, fine and colloidal grinding. Apply accordingly: crushers (e.g., cheek, roll, etc.) and mills (e.g., runners, rotating drum mills with grinding balls, finger disintegrators, colloidal bead mills of wet grinding with small glass balls, ultrasonic grinding, etc.).

Classification is the separation of a mixture of particles into fractions by particle size. Apply: mechanical classification (screening, screening) on sieves, sieves, perforated drums, etc.; hydraulic classification in hydrocyclones, sedimentation tanks; air classification (separation) – in jet machines, cyclones, separators.

Grinding is a very energy-intensive process. The power consumed for grinding depends on the properties of the material and the multiplicity of grinding.

Specific energy consumption for grinding they consist of the cost of elastic and plastic deformation e and the cost of increasing the surface of the material to be ground and the specific surface energy.

Therefore, the main rule when grinding – do not grind. In addition to unnecessary energy costs, the quality of the crushed product often deteriorates, and the trifle and dust can lead to clumping, sticking, sintering during further processing.

In industry, usually use a sequential scheme of coarse, medium, fine grinding with intermediate classification (sieving), with the removal of the cycle of particles required (or less) size and return (recycle) of the particles to re-grinding (fines are sometimes sent to the agglomeration).

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METHODOLOGY IN MULTICRITERIA PROBLEMS OPTIMIZATION AND UNIFICATION OF PARAMETERS OF POWER SUPPLY SYSTEMS

Abstract: The article deals with the General provisions of the method of formation, mathematical models used in multi-criteria optimization and unification of the parameters of power supply systems. The developed algorithm of multi-criteria harmonization of cross-sections of the lines method for vector optimization of additional criteria of energy losses and consumption of conductive metal and the particular value of an optimized (unificarea) parameters.

Keywords: multicriteria analysis, simultaneity coefficient, unification, normalization, optimization.

The literature on the optimization and unification of large energy systems describes possible methods for solving multicriteria problems and the complexity of obtaining quite specific and reliable recommendations based only on the cognitive application of the necessary criteria or their use with "weight" coefficients, etc. [1].

In connection with these difficulties, the following briefly describes the proposed and used in subsequent works method of making recommendations for the optimal construction of power supply systems (SES). At the same time, the process of developing optimization solutions and recommendations consists of two stages:

1) the stage of formalized determination of the area of optimal solutions with possible full consideration of all influencing factors and conditions;

2) development of decisions and recommendations based on the results of a formalized decision and taking into account the effects of conditions and criteria that are not compatible with the forms of their fixation.

The basis of decisions at the first stage is the technical and economic model of SES (or its reasonably allocated part) in the form of costs. At the same time, all investments and costs of operation of SES facilities are determined taking into account their dependence on specific social and industrial conditions, construction and operation of electrical installations in the city, compliance with the requirements of environmental protection and human health, requirements of urban planning and urban architecture, the influence of climatic and geographical conditions, etc. In one form or another, the technical and economic model also takes into account the influence of the time factor (changes in economic and technical indicators, one-time or dispersion of investments, increase in loads, etc.).

Another part of the influencing factors and conditions, which can not be expressed in the monetary form of costs, but can be represented by certain technical characteristics, is introduced into the optimization process in the form of technical restrictions and, further, functionally associated with the optimized parameters of SES (for example, the electric field strength near substations, voltage losses, etc.). These constraints are included in the optimization mathematical model.

The application of certain methods of mathematical optimization and unification and the preparation of the SES model revealed:

a) extreme value of technical and economic model and the corresponding theoretical-optimum values of parameters of SES;

b) the area of technical and economic stability of the model and the equally optimal values of the considered parameters of the SES (within this area);

c) the sensitivity of the technical and economic function to changes in the initial information, as well as to the difference in the values of the parameters of The SES optimal;

g) if required by the terms of the task, it sets the optimal proportion of the above costs for individual subsystems, assemblies and sections of lines SES, etc.

Further, the analysis and synthesis of the complexes of the obtained results are carried out, which in most cases allow to formulate recommendations for planning the optimal development of the structure and parameters of SES, taking into account the influence of a significant (or decisive) part of all the above criteria.

It is obvious that in some cases, first of all, in specific conditions, the previous study does not give unambiguous answers to all the main parameters of electricity supply. However, the main task of planning the optimal development of SES will certainly be fulfilled: the areas of optimal values and the necessary laws of development of structures and parameters of these systems will be determined.

In cases where the influence of not all criteria can be taken into account in the form of technical limitations or characteristics of the main model of SES, the second stage of the study should be used. The latter consists in the secondary evaluation and selection of the solutions obtained by the formalized method on the basis of the system and hierarchical subordination of the criteria:

- socio-economic;
- environmental and human health protection;
- urban planning and urban engineering;
- technical and economic indicators;
- quality of implementation and functioning;
- geographical and climatic conditions.

Consistent application of these criteria is based on the method of expert assessments and taking into account the specific objectives of the study or planning.

The significant stability of the technical and economic cost function (the main criterion) to the optimization parameters (for example, the cross-section of lines, the power of transformers, the number of applied cross-sections of lines, etc.) does not allow you to clearly select these parameters. In this case, it is necessary to take into account additional criteria for a certain choice of parameters. This means that when solving the optimization problem under consideration, it is necessary to perform taking into account additional criteria.

Vector optimization method can be used to solve the problem [1].

The developed algorithm of multi-criteria harmonization of cross-sections of the lines when using the method of vector optimization for additional criteria of the energy loss DE(NF) and consumption of conductive metal G(NF).

The application of the vector optimization method to the selection of the number of applied line sections according to additional criteria of power loss and consumption of conductive metal is based on mathematical models of these criteria.

If the optimized parameter to consider the number of used cross-sections of the lines, the mathematical model of the additional criteria of the energy loss DE(NF, N) and consumption of conductive metal G (NF, NB) for the PC has the form [2]:

$$\Delta Э(N_{F,H}) = A_7^H N_{F,H}^{0,3} \quad G(N_{F,H}) = A_8^H + A_9^H N_{F,H}^{-1}$$

Where: $A_7^H = \Delta Э_{(1)}^H \delta^{-0,46} S_{ТП(У)}^{2,46} M_{H(оср)}^{-1,21} F_{2,H(оср)}^{-1}$

$$A_8^H = G_{(1)}^H \delta^{-0,19} S_{ТП(У)}^{0,19} M_{H(оср)}^{1,06} F_{2,H(оср)}$$

$$A_9^H = G_{(2)}^H \delta^{-1,38} S_{ТП(У)}^{1,38} M_{H(оср)}^{-0,13} F_{2,H(оср)}$$

Here: $\Delta Э^H{}_{(1)}$, $G^H{}_{(1)}$, $G^H{}_{(1)}$ – generalized constant coefficients, which are the initial data for this problem.

$M_{H(оср)}$, $F_{2,H}$ – accordingly, the number of lines departing from the *TA* and the cross section of the head section of the lines obtained subject to restrictions.

The main objective of the method is to optimize the additive scalar efficiency vector:

$$Y(N_F) = \lambda_1 \Delta Э(N_F) + \lambda_2 G(N_F)$$

Where λ_1, λ_2 – accordingly, the coefficients of importance of the criteria of power loss and consumption of conductive metal.

When solving multi-criteria optimization problems, it is necessary to bring the criteria under consideration to a single measurement scale (normalization).

We define the normalized criteria of power losses $\Delta Э^*(N_{F,H})$ and the consumption of conductive metal $G^*(N_{F,H})$ for *PC*:

$$\Delta Э^*(N_{F,H}) = \frac{\Delta Э(N_{F,H}) - \min \Delta Э(N_{F,H})}{\max \Delta Э(N_{F,H}) - \min \Delta Э(N_{F,H})} = \frac{N_{F,H(\max)}^{0,3\ -1}}{N_{F,H(\max)}^{0,3\ -1}}$$

The following are accepted:

$\min \Delta Э(N_{F,H}) = A_7^H$ при $N_{F,H} = 1$

$\max \Delta Э(N_{F,H}) = A_7^H N_{F,H(\max)}^{0,3}$ при $N_{F,H} = N_{F,H(\max)}$

The normalized flow criterion for conductor metal is:

$$G^*(N_{F,H}) = \frac{N_{F,H}^{-1} - N_{F,H(\max)}^{-1\ -1}}{1 - N_{F,H(\max)}^{-1}}$$

The maximum number of line sections (*NF* (max)) that can be applied to Rs is determined by the number of parcels in each line. In turn, the number of parcels is determined by the number of connections to the lines and is:

$$N_Y^C = \frac{S_{ИП}}{k_0 S_{ТП(У)} M_C}$$

Where K_0 is the coefficient of simultaneous loading of transformers for the network lines.

The choice of the optimality principle on the additive scalar vector of efficiency can be identify with the choice of the criterion of the best approximation of normalized values of criteria $\Delta Э^*(N_F)$ and $G^*(N_F)$. The optimal solution is chosen according to the model [1]:

$$N_F^0 = F^{-1}\left[\min_{N_F}\gamma^*(N_F)\right] =$$

$$= F^{-1}\left[\min_{N_F}(\lambda_1 \Delta\Theta(N_F) + \lambda_2 G^*(N_F))\right]$$

where F^{-1} is the reverse conversion of γ^* to N_F.

In this task, the most uncertain and, at the same time, essential is the choice of ratios of coefficients λ_1 and λ_2. Therefore, fundamentally calculations should be carried out for three possible ratios of coefficients: $\lambda_1 > \lambda_2$ – the loss of electricity is more important than the flow of conductor metal; $\lambda_1 = \lambda_2$ – they are of equal importance; $\lambda_1 < \lambda_2$ – The flow of conductor metal is more important than Loss of electricity.

Optimum values of number of applied sections of *RS* lines are obtained depending on the density of electric load for loopback and for two-beam circuits of networks. Thus the consideration of different degrees of importance of the considered criteria adverse a significant influence on the choice of the optimal number of applied sections of the *RS* lines. So at $\lambda_1 > \lambda_2$ Optimal is the application of only one section of lines, otherwise $(\lambda_1 < \lambda_2)$–2 ÷ 4 sections of lines. At equal importance of criteria $(\lambda_1 = \lambda_2)$, execution of *RS* is expedient with application of one or two standard sections, and *RS* – with application of two sections of lines in all range of density of electric load (5 mw/km^2 and more).

The preferred importance of the energy saving factor is the principle, rather than the economy of conductor metal consumption. So one of the main provisions of the strategies of action for the further development of the Republic of Uzbekistan for 2017–2021 years is the implementation of active energy-saving policies in all directions, in particular reduction of electricity losses. In addition to the development of the national economy, the problem of saving natural energy resources will remain quite relevant.

Thus, it may be considered expedient (justified) to solve the problem at the preference of the criterion of loss of electricity $(\lambda_1 > \lambda_2)$ or, in the extreme case, its solution at $\lambda_1 = \lambda_2$. The solution when $\lambda_1 > \lambda_2$ corresponds to the application of one section of cable living in Rs. It is recommended to use the section 150 mm^2 in considered *RS*.

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EVALUATION OF DIFFERENT VISCOSITY INDEX IMPROVERS IN LOCAL LUBE OIL BASE STOCK BY MEANS OF SONIC OSCILLATOR

Abstract: In this paper the VIIs' (polymers') stabilities to the destruction in local base oil are compared, it covers the evaluation of the shear stability of engine oils in terms of the final viscosity that results from irradiating a sample of the engine oil in a sonic oscillator. The correlation has been presented between the shear degradation that results from sonic oscillation and that in engine. PVL (permanent viscosity loss) and PSSI (permanent shear stability index) of oils prepared with different viscosity modifier were evaluated. As a result, the effectiveness of each additive for lube oils was evaluated.

Keywords: VII, lubricant, sonic oscillator, engine oil, permanent viscosity loss, permanent shear stability index.

1.Introduction

Modern high-performance lubricants are specifically formulated with a carefully selected balance of performance additives and base stocks to match the lubrication requirements of the equipment in which they are used. Lubricants are often designed to provide a viscosity that is low enough for good cold weather starting and high enough to provide adequate film thickness and lubricity in hot, high-severity service [1]. Viscosity index (VI) represents the effect of temperature on the kinematic viscosity of lubricant oils, and was initially proposed by Dean and Davis in 1929. It measures the stability of the kinematic viscosity with temperature [2]. The higher the VI, the more stable the kinematic viscosity with temperature. For petroleum lubricant oils, a VI slightly above 100 is almost the maximum limit attainable by economical refining processes. Any additional increase in the VI can only be achieved with the addition of polymers known as Viscosity Index Improvers (VIIs) [3].

In the following work we have made several engine oils by adding several types of VIIs to our local mineral base oil. Furthermore, we checked their PVL and PSSI by means of sonic oscillator in order to compare their properties during their functioning period. The results of this work and conclusions are given at the end.

2. Experimental Part

2.1. Apparatus

Disperser ultrasonic low-frequency UZDN-2T, which includes an ultrasonic generator, magnetostrictive radiators at 22 kHz with exponential concentrators. *Cooling Bath or Ice Bath*, to maintain a jacket temperature of 0 °C, with a rubber cover to fit a reaction tube. *Test tube as a reaction vessel. Chronometer. Thermostats* to keep the temperature at 40 ° C and 100 ° C. *Viscometer*, any viscometer and bath meeting the requirements of Test Method D445 or GOST 33–2000. *Mercury glass laboratory thermometers* in accordance with GOST 28498 with a scale division price of 0.5 °C.

2.2. Materials

Solvents for washing the reaction vessel; gasoline aviation grade B-70 according to GOST 1012, toluene according to GOST 5789, acetone according to GOST 2603. AMG-10 oil that meets the requirements and norms specified in GOST 6794–75. K-61: Thickening additive for oils and greases. J0050 ethylene propylene rubber copolymer lubricant additive. High viscosity modifier Infineum SV261. PAO-150. An additive (a prototype sample) that we have produced in a laboratory condition. Local mineral base oil.

2.3. Procedures

We conducted an experiment according to some standard Interstate Test Methods [4–6]. By combining these methods, we could achieve our aim, to compare our VII, which we have synthesized in laboratory condition, to other VIIs present in local market. This experiment was carried out in laboratory "PetroTestAvto" LLC.

2.3.1. First of all, we prepared engine oils with the same kinematic viscosity (the deviation is 0.3 mm^2/sec, which is allowable) at the temperature of 373 K. Kinematic viscosities of the lubricants were determined [6].

Figure 1 Ultrasonic low-frequency disperser UZDN-2T

2.3.2. Generator UZDN-2T is included in the electric network, water is supplied to the radiator jacket and the lamps are heated for at least 1 minute. The system is adjusted to resonance for the maximum noise of the test oil. The power setting is determined according to ASTM D2603.

2.3.3. 15 mL of the engine oil sample is introduced to be tested into a clean reaction tube and immersed in the constant temperature bath at 0 °C. The reaction tube is kept in a vertical position. The sample is allowed to equilibrate for 12.5 min. The horn is immersed in the fluid. The sample is irradiated for 40 min at exactly the same power setting determined. Upon completion of irradiation, the sample is removed and the sonic horn is cleaned in preparation for the next test.

2.3.4. 15 mL sample from engine oil is irradiated in a sonic oscillator for a period of time and the changes in viscosity are determined by ASTM Test Method D445 or GOST 33–2000. Viscosity indices of these engine oils have been determined as recited in GOST 25371–97 (ISO 2909–81). PVL and PSSI of the engine oils have been calculated. The data, which was taken before sonic shearing test by means of UZDT-2T, has been reported in Table 1 and the results after the test have been given in (Table 2).

3. Measurements

3.1. Viscometric Measurements were carried out according to ASTM Test Method D445 or GOST 33–2000.

3.2. Permanent shear stability index of each lubricant is calculated via the formula below:

$$PSSI = \frac{KV_{fresh} - KV_{sheared}}{KV_{fresh} - KV_{base}} * 100$$

3.3. Thickening power of each VII is calculated using the following equation:

$$TP = \frac{KV_{fresh} - KV_{sheared}}{KV_{base} * C_{\%}} * 100$$

3.4. The stability of the viscosity of the oil or PVL – the relative decrease in viscosity after the radiation on the unit UZDN-2T in percent calculated by the formula:

$$PVL = \frac{KV_t^0 - KV_t^\tau}{KV_t^0} * 100$$

Where, KV_t^0 is the kinematic viscosity of the test oil at 100 °C, mm²/s; KV_t^τ kinematic viscosity at 100 °C after radiation, mm²/s.

3.5. Viscosity indices were calculated according to GOST 25371–97 (ISO 2909–81).

4. Results and Discussion

Table 1.– The data before sonic shearing

Name of an additive	VII% Wt.	KV at 100 °C	KV at 40 °C	VI	Increase in viscosity	Thickening power
Base Oil	0	9.15	82.92	81	–	–
J0050	0.42	13.26	120.13	106	4.11	106.9
K-61	0.51	13.03	111.73	111	3.88	83.1
Infineum SV261	6.65	13.29	115.99	111	4.14	6.8
PAO 150	9.7	13.14	115.34	109	3.99	4.5
Prototype sample	10.1	13.03	103.18	123	3.88	4.2

Table 2.– The data after sonic shearing

Name of an additive	KV at 100 °C	KV at 40 °C	VI	Increase in viscosity at 100 °C	Thickening power	PVL	PSSI
Base Oil	9.15	82.92	81	–	–	–	–
J0050	10.93	102.47	89	1.71	46.3	17.6	56.7
K-61	10.86	91.67	103	1.66	36.6	16.7	55.9
Infineum SV261	12.49	117.1	98	3.34	5.5	6.0	19.3
PAO 150	12.59	112.81	103	3.44	3.9	4.2	13.8
Prototype sample	12.62	106.36	112	3.47	3.8	3.1	10.6

By this experiment we evaluated the shear stability with minimum interference from thermal and oxidative factors that may be present in engine. The essence of the method is to determine the relative decrease in the viscosity of the oil after scoring on an ultrasonic unit due to mechanical destruction (degradation) of polymer additives. By this way, we can predict any VII's functioning period in engine oil. Although, other than polymer degradation many factors, such as fuel dilution and oxidation may effect the viscosity index of used engine oil, GOST 23175–78 [7] can be used to evaluate thermal and oxidative stability beforehand. Moreover, in engines, which run with gas, the dilution of oil does not happen.

5. Conclusions

5.1. By this work we compared the VIIs' (polymers') stabilities to the destruction in local base oil, it covers the evaluation of the shear stability of engine oils in terms of the final viscosity that results from irradiating a sample of the engine oil in a sonic oscillator.

5.2. Evidence has been presented that a good correlation exists between the shear degradation that results from sonic oscillation and that in engine. Although, the process in engine is so complicated and simulation it in laboratory condition is so arduous, we can at least predict how the VIIs will perform their function in there.

5.3. PVLs, TPs, PSSIs and viscosity indices of lube oils with different viscosity modifiers were evaluated. As a result, the most effective additive for lube oils, concerning PVL and PSSI, has been evaluated the additive (prototype sample) produced in laboratory condition from local raw materials, while it comes to thickening power this is valued the lowest one. Moreover, viscosity index of the lube oil prepared adding the prototype sample has been the highest, before and after the shearing process.

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THE TASKS OF ORGANIZING AND MANAGING THE INTEGRATED DIGITAL NETWORK OF OPERATIONAL AND TECHNOLOGICAL COMMUNICATION BASED ON PIC-D DEVICES AT THE ANGREN-PAP RAILWAY SECTIONS

Abstract: The article discusses the primary transport layer of the network based on the integrated optical device MO-16E1-GE. A device and software has been developed that enables remote control and monitoring of an integrated digital network of operational and technological communications at the Angren-Pap railway sections.

Keywords: operational and technological communication, types of communication, software, switching, synchronization.

Introduction

Railway transport is of great strategic importance for the Republic of Uzbekistan. It links together the economic system, ensures the stability of industrial enterprises, the timely delivery of the most important goods to the most remote corners of the country. Uzbekistan Temir Yollari Joint-Stock Company (UTY JSC), today carries almost 40% of cargo and over 70% of the country's passenger traffic [1, 16–17].

The quality of the transportation process in railway transport is determined by the speed, reliability and safety of delivery of goods and passengers to their destination. These indicators mainly depend on the success of the functioning and interaction of units and farms directly involved in the organization of the movement and operation of rolling stock.

A significant share in the organization of this interaction belongs to the telecommunication networks of railway transport of Uzbekistan, which is designed to provide communication between enterprises and structural units of railway transport in accordance with the Rules of technical operation of Railways of the Republic of Uzbekistan.

The necessary volumes and quality of communication are determined in accordance with the needs of the railway transport management system, as well as taking into account the development of communication technology and the possibility of expanding the list of services provided to subscribers of communication networks.

Types of operational and technological communication

Among the features of the transportation process on the railway transport can be called the multiplicity and territorial fragmentation of its production units, the close relationship in the work, in addition, the continuity of the production process in time. This determines the basic requirements for the organization and management of Railways [2, 132–133]. The transportation process involves employees of various specialties, the structure of which are: railway track, artificial structures, rolling stock (locomotives, cars), automation and telemechanics devices, numerous stations and separate points, energy devices, information and computing centers (ICC), etc. Strict discipline, compliance with the train schedule, operational development of measures and regulation of the fleet of cars and locomotives, ensuring the safety of trains, the minimum time of delivery of goods and passengers require all components of this complex diversified economy to work in close cooperation with each other. To ensure the interaction and smooth operation of the above-mentioned links of railway transport management, a technological communication network (hereinafter the railway communication network) has been created.

Communication network of railway transport of the Republic of Uzbekistan is a set of primary and secondary networks for communication of enterprises, organizations and structural units of railway transport in accordance with the Rules of technical operation of JSC "UTY", as well as taking into account the development of communication technology and the possibility of expanding the list of services provided to subscribers of networks.

Depending on the purpose, type of information transmitted and the impact on the management of the transportation process, secondary networks of the JTS and the CU Are organized. They serve to meet the needs of railway units for various communication services (Figure 1).

In the organization of the secondary network connection, the important role played by the network of OTS [3, 232–233; 4, 7–8].

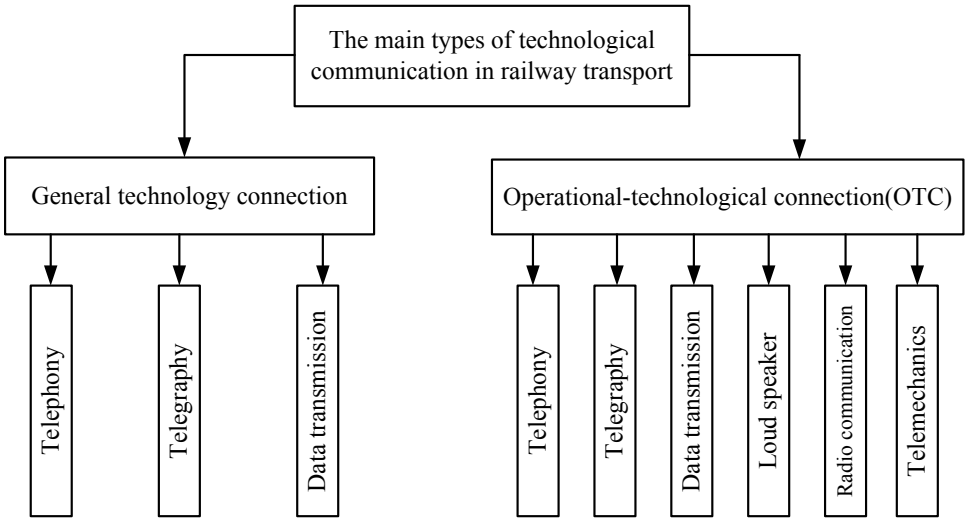

Figure 1. Classification of the main types of technological communication on railway transport

This is due to the fact that it is intended for connections and negotiations of dispatchers of the main services directly organizing transportation processes: transportation services (E), locomotive facilities (T), track facilities (P), wagon facilities (B), energy facilities (e), passenger (L), etc., with performers of technological processes of operational work which are at stations, stages and mobile objects within dispatching sites (circles), and also heads of stations and other objects of railway transport with the corresponding performers. On the territorial basis of the railway communication network can be divided into networks of main, road, separate and local communication [5, 15–16], in each of these networks organized a complex of CU and OTS, differing scope and degree of impact on the management of the relevant departments of railway transport.

Types of operational and technological communication devices used in Angren-PAP railway sections

For (Figure 2) shows a diagram of the railway sections of Angren-PAP, which have 6 stations and the length of the section is 129.5 km.

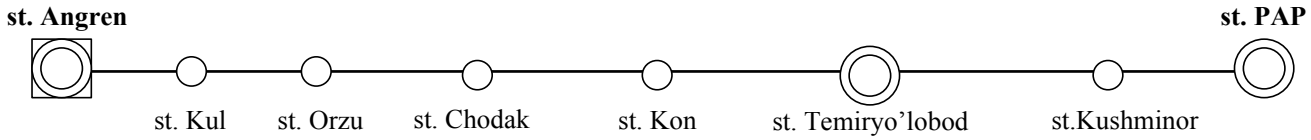

Figure 2. Diagram of the areas of Angren-PAP

The following types of OTC are organized in the Angren-PAP section (Figure Three):

- Train dispatching communication (PDS).
- Service dispatch communication (VTS).
- Linear-path communication (LPS).
- Station connection (PS).
- Ticket dispatch communication (PDS).

The following types of canal-forming equipment are used in Angren-PAP railway sections:

- multiplexer (MO-16E1-GE);
- flexible primary multiplexer (SGM).

MO-16E1-GE is a multiplexer designed to transmit Gigabit Ethernet network data and eight / sixteen E1 streams over an optical channel with a speed of 1.25 Gbit/s.

The total capacity of E1 flows in the optical channel is 88 flows. The device is an ADM (Add Drop Multiplexer) multiplexer and has the I/o capability of E1 streams on any network node. Unused streams are switched between two optical ports to transmit to the next nodes in the network. Switching E1 is carried out in the multiplexer at the level of E1 flows.

The multiplexer supports such network topologies as" point-to-point"," point-to-point "with redundancy," chain"," ring". The maximum number of multiplexers in a "chain" or "ring" is 32 nodes. Gigabit Ethernet and E1 traffic streams are protected from an optical link failure in redundant ring and point-to-point topologies.

SGM – flexible primary multiplexer multi-service access routable. Universal capabilities and a full set of standard user interfaces of the multiplexer allow to use it to a wide range of operators.

This state-of-the-art solution can be used on primary network sites, access nodes, technological network outposts with connection to PSTN and providing a complete set of modern analog/digital channel endings.

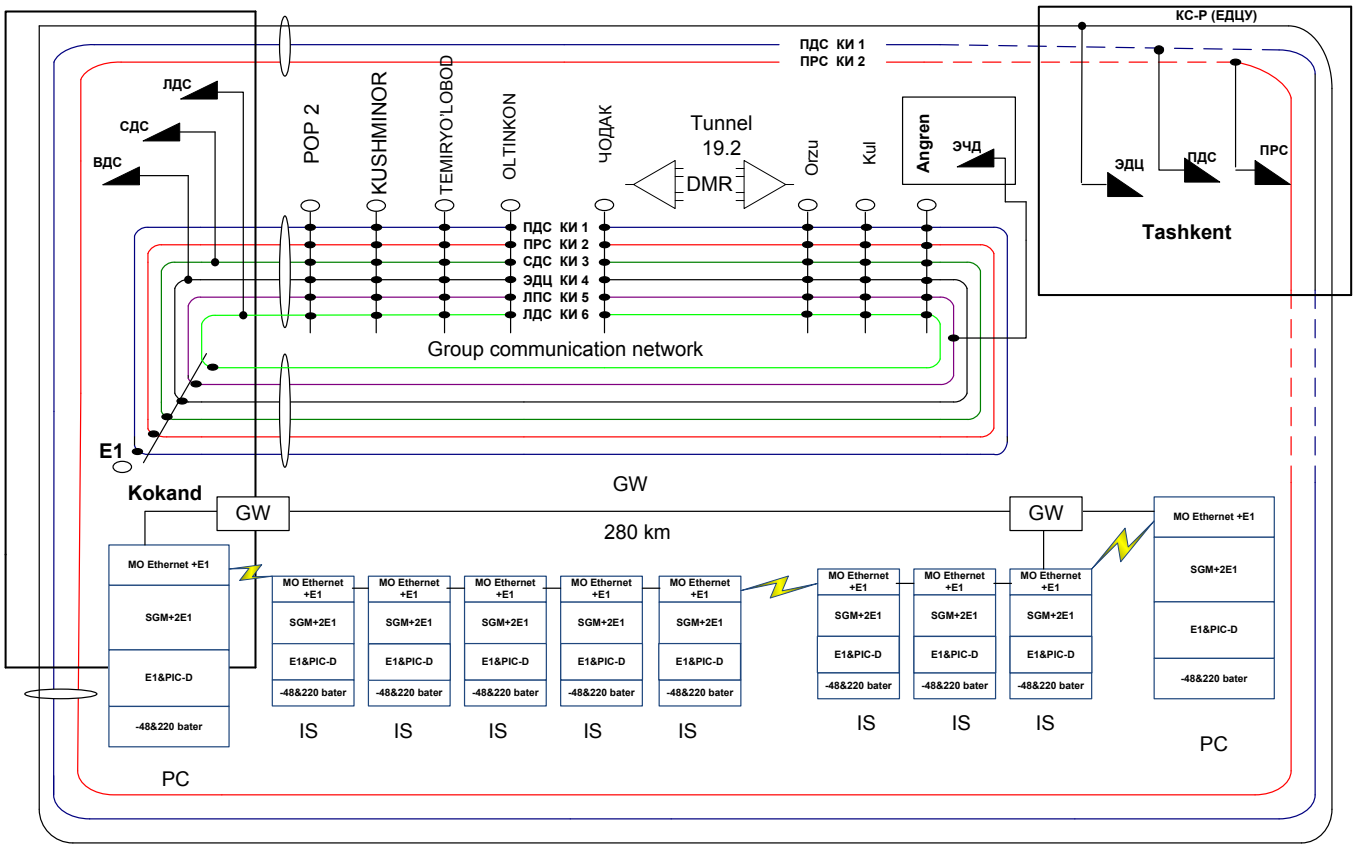

Figure 3. The scheme of passing the upper and lower level rings through multiplexers

The multiplexer can be used to organize distributed data networks, interconnect LAN and allows remote (local and network) management of multiplexers.

According to the type of communication channels used, the system can be configured in any combination using a variety of interface modules, including standard telephone channels, dedicated analog and digital lines, high-speed digital lines, E1 lines and LAN connection (Ethernet LAN). An important feature of the multiplexer is the ability to create an IP-data network superimposed on the existing TDM-network of E1 channels. This is provided by the routing function built into the multiplexer control module.

The place of switching stations are applied point of intermediate communication digital (Figure –D) on the basis of the hybrid device for service of subscribers of OTS Of management of the road having digital panels of operational communication. The (Figure –D) device provides joint work with linear complexes of digital operational and technological communication, administrative station, and also with the equipment replacing them and is fully compatible with them.

This device is domestically produced, OOO "Elius" working in the market of Uzbekistan since 1992 the Main activity of LLC "Elius – development and manufacture of telecommunication equipment. The company has a staff of highly qualified engineers and programmers capable of developing and manufacturing sophisticated modern electronic equipment. The development uses the latest chips of well-known manufacturers, which allows you to create high-quality and reliable products. All products are certified. The company also produces the development and manufacture of electronic equipment under the order according to the technical specifications of the customer.

It can be concluded that the existing OTS network of the railway of Uzbekistan is a combination of analog and digital OTS systems, and in quantitative terms analog systems prevail. The digital component includes: a switching station In the management of the road, digital group channels and digital remote control of operational communication at the dispatcher control of the road. All user devices outside the Control of the road are analog.

Settings and software of operational and technological communication devices

The (Figure–D) uses Hyperterminal software, which is a terminal program for the Microsoft Windows operating system and OS/2, developed in 1985. For example, the PIC-D device supports the Simple Network Management Proto-

col (SNMP) remote management Protocol, which connects over TCP/IP.

This Protocol is considered to be a standard Internet Protocol for programming and managing devices in IP-technology. The Protocol is typically used in network management systems to monitor connected devices for conditions that require administrator attention. For configuring and programming the device (Figure–D) is necessary for the administrator to choose the right interface cable.

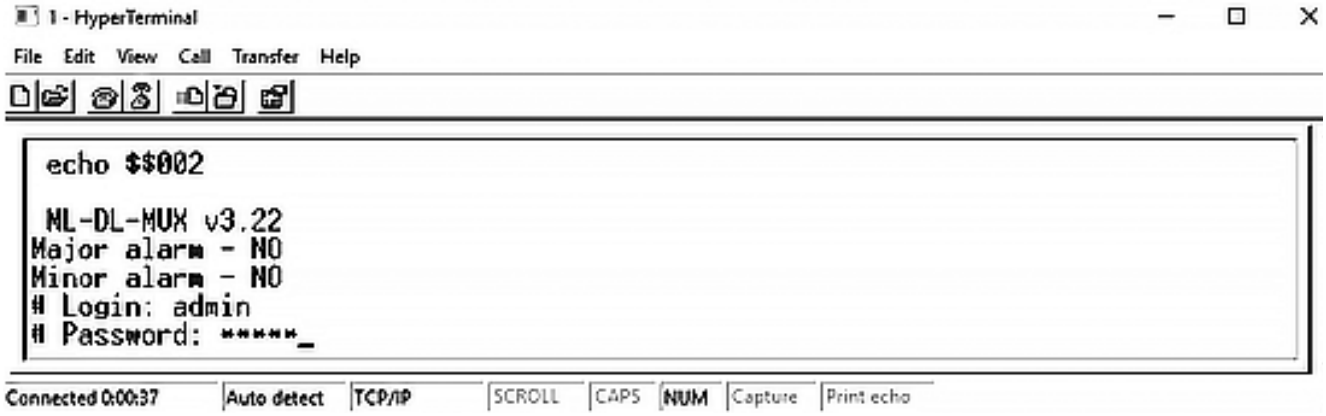

Figure 4. Connection to PIC–D device

After the connections, we dial the echo $ combination to find the device identification for further configuration. After detecting the device identification, type the command $002%01, where $ – means the connection command; 002 – the device identification number; 01–the CPU number to control the PIC-D device as shown in (Figure 4.)

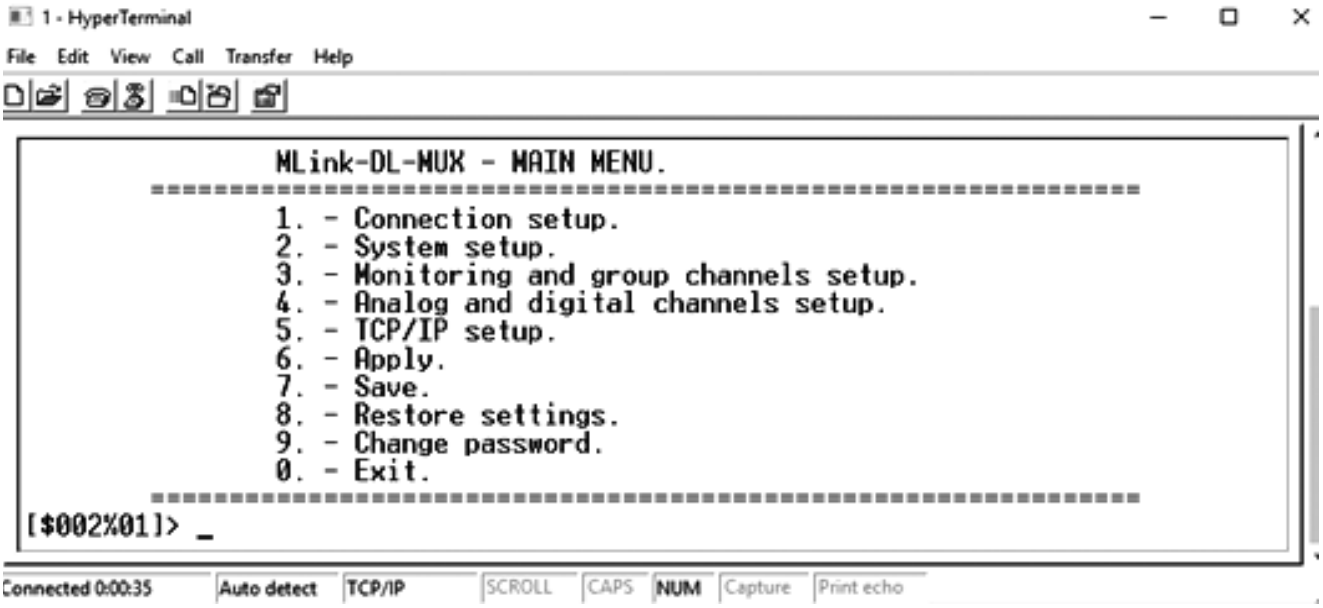

Figure 5. Main menu of PIC–D device

Then we get to the main menu where Connection setup is the main one for switching settings. In order to make connections you need to enter the menu by pressing the number 1 (Figure 5).

Next, we look at the basic functional settings for programming PIC–d devices.

For (Figure 6) the connection setup menu (Configure connections) is illustrated.

To implement the switching, make an entry:

- M8cb101: b101;
- M8cb102: b102;
- M8cb103: b103;
- M8cb104: b104;
- M8cb105: b201;
- M8cb106: b202;
- M8cb106: b203;
- M8cb106: b204.

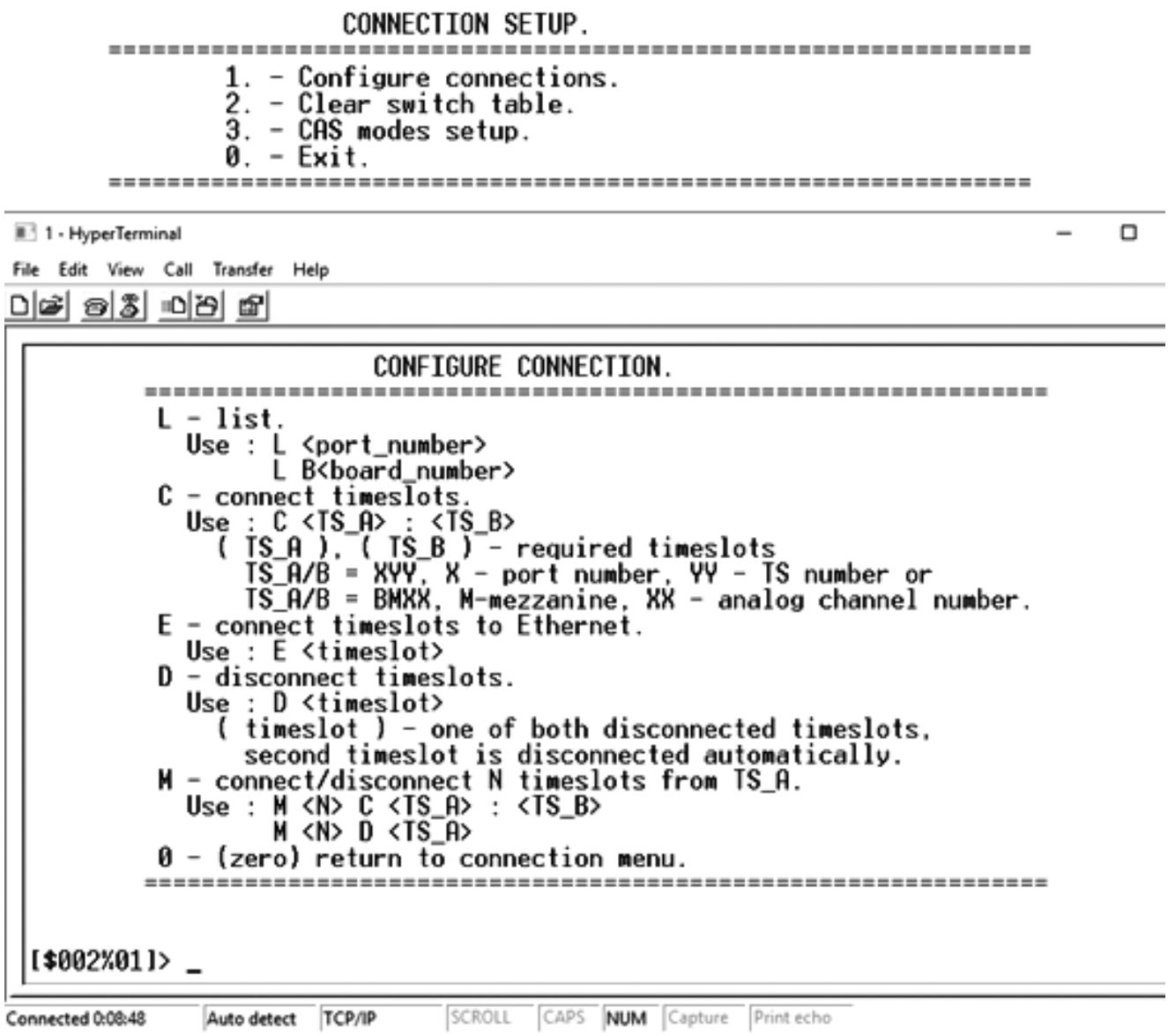

Figure 6. Connection settings menu

This means, to connect wire channel mezzanine Board VC port 4 VC Board 16 and the Board FXS4 to let 4 phone.

In order to check the cross-connections filling table, type the command L1, where L denotes the sheet, and 1 denotes the port number or the card number (Figure 7).

System Setup

This menu is used to configure and monitor the E1 system (System Setup) using the Single-pair high-speed DSL (SHDSL) standard, which provides symmetrical duplex data transmission over a pair of copper conductors. Using this option, devices PIC–D to operate the sync settings, date, time, connection speed of devices and to obtain device information and statistics on the Protocol G826 (Figure 8).

Monitoring and group channels setup

Operational and technological communication on railway transport is organized on the principle of a group channel (one to speak all listen) [6, 146–147].

For (Figure 9) shows the setting group and channel monitoring.

To create a conference call, go to the monitoring and group channels setup section, then Group voice channels setup, then Modify group channels and type (Figure 9).

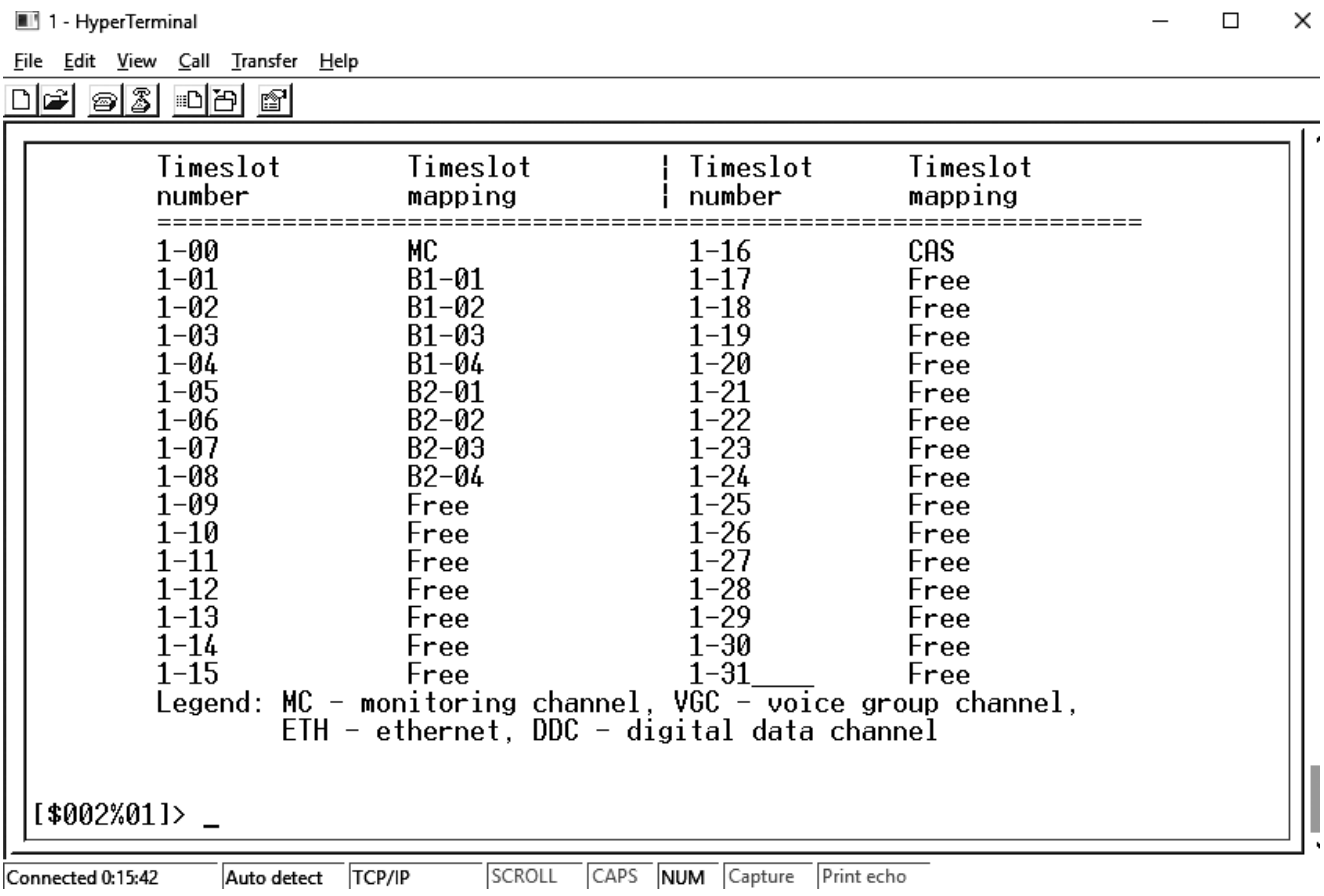

Figure 7. Check the cross-connect fill table

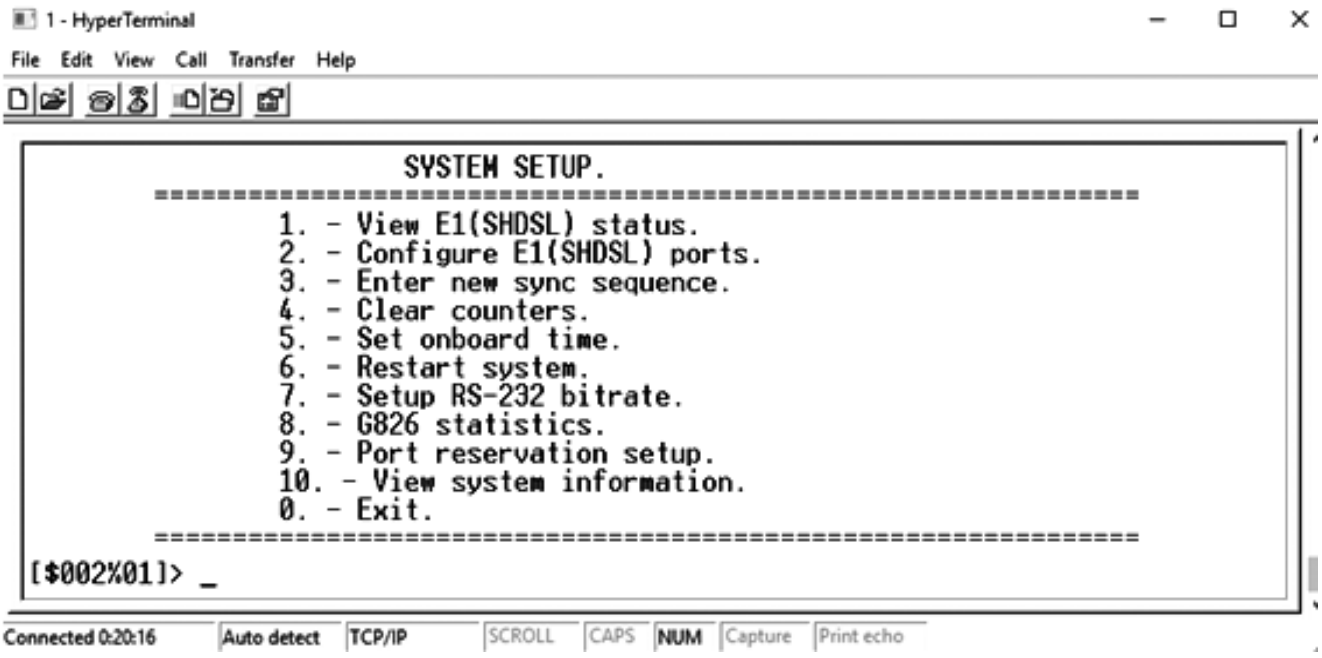

Figure 8. Main menu of device system settings

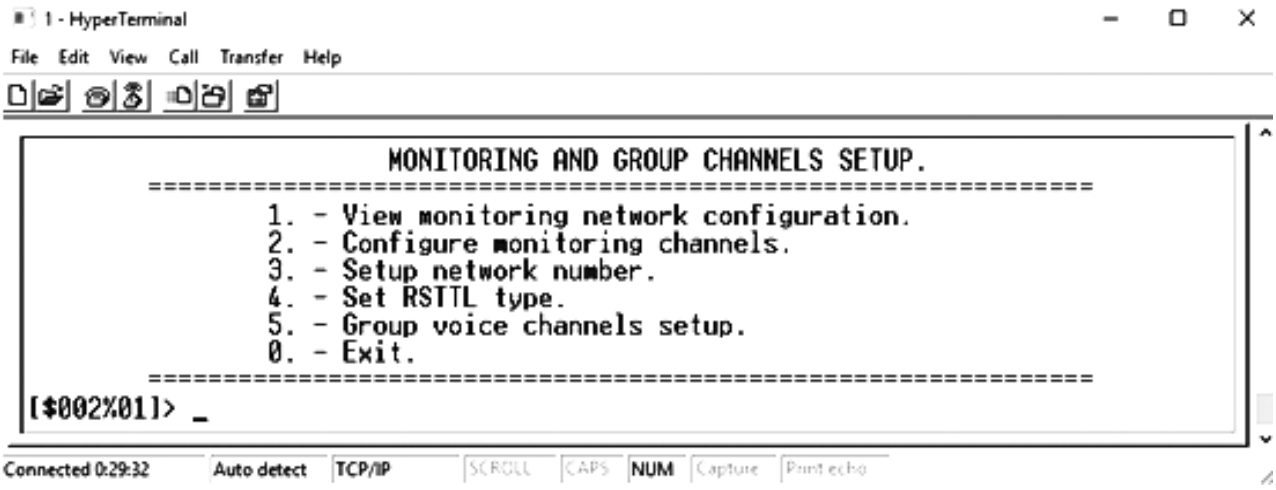

Figure 9. Configure group channel and monitoring

e0:1t201r – remote; e1: 1tb0101 – local, where e – indicates enable; 1 t – conference number; b – peripheral Board (Figure 10)

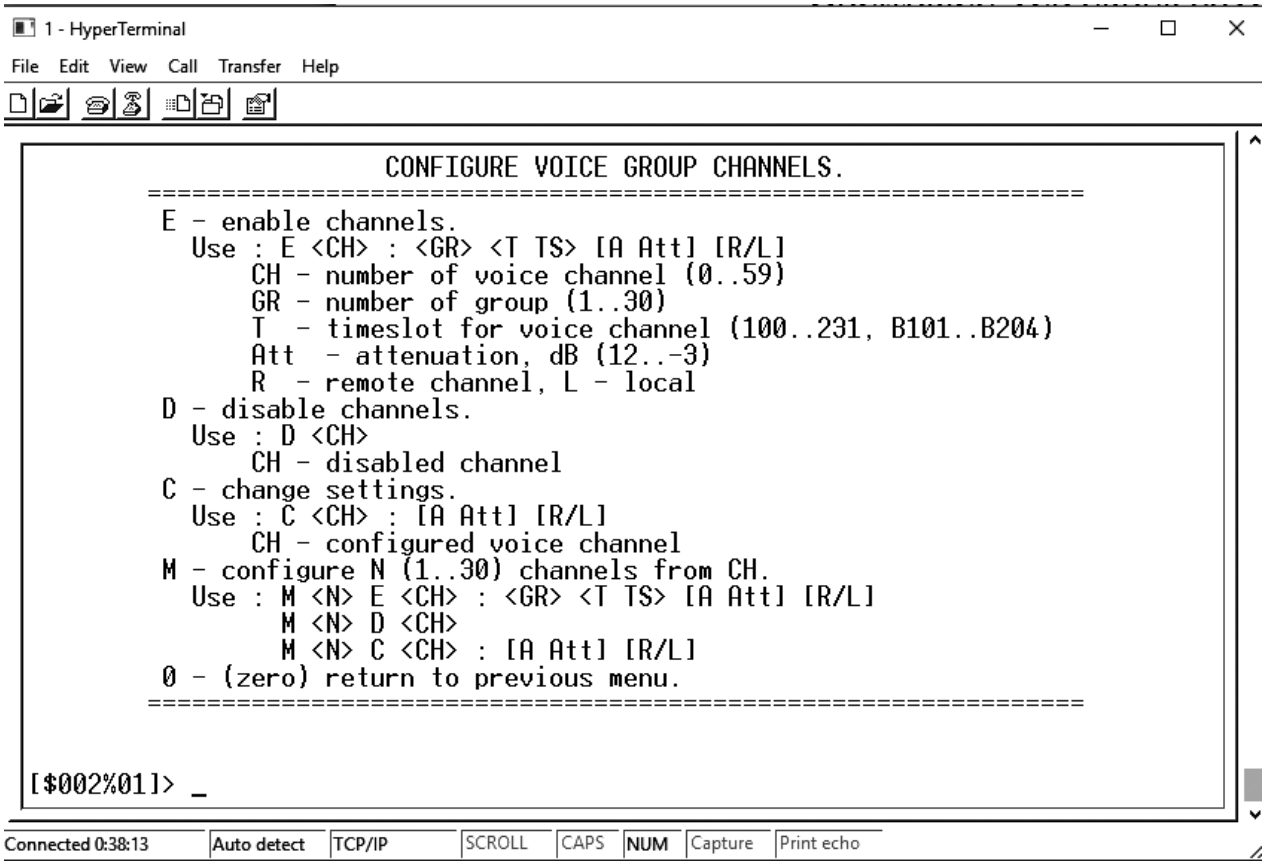

Figure 10. Setting up the group channel of PIC–D devices

Conclusion

Used in the Angren-PAP railway section, the point of intermediate communication on the basis of a hybrid device (PLC-D) is a technical and economic benefit for UTY. The main advantages of this proposed device are the following:

– devices are manufactured in the Republic of Uzbekistan;

– no special training required;

– there are additional components for network expansion;

– timely updating of software (SOFTWARE).

Based on the above, it can be concluded that the most important task at the moment is the rational choice of the device for obtaining objective assessments of the quality of OTS service on integrated digital networks of UTY JSC.

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TOPICAL CONVEYORS ARE MATHEMATICAL MODELS OF ASYNCHRONOUS MOTORS

Abstract: The article discusses, the process of launching of short-attached rotor asynchronous engines used in Angren conveyors is mathematically modeled.

Keywords: asynchronous motor, shorted rotor, sliding, starting voltage

The most important transitions are asynchronous engines. In order to investigate these processes, it is important to prioritize the voltage and frequency of currents or other dimensions of the ECM. Asynchronous machine equation can be obtained from the equation of the equation of the equation. The equilibrium equation of the voltage in the order determined is the following:

$$\left.\begin{aligned}
&\dot{U}_{s\alpha} = R_s\dot{I}_{s\alpha} + j\omega L_s\dot{I}_{s\alpha} + j\omega M\dot{I}_{r\alpha},\\
&\dot{U}_{s\beta} = R_s\dot{I}_{s\beta} + j\omega L_s\dot{I}_{s\beta} + j\omega M\dot{I}_{r\beta,}\\
&-\dot{U}_{r\alpha} = R_r\dot{I}_{r\alpha} + j\omega L_r\dot{I}_{r\alpha} + j\omega M\dot{I}_{s\alpha} + M\dot{I}_{s\beta}\omega_r + L_r\dot{I}_{r\beta}\omega_r,\\
&-\dot{U}_{r\beta} = R_r\dot{I}_{r\beta} + j\omega L_r\dot{I}_{r\beta} + j\omega M\dot{I}_{s\beta} + M\dot{I}_{s\alpha}\omega_r + L_r\dot{I}_{r\alpha}\omega_r,
\end{aligned}\right\} \quad (1)$$

Here $\dot{U}_{s\alpha}$, $\dot{U}_{s\beta}$, $\dot{U}_{r\alpha}$, $\dot{U}_{r\beta}$ – stator and auxiliary bands at the α and β axes; ω_r – rotor velocity; The $\dot{I}_{s\alpha}$, $\dot{I}_{s\beta}$, $\dot{I}_{r\alpha}$, $\dot{I}_{r\beta}$ – stator and rotor correspond to the axes α and β; R_s, R_r – Stator and rotor bearing resistance; L_s, L_r – stator and rotor travel inductance inductance; M – mutual inductivity; j – is the moment of inertia.

For asynchronous machines with a short rotor, $\dot{U}_{r\alpha} = 0$; When $\dot{U}_{r\beta} = 0$, $j\omega L_s = j\omega M + j\omega l_{s\sigma}$, $j\omega L_r = j\omega M + j\omega l_{r\sigma}$; $x_0 = \omega M$; $x_s = \omega l_{s\sigma}$; $x_r = \omega l_{r\sigma}$ For and the relative velocity $\nu = \omega_r/\omega_s$, the equation for the asynchronous machine follows:

$$\left.\begin{aligned}
&\dot{U}_{s\alpha} = R_s\dot{I}_{s\alpha} + jx_s\dot{I}_{s\alpha} + jx_0\dot{I}_{s\alpha} + jx_0\dot{I}_{s\alpha},\\
&\dot{U}_{s\beta} = R_s\dot{I}_{s\beta} + jx_s\dot{I}_{s\beta} + jx_0\dot{I}_{s\beta} + jx_0\dot{I}_{s\beta},\\
&0 = -R_r\dot{I}_{ra} - jx_r\dot{I}_{r\alpha} - jx_0\dot{I}_{ra} - jx_0\dot{I}_{s\alpha} + x_0\dot{I}_{r\beta}\nu + (x_r + x_0)\dot{I}_{r\beta}\nu,\\
&0 = -R_r\dot{I}_{r\beta} - jx_r\dot{I}_{r\beta} - jx_0\dot{I}_{r\beta} - jx_0\dot{I}_{s\beta} + x_0\dot{I}_{r\alpha}\nu + (x_r + x_0)\dot{I}_{r\alpha}\nu.
\end{aligned}\right\} \quad (2)$$

By taking $\dot{I}_{s\beta} = j\dot{I}_{s\alpha}$, $\dot{I}_{r\beta} = j\dot{I}_{r\alpha}$, and by passing an interval for stator and rotor torches located on an axis, we take the following:

$$\left.\begin{aligned}
&\dot{U}_s = R_s\dot{I}_s + jx_s\dot{I}_s + jx_0\dot{I}_0,\\
&0 = -R_r\dot{I}_r - jx_r(l-\nu)\dot{I}_r - jx_0(l-\nu)\dot{I}_r - jx_0(l-\nu)\dot{I}_s,\\
&\dot{I}_0 = \dot{I}_s + \dot{I}_r.
\end{aligned}\right\} \quad (3)$$

To rattle the rotor strap with the stator rim

$$S = \frac{\omega_c \pm \omega_r}{\omega_c} = 1 \pm \nu, \quad (4)$$

Using the expression, we obtain an asynchronous machine equation after weighing and replacing $\dot{E}_0 = -j\dot{I}_0 z_0$ and

$$\begin{aligned}
&\dot{E}_s = \dot{E}_r = \dot{E}_0\\
&\dot{U}_s = -\dot{E} + \dot{I}_s z_s, 0 = \dot{E}_0 - \dot{I}'_r z_r - \dot{I}'_r R'_r(1-s)/s,\\
&\dot{I}_0 = \dot{I}_s + \dot{I}'_r,
\end{aligned} \quad (5)$$

The Voltage Equilibrium Equation (4.2) can be written as follows

$$\left.\begin{aligned} U_{s\alpha} &= d\Psi_{s\alpha} / dt - w_s \Psi_{s\beta} + R_s I_{s\alpha} \\ U_{s\beta} &= d\Psi_{s\beta} / dt - w_s \Psi_{s\alpha} + R_s I_{s\beta} \end{aligned}\right\} \quad (6)$$

The voltage for the rotor motor is as follows:

$$\left.\begin{aligned} 0 &= d\Psi_{r\alpha} / dt - (w - w_s)\Psi_{r\beta} + R_r I_{r\alpha} \\ 0 &= d\Psi_{r\beta} / dt - (w - w_s)\Psi_{r\alpha} + R_r I_{r\beta} \end{aligned}\right\} \quad (7)$$

Motion equation

$$\frac{dw_r}{dt} = \frac{p}{j}(M_{эм} - M_c \quad (8)$$

The equations (1–8) are known to everyone. Equations (6), (7) and (8) are easily resolved using the ECM. It is well known that coal extracted from Angrean will be transported by combined transport, such as motor carriages, conveyor belts (wells and road conveyors). In the Angren conveyor belts, short circuiting rotor asynchronous engines are used. The power of these engines is 55 kWt (1500 rp/m), 75 kWt (1000 rp/m), 90 kWt (1500 rp/m), 160 kWt (1000 rp/m) and so on. These engine start-up calculations are made on a personal computer. Figure 1 shows the connection of $M_{эм} = f(t)$ and $\omega = f(t)$ to the U = 380V, $2p$ = 4, when the asynchronous motor with a 55 kWt powered conveyor failure occurs. Picture 2 shows that the cranes $i_{s\alpha}$, $i_{s\alpha} = f(t)$ on the stator and rotor at the conveyor stop position for the same motor.

Picture 1 and 2 show that for t = 0.4s, the currents in the rotor $i_{s\alpha}$ and the stator $i_{s\alpha}$ are the highest values, and this electromagnetic moment lays the highest value for $M_{эм}$.

Then the i and i currents disappear, the electromagnetic moment M decreases and the rotor rotates at the rotation velocity value w. The start time continues in t = 0.45s.

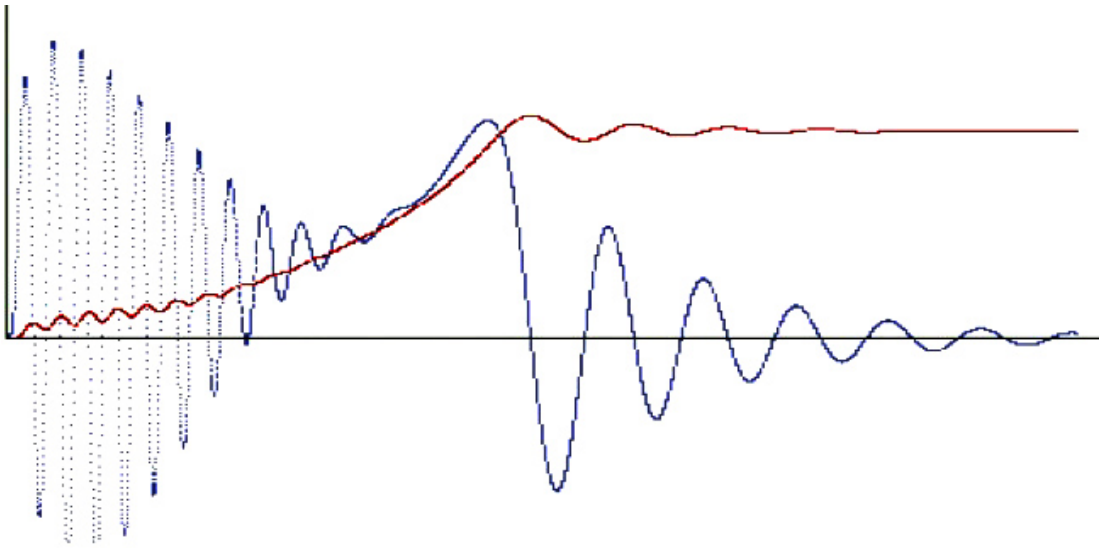

Figure 1. the connection of $M_{эм} = f(t)$ and $\omega = f(t)$ to the start of AM with power of 55 kWt, U = 380 V, $2p$ = 4

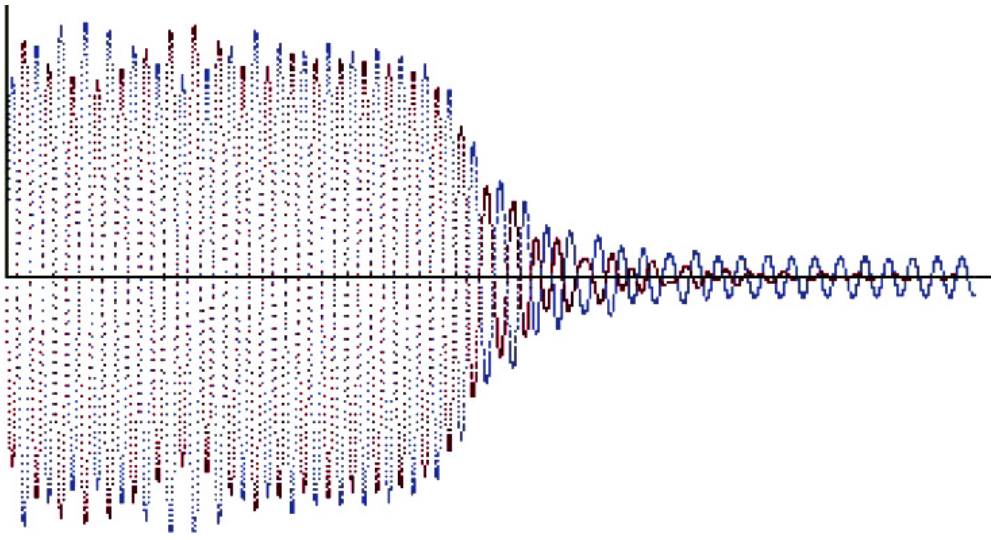

Figure 2. Time dependence of the current on the rotor I and the Stator I

Figure 3 shows the bonding of $M = f(t)$ and $w = f(t)$ in the launch of an asynchronous motor with the load capacity of the lanthan conveyor load of 55 kWt $2p = 4$, and $U = 380$ V. Figure 4 shows the bonding i_{sa}, $i_{sa} = f(t)$ on the conveyor belt for the same motor. The start time is $t = 0.95$ s.

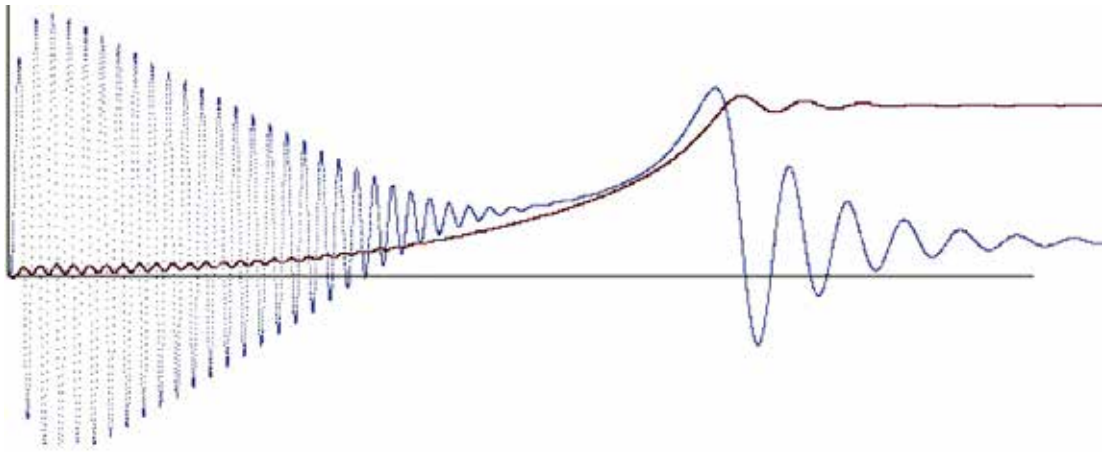

Figure 3. Connection of $M_{эм} = f(t)$ and $\omega_r = f(t)$ asynchronous motor start with 55 kWt $2p = 4$, $U = 380$ V with conveyor belt load

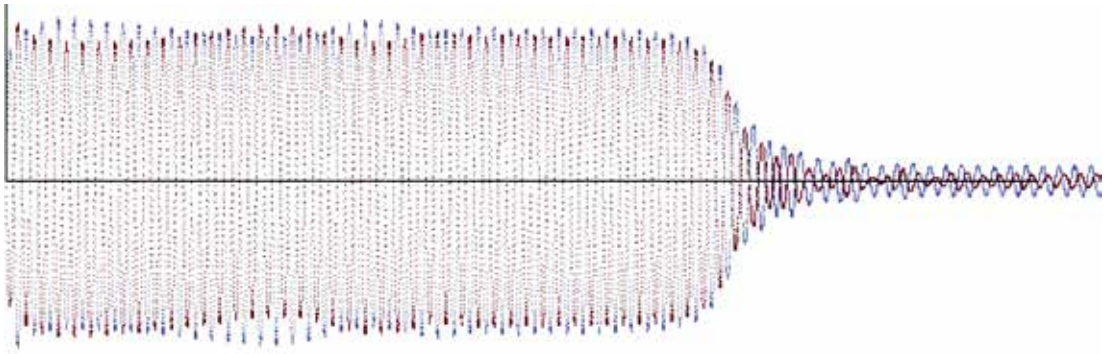

Figure 4. Connection of i_{sa}, $i_{sa} = f(t)$ on the belt conveyor loading

Thus, it is possible to determine mathematical modeling of the start-up process of short-attached rotor asynchronous engines used on the Angren conveyor belt conveyors, and to define optimum start time, moment and moment.

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EXTRACTION IRON AND ITS COMPOUNDS FROM SLAGS BY USING GRAVITATION METHODS

Abstract: The article considers the issues of additional extraction of iron and its oxidized compounds from steel-making slags SC "Uzbeksteel". It is shown that after the separation of the magnetic components in the dump slags a significant amount of iron remains, the concentration of which is comparable to the poor iron ores of Uzbekistan.

Keywords: slags, iron extraction, steel-smelting slags, additional extraction, magnetic components, gravitational precipitation.

For years of independence the Republic of Uzbekistan has turned into dynamically developing state which is moving ahead on the way of technological progress. Problems of rational use of natural resources and environmental protection are under constant attention of the leadership of the Republic of Uzbekistan [1]. The basic concepts of waste-free and low-waste technology are so far formulated; the main objectives and the directions of their development are planned. Features are revealed and the main directions of development waste-free and low-waste technologies of mining and metallurgical productions which consist in development of essentially new directions, nonconventional ways and improvement of the existing production technologies, for reduction at all his stages of harmful emissions of complexity of use of raw materials and full use of the formed waste are planned. It directly concerns also the only enterprise of ferrous metallurgy in the Republic, SC "Uzbeksteel".

When melting ferriferous raw materials, at the expense of the proceeding physical and chemical changes steel-smelting slags are formed. The maintenance of Fe_{total} in the formed slags makes the considerable size (50–70%), and pure iron of 10–12%. Now on Uzbeksteel these slags for extraction of ferriferous components and pure iron are exposed to crushing, crushing and magnetic separation. After processing slags contain 15–25% of the sum of Fe_2O_3 and FeO and also 2–4% of Fe_{met}. These slags aren't processed and stored now in special dumps while when melting steel in the martin and arc steel-smelting furnace as oxidizers apply Fe_2O_3, FeO, iron ore, scale, agglomerate, iron ore briquettes and other materials abroad, for currency. At the same time the plant incurs substantial damages on the organization and operation of slag dumps. Today reserves of slags make 1–1,5 million tons, the annual gain makes 60–80 thousand tons [2].

When carrying out approximate calculations it is possible to see that the quantity of Fe_2O_3 which is contained in the saved-up steel-smelting slags is 100–150 thousand tons, and the amount of pure iron is 20–40 thousand tons. As a result of extraction of iron and its connections from steel-smelting slag the volume of the oxidizer delivered from abroad will be reduced by 6,0–10,0 thousand tons when processing 60,0–80,0 thousand tons of steel-smelting slags in a year. Besides, it will have also considerable social effect since the ecological situation around the plant improves. As a result of the research works which are carried out at departmentof Metallurgy it has been established that for extraction of iron and its compounds from the processed steel-smelting slags application of methods of gravitational enrichment is possible. The fact that about 90% of iron and manganese ores are enriched with gravitational methods also demonstrates to it and also individual share of gravitational methods in processing of the oxidized iron ores annually increases [3].

For definition of an optimum way of extraction of iron and its connections the following methods of gravitational enrichment have been used: jigging; enrichment on a screw separator; enrichment on a concentration table. Chemical consists steelmaking slag SC "Uzbeksteel",%: Fe 1.5–1.6; FeO 7.4–9.8;

Fe_2O_3 15.4–17.5; CaO 22.0–26.0; SiO_2 24.0–28.0; Al_2O_3 5.8––7.0; MnO 7.9–10.2; MgO 7.61–10.7; P_2O_5 0.2–0.13; SO_3 0.2–0.26; others 2.8–5.1.

Optical properties of Fe_2O_3 sample were determined through UV-spectrum. The optical absorption spectra was recorded by using SHIMADZU IRAffinity – 1 (Figure 1).

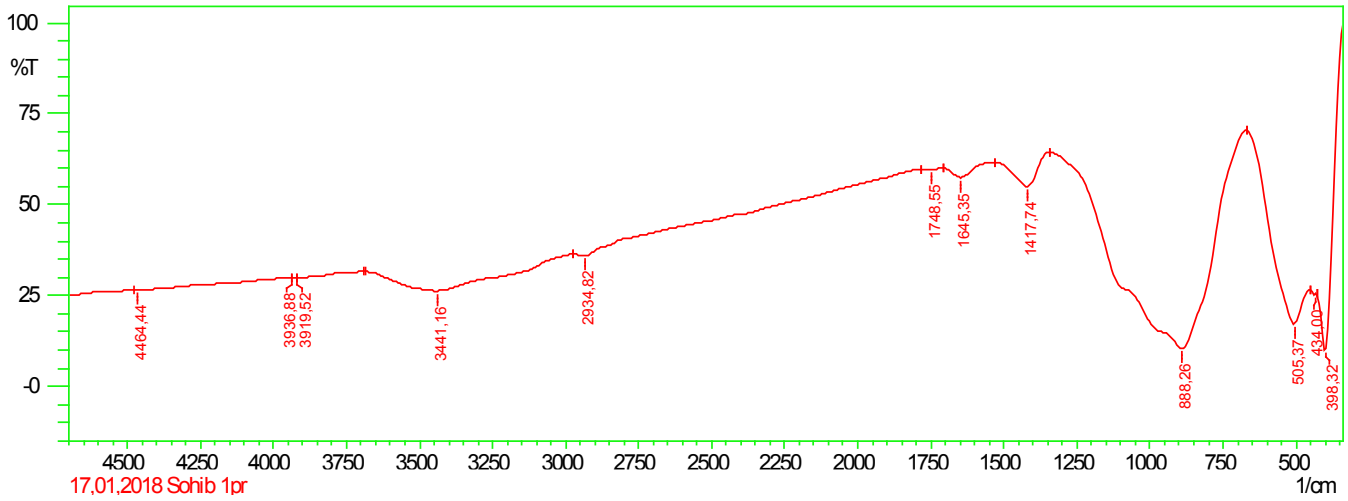

Figure 1. UV-spectrum of steel smelting slag SC "Uzbeksteel"

The UV spectrum of iron oxide manifests prominent absorption band located at 398.32.434.00 and 507.37 cm^{-1}.

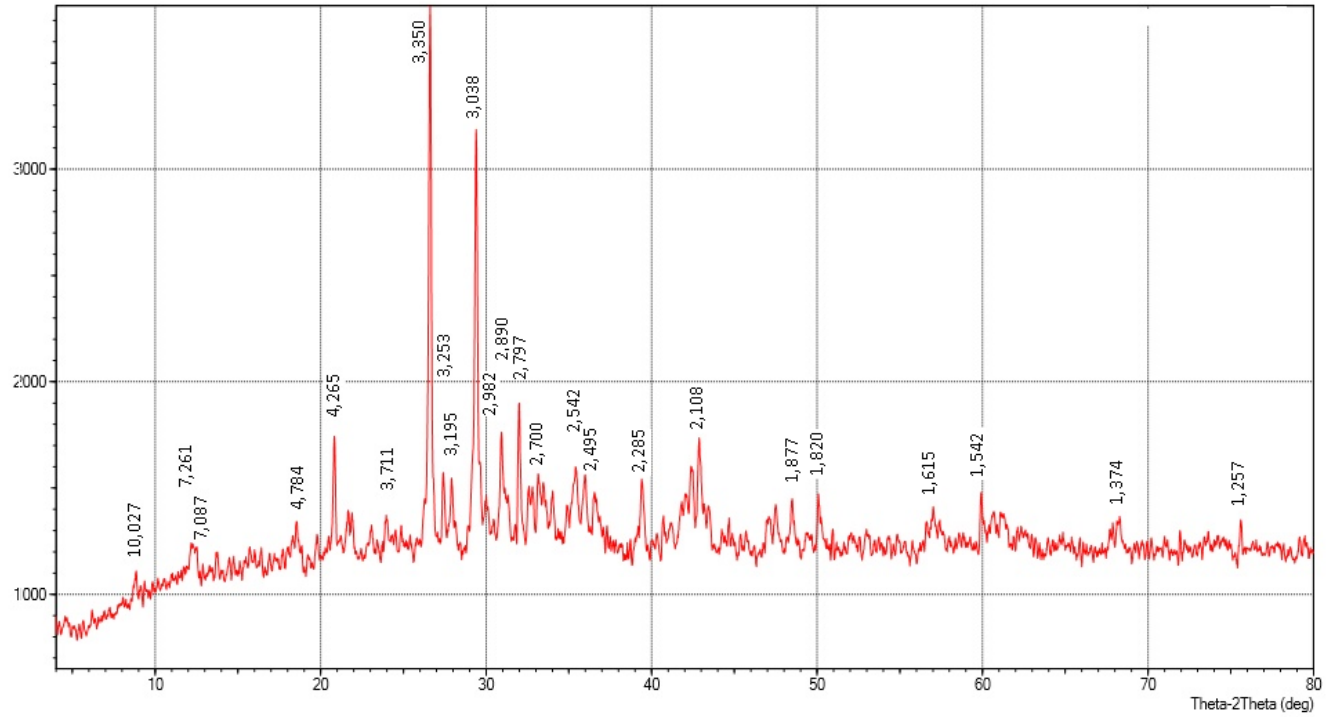

Figure 2. XRD pattern of steel smelting slag SC "Uzbeksteel"

The structural features of minerals are explored from XRD date (Figure 2). They are: anortit with sodium feldspar – 4.265; 3.343; 1.813; 1.539 Å; mullite – 2.855; 2.452 Å; hematite – 2.696; 2.518; 1.834; 1.688 Å; enstatit – 3.157 Å; magnetite 2.541; 1.612 Å. On the structure steel-smelting slags are self-breaking up and low-active. The maintenance of Fe in slags fluctuates within 50–70%, pure iron – 10–12%.

Table 2. – Particle size distribution of the processed steel-smelting slag

Class, mm	Mass, kg	Out put, %	Total «+», %
+3.0	0.859	17.18	17.18
–3.0+2.5	0.280	5.6	22.78
–2.5+2.0	0.320	6.4	29.18
–2.0+1.5	0.470	9.4	38.58
–1.5+1.2	0.243	4.86	43.44
–1.2	2.828	56.56	56.56
Total	5.0	100	100

Extraction of iron and its connections from the processed steel-smelting slags is based by method of a jigging on a difference of speeds of a motion of grains in the pulsing environment [4]. The jigging was carried out in the laboratory two chamber jigger. At a jigging initial material is exposed to division into the layers differing on density and fineness which are formed on a jigger sieve in a result of periodic action of the ascending and descending streams of the dividing environment, the driving mechanism caused by work. In the lower layers the heavy product, and in the top-easy concentrates. The hinge plate of the processed steel-smelting slags weighing 5,0 kg was exposed to a research. Average values of results of 5–6 pilot studies are presented in tab. 2. In experiments tails of the first jigging loaded again into the jigger therefore received two concentrates.

At enrichment on a screw separator the uniformity of food was maintained. An amount of water in food it was set at the rate of receiving a pulp with a density of 20–30% of firm. The consumption of flushing water is regulated visually and averages 0.05–0.2 p/a. Results of distribution of valuable components of the processed steel-smelting slags at enrichment on a screw separator are given in (tab. 3).

Table 2. – Qualitatively – a quantitative index of division of valuable components of the processed steel-smelting slag at a jigging

Products	Out put, %		Content, %		Extraction, %	
	kg	%	$FeO+Fe_2O_3$	Fe	$FeO+Fe_2O_3$	Fe
Original	5.0	100	17.6	3.8	100	100
Concentrate 1	2.45	49	15.2	2.21	42.3	28.6
Concentrate 2	1.05	21	16.8	2.3	20.0	12.8
Tails	1.5	30	34.4	7.4	37.7	58.6

Table 3. – Qualitatively – a quantitative index of division of valuable components of the processed steel-smelting slag on a screw separator

Products	Out put, %		Content, %		Extraction, %	
	kg	%	$FeO+Fe_2O_3$	Fe	$FeO+Fe_2O_3$	Fe
Original	5.0	100	17.6	3.8	100	100
Concentrate 1	2.10	42.0	15.42	2.96	38.6	32.7
Concentrate 2	1.75	35.0	9.35	2.32	18.6	21.4
Tails	1.15	23.0	35.12	7.58	42.8	45.9

Analysis of data of tab. 3. shows that losses with tails make considerable size that significantly reduces indicators of process and can hardly be an effective method of processing of the fulfilled steel-smelting slags. At extraction of iron and its connections on a concentration table division of materials of slag comes from the processed steel-smelting slags in thin water flow, (sound board) flowing on a low-bevel flat surface of a table [5]. The sound board makes asymmetric returnable step the movements in the horizontal plane.

Pilot studies were conducted on a laboratory single-tier concentration table of LKS – 1Ya. The table is intended for material enrichment by fineness – 3 mm, productivity of a table of 15–20 kg/h; the size of the course of a sound board is regulated in repartitions of 8–16 mm; number of the courses in a minute 275–325; inclination of a sound board from 0 to 100; water 0,5 consumption of m^3/h. After establishment of technical indicators of a table began performance of pilot study. At first water in the quantity sufficient for a covering was pumped

by a thin layer of all surface of a table. The processed steel-smelting slag moved in a loading box of a table in the form of the pulp received after crushing with L: S relation = 2:1.

Qualitative quantitative indices of enrichment of the crushed processed steel-smelting slags on a concentration table are given in (tab. 4).

Table 4. – Average values qualitatively – quantitative indices of division of valuable components of the processed steel-smelting slag on a concentration table

Products	Out put, %		Content, %		Extraction, %	
	kg	%	$FeO+Fe_2O_3$	kg	%	$FeO+Fe_2O_3$
Original	5.0	100	17.6	3.8	100	100
Concentrate 1	1.46	29.3	37.9	10.2	63.0	78.2
Concentrate 2	1.2	24.0	16.8	1.73	22.8	11.2
Tails	2.34	46.7	5.3	0.9	14.2	10.6

By results of the conducted researches it is visible that at enrichment of the processed steel-smelting slags on a concentration table extraction of valuable components makes,%: a concentrate 1 – $FeO+Fe_2O_3$–63.0; Fe-78.2; a concentrate 2 – $FeO+Fe_2O_3$–22.8; Fe-11.2. The comparative analysis of indicators of extraction of FeO, Fe_2O_3 has been made for the choice of an optimum way of gravitational enrichment of the processed steel-smelting slags (tab. 5).

As a result of the carried-out comparison of results of enrichment of the processed steel-smelting slags, it is established that an optimum method at which the maximum extraction of FeO, Fe_2O_3, Fe is reached is enrichment of the processed steel-smelting slags on a concentration table.

Table 5 – The comparative analysis of extraction of useful components from the processed steel-smelting slags by method of gravitational enrichment

Method extraction	Extractivevaluable compounds	Extraction, %		
		Concentration-1	Concentration-2	Tails
Jigger	$FeO + Fe_2O_3$	42.3	20.0	37.7
	Fe	28.6	12.8	58.6
Screw-separator	$FeO + Fe_2O_3$	38.6	18.6	42.8
	Fe	32.7	21.4	45.9
Concentration table	$FeO + Fe_2O_3$	63.0	22.8	14.2
	Fe	78.2	11.2	10.6

It is established that for processing of these slags by the most acceptable use of gravitational enrichment is. Use of this development in the industry will allow to expand a source of raw materials of plant without capital expenditure for geological and mining operations and to pass to low-waste technology. At the same time waste slag can be actually eliminated that will favorably affect an ecological situation around iron and steel works.

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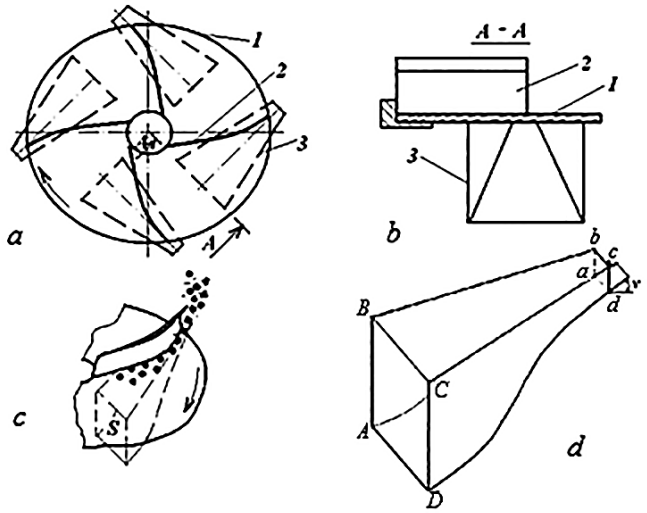
SUBSTANTIATING PARAMETERS OF ADVANCED CENTRIFUGAL APPARATUS

Abstract: In article are brought information about the design, the technological process of new pneumo-centrifugal apparatus for application of mineral fertilizers and their mixtures, as well as the results and analysis of theoretical researches, in particular, the radius of fertilizer supply to apparatus.

Keywords: Centrifugal apparatus, mineral fertilizers, construction, technological process, windage, radius.

Based on the findings from pneumo-centrifugal apparatus analysis, pieces of fertilizers with a smaller windage coefficient are farther away and those with a large windage coefficient go to the ground nearer distance. Thus, it is possible to ensure that fertilizer grains, which have high windage coefficient, go farther distance and this way ensuring the closeness or uniqueness of the distance between the various windage fertilizers pieces [1; 2].



a – over-sight seen scheme of the centrifugal apparatus; *b* – A-A outline diagram of the apparatus; *c* – the motion scheme of fertilizer grains by the blade; *d* – attachment scheme. 1 – horizontal disk; 2 – blades; 3 – attachment

Figure 1. The scheme of centrifugal fertilizer apparatus

The fertilizer grains, which have high windage coefficient, can only be carried out only under influence of additional airflow. As a technical solution to this problem, a new centrifugal apparatus has been developed (Figure 1). The centrifugal apparatus consists of a flat horizontal disk 1 and an overlay blades 2 attached to it, as well as a device 3 additional airflow generated on the bottom of the disc. Each blades compliance with an attachment is fitted at the bottom of disc (Figure 1 a, b).

The technological process of apparatus is performed following way (Figure 1, c): mineral fertilizers are given to disk 1 which rotates rapidly with ω angular velocity. They continue their movements along the crossed line adjacent to the disc 1 and blade 2, while the influence of centrifugal force, and is thrown at its initial v_o speed.

During the disc rotation, the air is entering through *ABCD* duct's entrance, and is come out through *absd* (figure 1, *d*). As the surface of outlet hole is λ times smaller than the opening, coming out air flow rate is increases approximately by as much.

Thus, proposed centrifugal apparatus shows two functions at the same time, the first one indicates the scattering of fertilizer, the second is to generate additional airflow and to throwing it away after the fertilizer pieces.

It is known that, fertilizer is poured into centrifugal apparatus through special holes of bunker floor which under process of technological operations of fertilizer machines.

The velocity of fertilizers poured into apparatus [3; 4]

$$V_T = \sqrt{2gh} \qquad (1)$$

here g – free flow rate, m/s^2;

h – pouring height, m.

Given that, h = 0.03–0.05 m the distance between the bunker floor duct's, it can be assumed that the pouring speeds of different sizes and shape are the same.

The location of bunker floor hole relative to disk of fertilizer apparatus will be affected by fertilizer releasing and scattering.

The use of logarithmic blade in direction of rotation of bubble is brought in preliminary study of fertilizer pieces' release from disk at short intervals [5].

Differential equation of fertilizer pieces' motion along logarithmic blade

$$\ddot{S} = \omega^2 r\cos\psi_0 - fg + f\omega^2 r\sin\psi_0 - 2f\omega\dot{S}_r \qquad (2)$$

here ψ_o – angle, between relative velocity and the centrifugal force;

S – distance traveled along the blade, m.

Solution of equation (1)

$$S = C_1 e^{P_1 t} + C_2 e^{P_2 t} + \frac{fg\sqrt{1+a^2}}{(a+f)\omega^2} \qquad (3)$$

here P_1 and P_2 – roots of equations; C_1, C_2 – initial **conditions of movement, constant magnitudes $s = r_o$, $S = 0$ determined by the initial conditions of the motion when $t = 0$.**

Outlet angle β of fertilizer apparatus is a direct indicator that affects the uneven scattering of fertilizers. This indicator depends on fertilizer transmission distance to the disk r_o, the blade length S and angular velocity ω of disk.

The S expresses the total length of the formula (3). However, mineral fertilizers pieces are given away from the center of disk to r_o distance, not at the beginning of blade, r_1 initial radius of logarithmic spiral shaped blade (Figure 2). As can be seen from picture $r_o > r_1$.

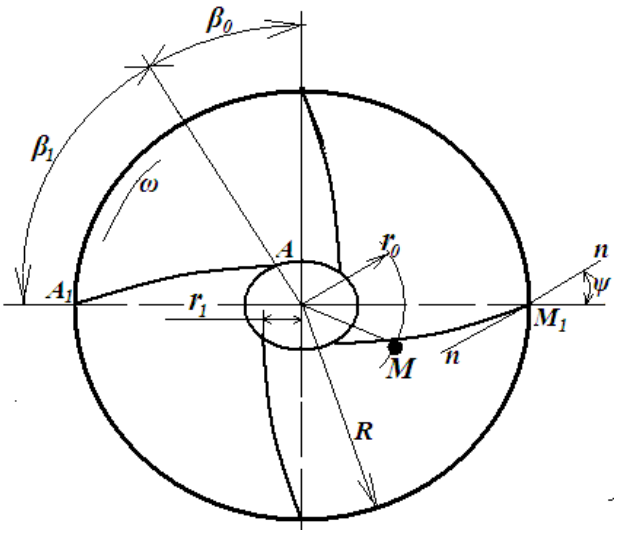


Figure 2. A scheme for determining the length of blade fertilizer grains have passed

It can be determined by the following expression of logarithmic spiral shaped blade MM_1 arc length [6]:

$$L = \frac{r_1 - r_o}{\cos\psi} \qquad (4)$$

here r_1 – initial radius of blade, m;

ψ – angle, between tangential and radius vectors passing to any point.

It is shown in the line graph, influence to passed length of fertilizer grains over blade indexes in expression (4).

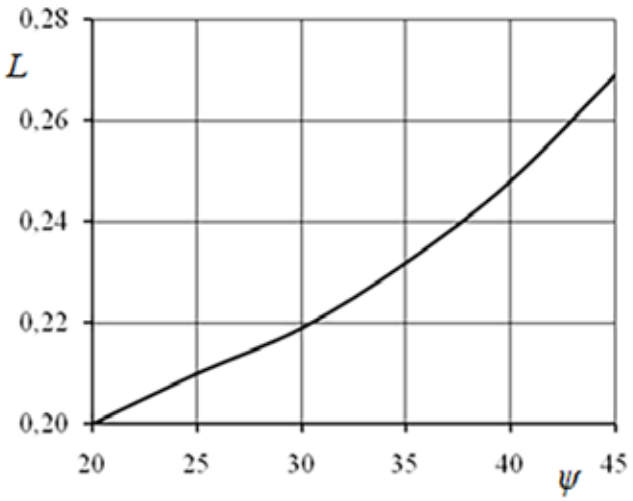


Figure 3. The line graph of change depending on angle ψ to the blade length

The graph shown in (Figure 3 is constructed with radius R = 0.3 m, r_1 = 0.05 m and r_o = 0.11 m of disc. As shown in (Figure 3), when the angle ψ increases, the width of blade is increasing according to with curvature regularities. The length is increasing in return decreasing logarithmic spiral of curvature radius. In this case, increased movement time of fertilizer grains by the blade. This allows the fertilizer grains to be fractionated. In this context, the length of blade is adopted 0.22–0.23 m corresponding to the angle ψ = 30–35°.

Figure 4 shows a line chart of change depending on blade length r_o to fertilization distance.

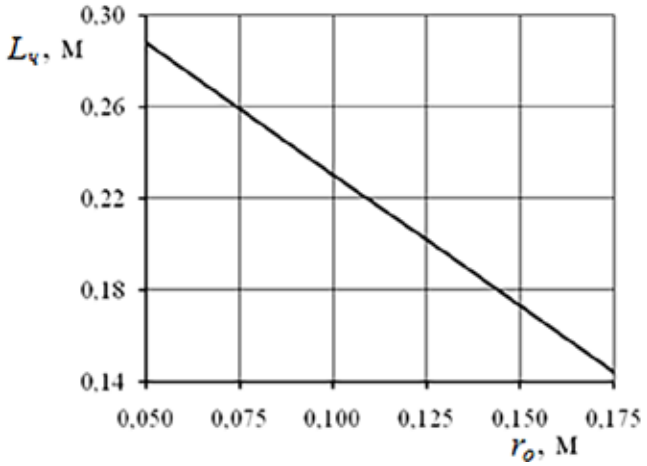


Figure 4. A line chart of change depending on blade length r_o to fertilization distance

The shown line chart in (Figure 4) is constructed at a disc radius R = 0.3 m, r_1 = 0.05 m and ψ = 30 °. As can be seen in (Figure 4), fertilizer radius increases as fertilizer grains movement of blade length decreases according to the linearity law. Therefore, the radius of fertilizing is enlarged and it is close to length of disc radius.

Based on the results of theoretical and experimental researches, radius of fertilizing was adopted between 0.100–0.125 m.

Summary: the proposed centrifugal apparatus is designed to simultaneously scattering the mineral fertilizers, to generate additional airflow, and redirect them after scattered fertilizing grains, blades in form of logarithmic spirals and fertilization radius will be in the range of 0.1–0.125 m.

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EXPERIMENTAL STUDIES OF STARTS MODES THE FREQUENCY-CONTROLLED ELECTRIC DRIVE OF PUMP UNIT

Abstract: The article deals with experimental studies of starting modes of frequency-controlled electric drive of the pumping unit. Starting modes of pumping units are studied taking into account the position of the valve in the pressure pipeline. The conditions of selection of the starting frequency converters of the "motor-pump" system with centrifugal pumps by asynchronous electric drive at the pump starts on the open and closed valve of the pipeline are revealed.

Keywords: start-up, frequency Converter, motor, current, power, pump unit, valve, pressure pipeline.

To automate the operation of pumping units, an important issue is to determine the start conditions: open or closed valve. The trigger mode determines the degree of difficulty and the cost of automatic management of pump installations. In this regard, we consider the mode of operation of the pumping unit at a frequency start with an open and closed valve and determine the rational start mode.

– To study the features of the pump in a system with a frequency-controlled electric pipeline network, it is necessary to know the limits of the required torque in the control frequency range from 0 to f_n.

The mechanical characteristics of a centrifugal pump are influenced by the following factors:

– state of the valve in the discharge pipeline (valve is open or closed);

– characteristics of the pipeline network to which the pump operates;

If the pipeline is short, without the height of the geodetic lift, then basically it is necessary to overcome the frictional resistance, with a long pipeline – the back pressure of the network. With a long pipeline, the mass of fluid that needs to be pumped is so great that the time required to communicate the acceleration fluid is much longer than the motor's acceleration time to the nominal speed of rotation[1].

When the pump is started on a closed valve, the effect of back pressure and hydraulic shock on the transition mode is eliminated. The starting characteristic in this case can be defined as follows

$$M_C = M_{MF} + M_O \left(\frac{f}{f_n} \right)^2, \qquad (1)$$

Where is $M_O = 975 \frac{P_O}{n_n}$ the moment of resistance when the pump operates at the rated speed with the latch closed; P_o – power consumed by the pump at $n = n_n$, $Q = 0$; n – speed of rotation of the pump shaft; f – frequency of control. Parameters with the index "n" correspond to the nominal value, without the index – to the current one.

Characteristics of the pump when starting with an open valve, when there is a back pressure is described by the dependence

$$M_S = \left(\frac{975}{102} \frac{Q\left(N_{SP} + RQ^2\right)}{n} - M_{MF} \right) \frac{1}{\eta} + M_{MF}, \qquad (2)$$

When starting with an open valve, in the presence of back pressure, the starting characteristic is determined by two formulas: until the pump has overcome the counter pressure N_{SP} and its capacity is zero, the characteristic is determined by formula (1), because the work under such conditions is similar to working on a closed latch [2]. From the moment when the pressure is greater than N_{SP} and the liquid supply begins, the characteristic is determined by (2). The starting characteristic of the pump with the open valve of the pipeline when operating on a network without back pressure, i.e. $N_{SP} = 0$ is expressed in dependence

$$M_S = M_{MF} + 0{,}95 M_N \left(\frac{f}{f_n} \right)^2, \qquad (3)$$

where is M_N – the nominal moment of the centrifugal pump.

Where Q – is the performance at a given rotational speed n; N_{SP} – static pressure; R – is the resistance of the pipeline; η – is the efficiency of the pump. According to [2], for the straight

pipeline section $R = 0.083\lambda lQ^2/d^5$ and for local resistances $R = 0.083\varphi Q^2/d^4$; here $\lambda = 0.02 \div 0.03$ is the coefficient of friction of water against the walls of the pipeline; l – is the length of the pipeline; d – is the diameter of the pipeline; φ – is the coefficient of local resistance equal to for valves $\varphi = 0.5$; for a 90°– rounded elbow, $\varphi = 0.3$ for a check valve $\varphi = 5.0$. The coefficient 0.083 has the dimension c^2/m.

We accept that the pressure developed by a centrifugal pump is proportional to the second power of frequency

$$\frac{N}{N_1} = \left(\frac{f}{f_1}\right)^2. \quad (4)$$

Expression (4) is valid under the condition of unchanged pump capacity Q.

At the nominal frequency f_n and nominal pressure, H_n defined by the intersection point of the characteristic Q-N pump at a frequency f_n, then the pressure developed at frequency f, is equal to

$$N = \frac{N_n}{f_n^2} f^2. \quad (5)$$

The calculation of the starting time can be performed using the drive equation of motion:

$$M - M_S = J\frac{d\omega}{dt}, \quad (6)$$

where does that

$$t = J\int_{\omega_1}^{\omega_2} \phi(\omega)d\omega. \quad (7)$$

where $\phi(\omega) = \frac{1}{M - M_S}$ – is the function of speed at frequency start; M – is the motor torque; J – total moment of inertia of the drive; ω – rotation frequency [1].

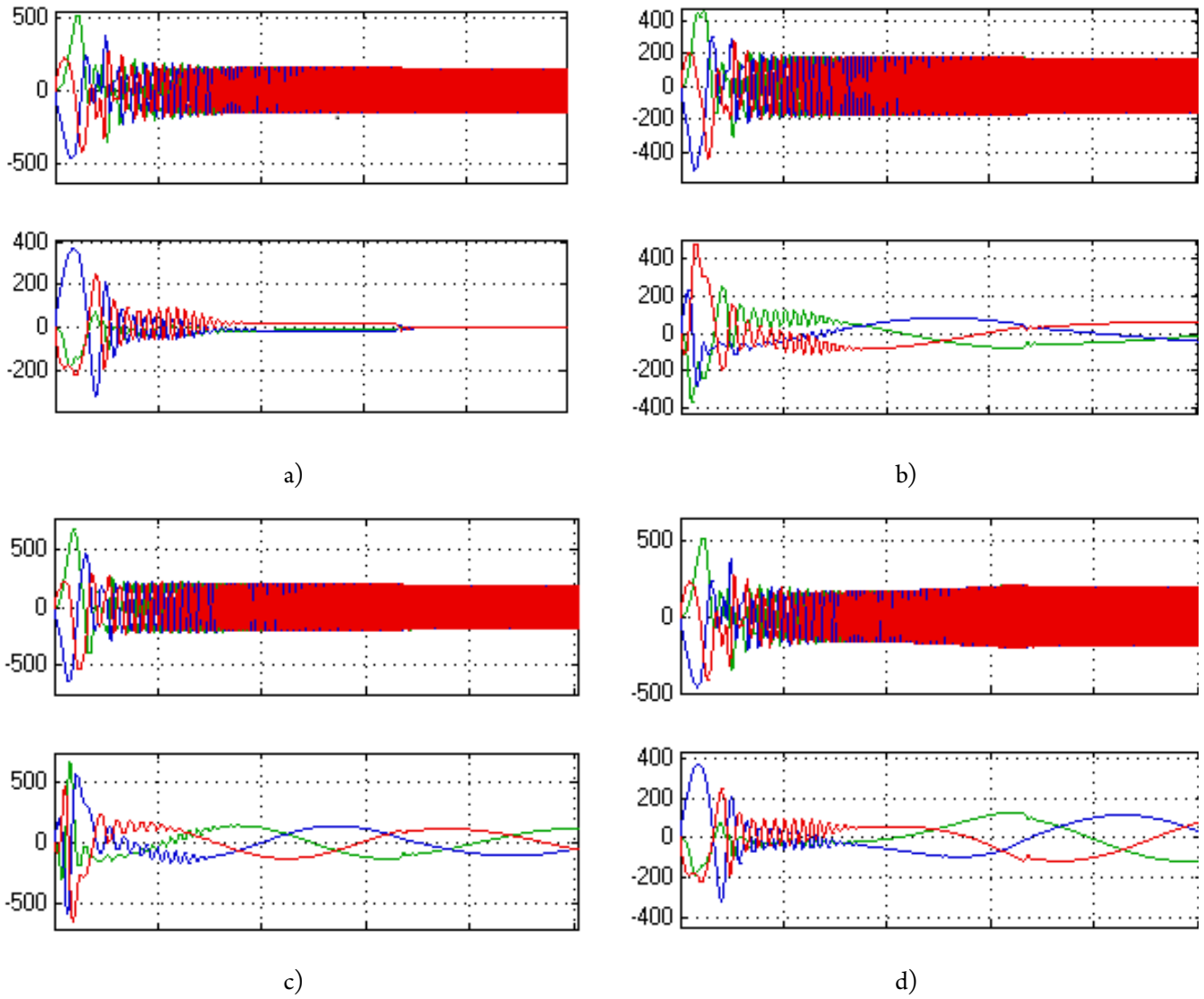

Figure 1. Changes in the stator i_{1abc} and rotor currents i'_{1abc} at a frequency start as a function of time: a) $M_S = 0$; b) $M_S = 0.5$; c) $M_S = 0.95$; d) $M_S = \omega^2$

We have examined experimental studies of the start-up of pumping units with asynchronous motors using the example of pumping units of the Chirchik pumping station in the Tashkent region.

The results of instrumental measurements of the electric drive of the equipment feeding from the frequency converter with a power of 160 kW are of interest. According to the measurements, a plot of water lifting from the pump to the water outlet from the pressure pipeline was constructed (Fig. 2).

In this case, the operation mode of the pump unit on the pressure pipeline is divided into six sections. 1-section – pump acceleration with the latch closed from the motor fed from the frequency converter. The stator current increases until the gate is opened; 2-site – the beginning of the opening until the valve is fully open; Section 3 – the process of filling the pipeline with the angle of rise of the pressure pipeline at the angle α1 is in progress; 4-section – the process of filling the pipeline with the angle of rise of the pressure pipeline by an angle α2; 5-section – is characterized by the fact that the outlet of water from the pressure pipeline begins; 6-section the beginning of water supply within the limits $Q = 0 \div Q_{nom}$ depending on the speed of the pump from the frequency-controlled electric drive.

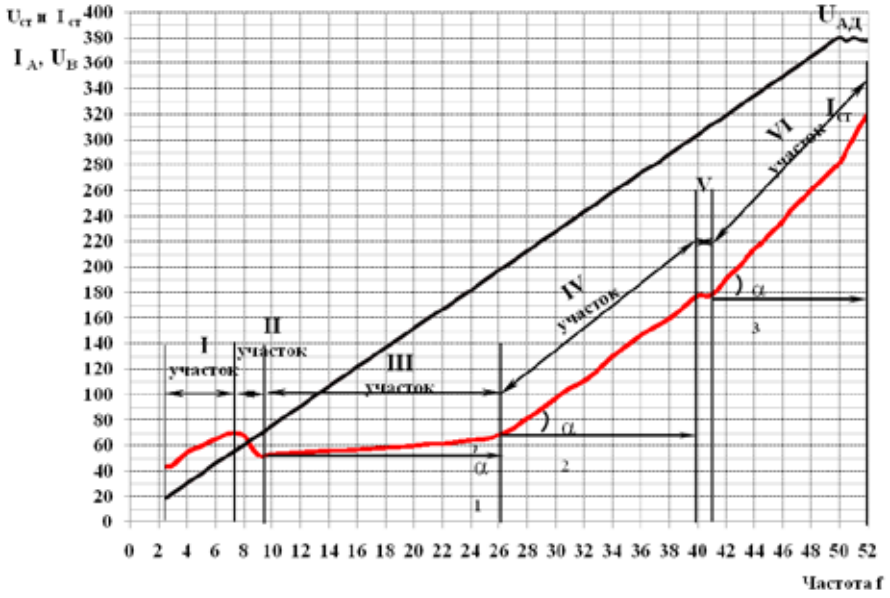

Figure 2. Graph of water lifting from the pump to the water outlet from the pressure pipeline

As seen in the process of accelerating the pump with the latch closed, there is an increase in the stator current of the motor. At the moment the valve opens, the stator current decreases and the stator current increases in the subsequent full opening of the valve, depending on the angle of inclination of the discharge pipeline. As the slope of the pipeline increases, the stator current increases until the water exits the pressure pipeline.

In conclusion, it should be noted:

– It has been established that the most rational frequency start-up of an asynchronous motor of a pump installation is a start-up with the intensity of frequency change in which the transient process and losses are minimal.

– It was revealed that with a frequency start with a given intensity and different load on the motor shaft, the dependence of the electromagnetic moment on time almost does not change. Electromagnetic transients are completely damped to a speed corresponding to the critical slip on a static mechanical characteristic.

– The shock electromagnetic moment at frequency start-up reaches its maximum at all loads on the shaft approximately at the same time. The maximum magnitude of the shock electromagnetic moment will change depending on the load from *0.8* at $M_c = 0$ to *2.1* at $M_c = 0.95$.

– It was determined that with a frequency start on a closed valve, the duration of the transition process is $t = 0.6$ *sec*. When starting with the open valve, the duration is $t = 0.9$ *sec*. The longest start-up is the start with the open valve when working on the network without backpressure.

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Section 11. Transport

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APPLICATION OF ULTRASONIC WAVES FOR RAIL FLAW DETECTION

Abstract: The purpose of this article is to identify the possibilities of excitation and reception of ultrasonic waves and the effect of defects in rail lashes on the processes of propagation.

Keywords: ultrasonic inspection, waves, rail, piezoelectric transducer, polarization, generator.

The main of all methods of ultrasonic flaw detection is the excitation of elastic mechanical vibrations propagating in a controlled environment [1, 7–8].

Quantifying changes in the processes of propagation of ultrasonic waves provides the necessary information about the detected defect. For the development of technical means of flaw detection and analysis of the results, it is necessary to know the peculiarities of the propagation of elastic waves in continuous homogeneous and inhomogeneous media. Such environments are: rail steel without internal defects and with defects; the materials from which the source of excitation of mechanical vibrations is made, the plexiglas-constructive medium between the source of vibrations and rail steel [2, 76–77].

In addition, the medium may be air, water, alcohol, special substances that provide acoustic contact between the source and the rail.

Flaw detectors usually operate in the frequency range of ultrasonic vibrations from 20 kHz to 106 kHz. In general, the operating frequency of ultrasonic flaw detectors is 2.5 MHz, and recently, the working range has been extended in the direction of low frequencies to 0.2 MHz, which increases the possibilities of flaw detection.

The differential wave equation can be represented for an elastic wave:

where $\Delta = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}$ – is the Laplass operator.

S – is the displacement of the particle from the equilibrium position.

For the detection of defects, an important characteristic is the length λ of the elastic wave:

$$\lambda = \frac{\upsilon}{\nu}. \quad (1)$$

For rail steel υ = 5900 m/s; ν = 2.5 MHz, then the wavelength λ = 2,36 mm. This is the length of the longitudinal wave in the metal of the rail at the operating frequency of the flaw detector.

Waves propagate in the medium; longitudinal, shear or transverse; superficial; normal and other waves.

The transverse elastic wave is a propagating elastic deformation of the form (shear, bending, torsion) only in solids.

The longitudinal elastic wave is the propagation of the elastic deformation of the volume (tension, compression) – in solid, liquid and gaseous substances. Elastic Wave Speed:

$$\Upsilon = \sqrt{\frac{M}{\rho}}, \quad (2)$$

where ρ is the density of a substance.

When propagating longitudinal waves, the modulus M is the Yunga modulus E, which characterizes the elasticity of the volume.

For liquids, M is the modulus of bulk elasticity to:

$$k = \frac{1}{\mathrm{B}}, \quad (3)$$

where B is the bulk compression modulus of a fluid.

For rail metal υ = 5900 m/s, for water υ = 1450 m/s, for plexiglass υ = 2657 m/s. When a transverse wave propagates,

the particles of the medium oscillate perpendicularly to the direction of the wave.

The speed of its spread in the metal is:

$$\upsilon_{transverse} = 0,55\upsilon_{longitudinal} \quad (4)$$

In rail flaw detection, the excitation and reception of ultrasonic vibrations is carried out using piezoelectric or electromagnetic acoustic transducers.

Piezoelectric transducers are based on dielectric polarization.

The polarization of dielectrics is characterized by the polarization vector $\overline{P}$, which is equal to the sum of the electric dipole moments of all molecules per unit volume of matter. For isotropic dielectrics:

$$\overline{P} = \varepsilon_0 \varkappa \overline{E}, \quad (5)$$

where $\varkappa$ is the dielectric susceptibility of the substance; ε_0 is the electric constant dielectric constant of the substance:

$$\varepsilon = 1 + \varkappa. \quad (6)$$

The dielectric constant characterizes the weakening of the external electric field in a dielectric by polarization charges. The value of ε depends on the frequency of oscillations of the electric current, since the polarization does not occur instantaneously, but it takes time. In ionic crystals, $\tau \approx 10^{-13}$ *C*, in polar dielectrics, $\tau \approx 10^{-6} \div 10^{-8}$ *C*. With increasing frequency, polarization decreases and tends to the value close to unity (electrons do not have time to oscillate after the field).

Polarization can occur in some dielectrics, not only under the action of an electric field, but also as a result of mechanical stresses arising in it. Such dielectrics are called piezoelectrics.

One of the ways to control the critical parts of mechanisms, machines, rail lashes is ultrasonic flaw detection. The process of finding defects is carried out with the help of an ultrasonic flaw detector – ultrasound (Figure 1.)

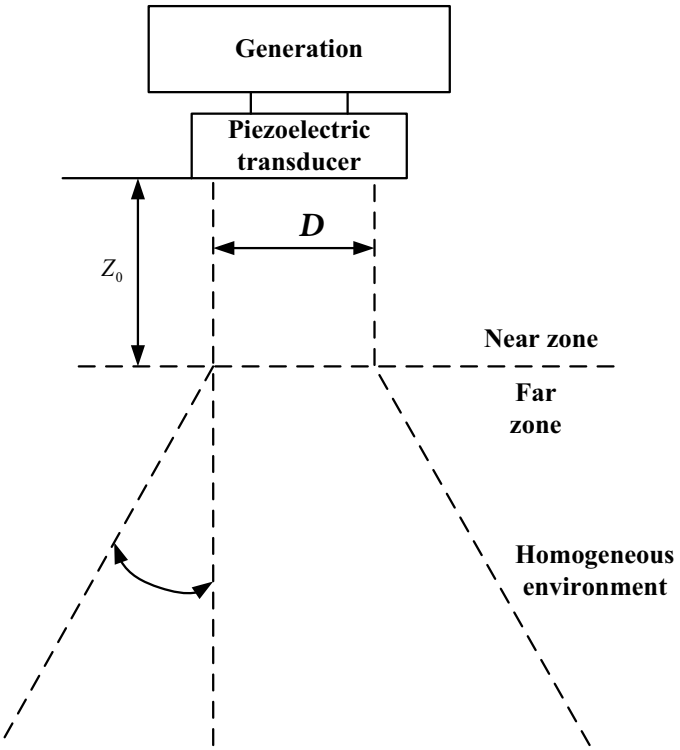

Figure1. Block diagram of the flaw detector operation

The main element of the device is a quartz plate. When a sound wave reflected by a defect (a crack in the rails, wear of the base of the rails) falls on it, the quartz is compressed and stretched at the oscillation frequency of the sound wave (ν = 2.5 MHz) and an alternating electrical voltage appears on its faces. From the generator, a high-frequency signal 2 enters the quartz plate. The quartz plate begins to oscillate and radiates ultrasonic waves into the volume of the rail rail being tested [3, 112–117].

Reflecting from a defect (rail crack), ultrasound returns to the plate, turning into an electrical signal 3, which goes to an oscilloscope 5. From the distance between the direct and reflected pulses, you can determine the depth of the defect 4 [3, 35–41].

The principle of operation of a flaw detector is that, under the action of a mechanical stress, an electric charge arises on the surface of quartz and some other dielectrics as a result of the polarization of the dielectric [5, 171–175].

In the construction of piezoelectric transducers rail flaw detectors are most often made of lead titanite zirconate of the

PZT-19 brand. The piezoplast resonance occurs when the frequency of its natural oscillations coincides with the frequency of the supplied alternating voltage.

The oscillation frequency of the piezoplates is determined by:

$$\nu = \frac{\upsilon}{2b}, \quad (7)$$

where ν is the oscillation frequency of the plate; υ-oscillation velocity, which for the plate: υ = 3300 m/s.

Of these conditions, the thickness of the piezoplates is found:

$$b = \frac{\upsilon}{2b} = 0.7\,mm. \quad (8)$$

In resonant mode, the transducer emits mechanical oscillations of the greatest amplitude. The piezoplastin should be located at a noticeable distance of z_0 = 15 mm from the rail track.

In the far zone, with the distance from the radiator, the amplitude of the ultrasonic oscillations decreases exponentially.

The attenuation coefficient is determined by:

$$\delta = \delta_a + \delta_s, \quad (9)$$

where δ_a – is the absorption coefficient; δ_s – is the scattering coefficient.

The emission zones of the piezoelectric transducer are shown in (fig. 2).

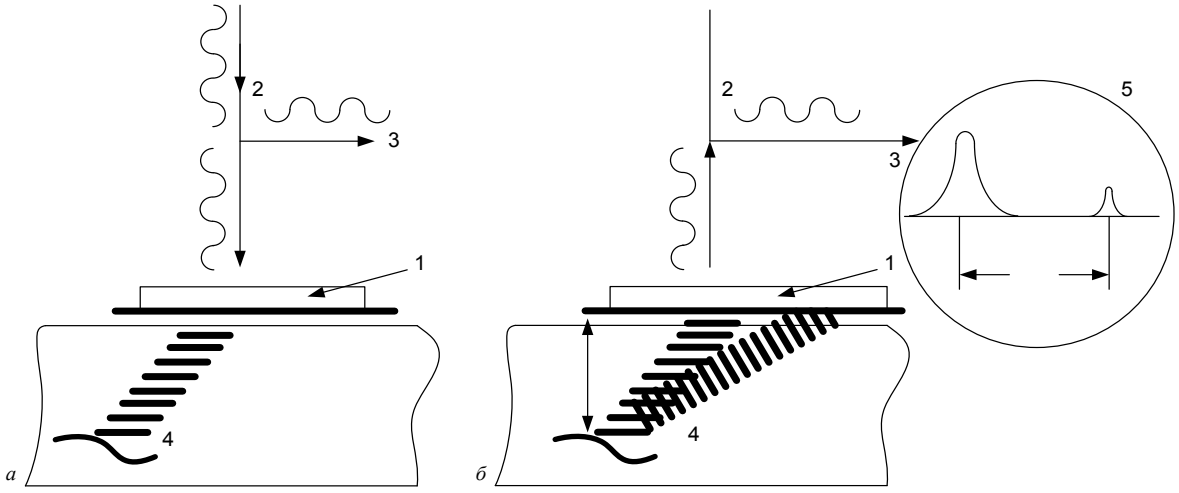

Figure 2. Zones of radiation of the piezoelectric transducer

In rail steel, the attenuation at the operating frequency of 2.5 MHz is not large, about:

$$1 \div 8 \frac{1}{m}.$$

Ultrasonic vibrations spread over a distance of 5–6 m. The attenuation coefficient increases with increasing frequency. With a decrease in the operating frequency of the flaw detector, ultrasonic vibrations can spread over the entire length of the rail.

Based on the above, we can draw the following conclusions:

1. The physical basis of all methods of ultrasonic flaw detection is the excitation of elastic mechanical vibrations propagating in a controlled environment.

2. The attenuation of ultrasonic vibrations decreases with a decrease in the working position of the flaw detector.

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INVESTIGATIONS OF THE VIBRATIONAL PROCESS OF A GRANITE MACADAM IN A BALLAST PRIZM

Abstract: With an increase in the train load on the axis and the speed of the trains, the vibrodynamic load from the wheels to the ballast layer increases, characterized by the amplitude of the oscillations, frequency, vibration speed and other parameters. The main indicators of the state of the track, their deviations from the normative position in the profile and in the plan directly depend on the bearing capacity of the ballast layer. Vibrodynamic impact on the ballast layer is known to have a negative effect on the strength and deformation characteristics, which entails a decrease in the bearing capacity of the ballast layer.

Keywords: ballast layer, granite crushed stone, amplitude, oscillations, damping of oscillations, bearing capacity, vibrodynamics.

1. Introduction

In recent years Uzbekistan has been paying great attention to the development of rail transport. There were new high-speed and high-speed directions to various cities of our region. The roads on which modern trains go were built at the beginning of the last century.

The noted defects of the ballast layer are revealed due to the use of materials with low strength characteristics, due to the insufficient thickness of the ballast layer, as well as due to vibrodynamic loads arising from passing trains, features from high-speed and high-speed passenger and freight trains with heavy-duty cars.

Numerous studies indicate that the strength properties of the soil of the roadbed are reduced due to the effect of vibrodynamic loads from passing trains, which suggests a similar reaction of the rubble to the vibrodynamic impact.

The above mentioned causes the need to conduct an investigation of the oscillatory process of the materials of the ballast layer.

2. Characteristics of the experimental site

Studies of the main characteristics of the oscillatory process of the ballast layer of the railway track were carried out on 4137 km of the Bukhara-Misken high-speed line. The upper structure of the road is represented by rails P65, welded in a length of 800 m. The leveling spans consist of three 25 m long rails with butt-jointed six-blade pads. There are reinforced concrete sleepers with a diagram of 1840 pieces/km, fasteners type KB, the track width is 1520 mm. Ballast prism single-layer. A layer of rubble under a under reinforced concrete sleepers 40 cm thick, sprinkled with crushed rock of fractions from 25 to 60 mm.

3. Study of the propagation of oscillations in the body of the ballast prism

The recording of the characteristics of the oscillatory process in the ballast layer was carried out by the SM-3 seismic receivers [1]. Three sensors were included in the kit, allowing to measure three components of the vibration amplitude: vertical (Z), horizontal along the axis of the path (X) and horizontal across the path (Y). The recording was carried out in digital format using an analog-to-digital signal converter, recorded in real time in the computer's memory. He basic scheme for recording the oscillations is shown in (Fig. 1).

The resulting amplitude of the oscillations $A_{рез}$ was determined by calculation according to the law of the vector sum:

$$A_{рез} = \sqrt{A_z^2 + A_y^2 + A_x^2} \qquad (1)$$

where: A_z –amplitude of oscillations in the vertical plane;

A_y – amplitude of oscillations in the horizontal plane across the path;

A_x – amplitude of oscillations in the horizontal plane along the path.

The results for each component of the amplitude of the oscillations were subjected to processing. As a result, the average and maximum probable values were obtained at a certain speed of freight trains. The probability level in all cases was 0.995.

$$A_{\max}^{top} = A_{av} + 2{,}5 \cdot S \qquad (2)$$

where: S – root – mean – square deviation.

The installation of the vibration sensors is shown in Fig.2

Experiments to study the propagation of vibrations in the body of the ballast layer, depending on the speed of the trains, were carried out for passenger trains in the speed range from 55 to 125 km/h.

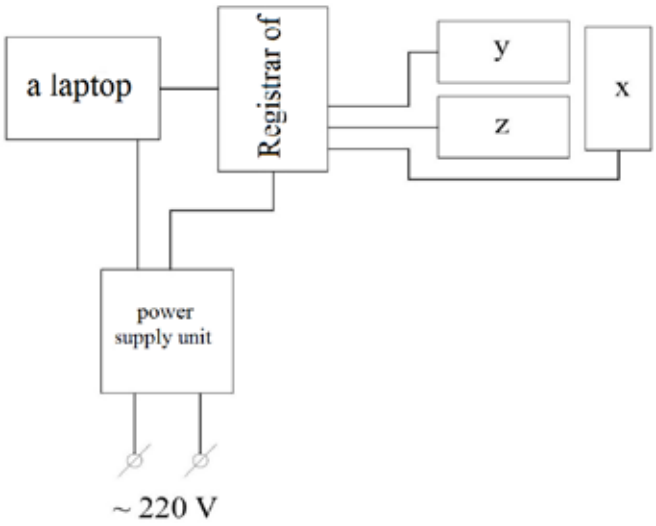

Figure 1. Schematic diagram of recording the oscillations of the ballast layer

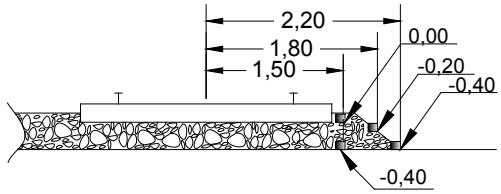

Figure 2. The scheme of installation of seismic receivers CM3 in a ballast layer on a line Bukhara-Misken (4137 km)

As can be seen from the above results, all the components of the oscillation amplitudes are characterized by rectilinear dependences. The intensity of the increase in the amplitude of the oscillations along the path (curve x in Figure 3) and across the track (curve in Figure 3) with slight increase in the velocities of motion has small differences. Absolute values of the maximum probable amplitudes of oscillations along the path do not exceed 104 μm, and across the path are 126 μm.

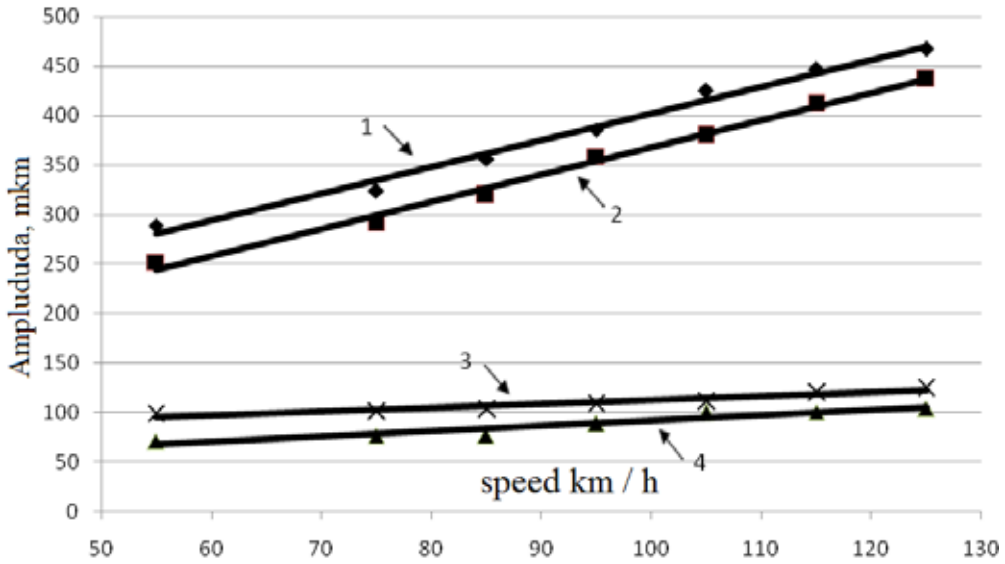

Figure 3. Dependence of the vibration amplitudes of the ballast layer on the speed of passenger trains. (1 – resultant amplitude of oscillations, 2 – vertical component of oscillations, 3 – horizontal component of oscillations across the axis of the path, 4 – Horizontal component of oscillations along the path)

The straight line 2 in (Fig. 3) shows the change in the amplitudes of the vertical component of the oscillations with the increase in the speed of the passenger trains. In the range of changes in speed from 55 to 125 km/h, the amplitudes increase along a straight line with an intensity of 27 μm per 10 km/h. The maximum amplitude of this component is recorded at a speed of 125 km/h and 437 microns.

The ones shown in (Fig. 3) results show that the magnitude of the resulting amplitude of the oscillations is determined to a greater extent by the magnitude of the vertical component.

Comparing the value of the oscillations with the point of view of the components, it can be concluded that the lowest level has an oscillation along the path. The fluctuations along the way are slightly larger. A high level of vibration refers to the vertical component.

4. Investigation of the propagation of oscillations in the body of the ballast layer

The main purpose of the study was to establish the patterns of propagation of the vibration amplitudes throughout the ballast body. Detection of the attenuation of the amplitudes over the depth of the ballast layer was carried out according to data recorded by sensors installed in accordance with the scheme in (Fig. 2) at a depth of 40 cm from the sole of the end of the sleepers. The findings damping of vibration amplitudes in the depth of the ballast layer are shown in (Fig. 4)and are characterized by a change in the depth indicator δ_z. It is defined as the ratio of the amplitudes recorded at a certain depth d of the bottom part of the sleepers $\left(A_z^{b.c.}\right)$, to amplitudes recorded on a ballast layer at the end face of the sleeper $\left(A_0^{b.c.}\right)$. (Fig. 4) is a graph that approximates the research data for the movement of passenger trains at speeds of 80 to 130 km/h.

The averaged value of δ_1 in the speed range from 80 to 130 km/h.

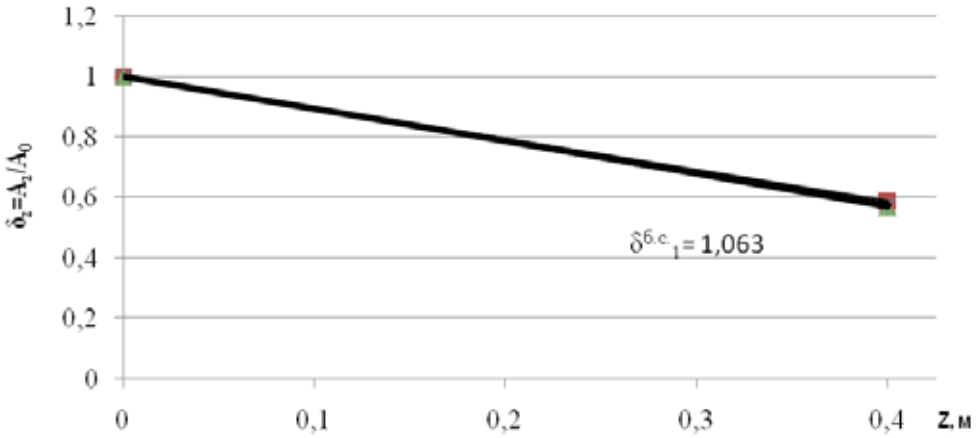

Figure 4. Change in attenuation coefficient over the depth of the ballast layer

The analysis of (Fig. 4) shows that the change $\delta_1^{b.c.}$ with depth is expressed by a linear relationship:

Then:

$$A_z^{b.c.} = A_0^{b.c.}(1 - \delta_1^{b.c.} \cdot z) \qquad (3)$$

where $\delta_1^{b.c.}$ – angular coefficient or attenuation coefficient of oscillations in depth in the ballast layer, $\delta_1^{b.c.}$ = 1.063 1 / m. $A_o^{b.c.}$ – amplitude ballast at the sleeper end, um. $A_z^{b.c.}$ – amplitude of the ballast layer at a depth from the sole of the butt end, μm. z-depth from the sole of the sleeper, m.

Formula (3) well reflects the results of propagation of the vibration amplitudes of the ballast layer at a depth of $0 < z \leq 0.6$ m.

A comparison of the results of calculating the oscillation amplitudes by formula (4) with the averaged values obtained in experiments at different speeds of passenger trains shows a good convergence of the calculated and experimental data. The greatest error is 2.3% and takes place at a depth of 0.4 m from the base of the sleepers.

5. Study of the propagation of oscillations in the direction across the axis of the path.

According to the experimental measurements, the amplitude of oscillations along the surface of the slope of the ballast layer and at the end of the sleepers at the edge of the ballast prism are determined. The results of these studies are presented in (Fig. 5). The data in (Fig. 5) are represented by the values of the maximum possible oscillation amplitudes at different speeds of motion.

The change in the amplitude of the oscillations as a function of the distance to the source in the transverse axis of the path is determined by the formula:

$$\delta_y = \frac{A_y^{b.c.}}{A_0^{б.c.}} \qquad (4)$$

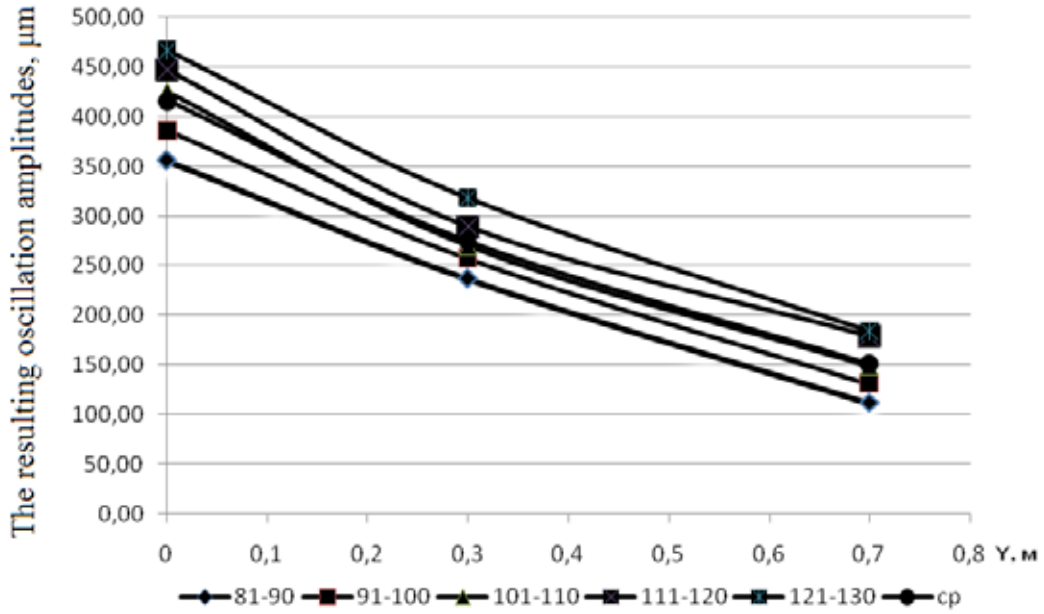

Figure 5. Attenuation of the amplitudes of the resulting oscillations in the transverse axis of the path direction during motion passenger trains with speeds from 80 to 130 km/h

$A_y^{b.c.}$ – the resultant amplitude of the oscillations in the ballast layer at a distance "y" from the sole of the butt end, μm.

$A_o^{b.c.}$ – amplitude of oscillation of the ballast layer at the sole of the butt end, μm.

Taking the angular coefficient according to the drawing as (0.362) 1 / m, we obtain:

$$A_y^{b.c.} = A_0^{b.c.} \cdot \left(1 - \delta_2^{b.c.} \cdot \left(y - 1.35\right)\right) \qquad (5)$$

where:

$A_o^{b.c.}$ – the resulting amplitude of oscillation of the ballast layer at the sole of the tie, μm;

$\delta_2^{b.c.}$ – coefficient of attenuation of oscillations across the axis of the path, $\delta_2^{b.c.} = 0{,}362\ [1/м]$;

y – distance from the track axis, m;

$\delta_3^{b.c.}$ – coefficient of attenuation of oscillations in the sloping part of the ballast, [1/m];

h – he height of the slope of the ballast above the point in question, m;

1.35 – the size of a half-sleeper, m.

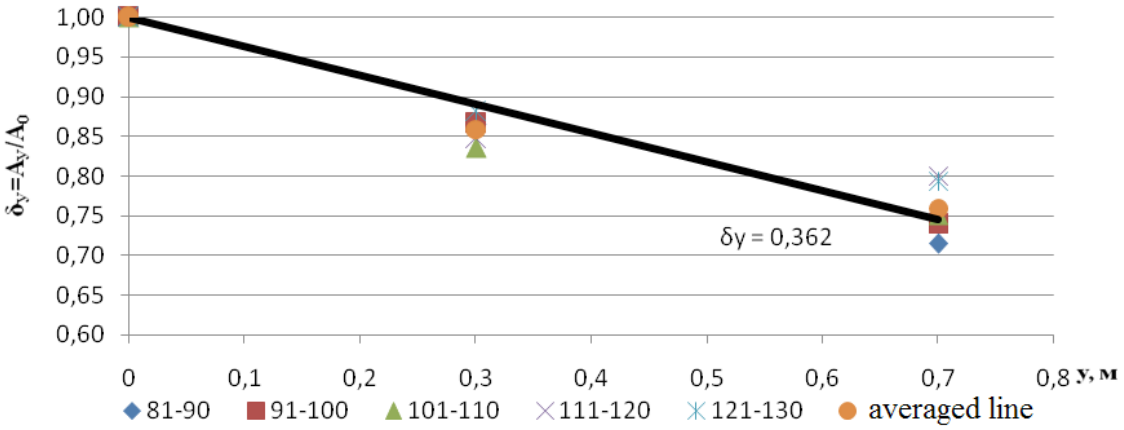

Figure 6. Damping of oscillation amplitudes in horizontal directions across the axis of the path

To determine the coefficient of fading in the slope, the formula proposed by I. V. Prokudin.

$$\delta_3^{b.c.} = \frac{\delta_1^{b.c.}}{1{,}5 \cdot ctg\alpha_1};$$

$$h_i = \begin{cases} 0 & npu\ y \le 0{,}5 \cdot b_{pl} \\ (y - 0{,}5b_{pl}) \cdot tg\alpha_1 & npu\ y > 0{,}5 \cdot b_{pl} \end{cases} \qquad (6)$$

α_1 – angle of the slope to the horizon; b_{pl} – width of the ballast prism bottom, m.

The attenuation of the resultant oscillations in the transverse axis of the path, expressed in terms of the ratio of the amplitudes, δ_y.

The propagation of oscillations in the ballast layer occurs simultaneously in the vertical and horizontal directions, so the expression for calculating the amplitudes of the oscillations takes the following form:

$$A_{zy}^{b.c.} = k \cdot A_0^{b.c.} \left(1 - \delta_1^{b.c.} \cdot z - \delta_2^{b.c.} \cdot \left(y - 1.35\right) - \delta_3^{b.c.} \cdot h_i\right) \quad (7)$$

k – coefficient of proportionality, $k = 1.08$;

6. Conclusions:

1. The amplitudes of the oscillations increase in direct proportion to the growth of the train speed. At the same time, the lowest level has oscillations along the path. The oscillations across the path are slightly larger. The highest level of vibration belongs to the vertical component.

2. In the depth of the ballast layer, the influence of the speed of movement on the level of the vibrodynamic effect decreases. At the level of the sole of the end of the sleepers, the intensity of growth of the amplitudes of the resulting oscillations was 26 μm for every 10 km/h of the speed increase, and at a depth of 0.4 m under the foot of the sleeper 13 μm, i.e. decreased by 2 times.

3. The attenuation coefficients of the oscillations along the depth of the ballast layer spilled from the granite crushed stone are determined. In the range from the sole of sleepers to a depth of 0.4 m, its value was 1.063 1/m.

4. The attenuation coefficients of the oscillations in the direction perpendicular to the axis of the path are determined. Within the zone up to 0.7 m from the butt end, its value was 0.362 1/m.

5. Dependencies (7) for calculating the oscillation amplitudes at any point of the ballast layer are proposed for subsequent calculations related to the estimation of the bearing capacity. The calculations performed with its application give a good convergence of the calculated and experimental data. The maximum error was 15%.

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Section 12. Physics

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PHOTON DRAG EFFECT IN p-Te

Absract: The spectral and temperature dependences of the current of the photon drag effect in the tellurium of hole conduction are calculated. In this case, the momentum of the photon is taken into account both in the law of conservation of energy and in the law of conservation of momentum. The calculation of the photocurrent was carried out in the approximation of the hole momentum relaxation time.

Keywords: photocurrent, photon drag, photon, relaxation time of hole momentum.

The effect of dragging by photons (PhDE) in tellurium, caused by the transfer of the photon momentum to the electronic subsystem, was experimentally observed in [3; 4]. A theoretical interpretation of the experimental results [3; 4] is given in [5] in the spherically symmetric band approximation and in [6], taking into account both the quadratic and linear in the wave vector ($\vec{k}$) contributions to the effective Hamiltonian of hole. As indicated in [7], taking into account the dependence of the square of the matrix element of the optical transition on leads to an additional contribution to the current of the PhDE.

Expanding the current density of the PhDE ($\vec{j}$), proportional to the intensity of light, along the polarization vector and the photon wave vector ($\vec{q}$), we have the following relation [8]

$$j_\alpha = I\sigma_{\alpha\beta\gamma\delta} e_\beta e^*_\gamma q_\delta, \qquad (1)$$

where I is the intensity, $\vec{e}$ is the polarization vector of light, and $\sigma_{\alpha\beta\gamma\delta}$ is the PhDE tensor $(\alpha,\beta,\gamma,\delta = x,y,z)$.

In what follows, we consider the theory of a linear PhDE produced in homogeneous crystals when they are illuminated by linearly polarized light. Then $\sigma_{\alpha\beta\gamma\delta}$ it is real and has nonzero components in crystals of arbitrary symmetry. Therefore, the EFM arises in media, both with a center of symmetry, and without an inversion center. For example, in tellurium, in the propagation of linearly polarized light along the main axis $(C_3 \| z)$, a PhDE current is generated both along the principal axis of the crystal and in the direction transverse to C_3

$$j_z = I\sigma_{zzxx} q_z,\ j_x = I\sigma_{xzxy} q_z \sin 2\theta',\ j_y = I\sigma_{xzxy} q_z \cos 2\theta' \qquad (6)$$

Here θ' is the angle between the plane of polarization of light and the axis of rotation of the second order, directed along the x axis.

In microscopic theory, the expression for the PhDE current in the relaxation time approximation has the form

$$\vec{j} = -e\sum_{n\vec{k}} \vec{v}_{n\vec{k}} f^{(\alpha s)}_{n\vec{k}} \qquad (2)$$

where $\vec{v}$ is the velocity operator, e is the elementary charge, $f^{(\alpha s)}_{n\vec{k}}$ is the asymmetric (nonequilibrium) part of the hole distribution function in the zone n. In the future, we calculate the calculation in approximation in the relaxation time $\tau_{n\vec{k}}$ and take into account the following Keldysh diagrams where the wavy line is a photon, the solid line is a hole.

In addition to taking into account the dependence of the optical transition probability on the photon momentum (both in the energy conservation law and in the momentum conservation law), we also take into account the following contribution to the PhDE current, which is related to the dependence of the magnetic field strength vector $\vec{H}$

$$\vec{H} = iA(\vec{q}\times\vec{e}). \qquad (3)$$

Here $\vec{A}=\vec{e}Ae^{i\vec{q}\vec{r}}$ is the vector potential of the light wave. Then we have the following additional term in the effective hole Hamiltonian H [10]

$$H'=\frac{eA}{c\hbar}\cdot\frac{\hbar^2}{2m_0}ig\left(\hat{\vec{\sigma}}\left(\vec{q}\times\vec{e}\right)\right)=i\mu_0 g\left(\vec{H}\hat{\vec{\sigma}}\right) \qquad (4)$$

where g is the g-factor of the holes, $\mu_0=\frac{e\hbar}{2m_0c}$ is the Bohr magneton, $\hat{\sigma}_\alpha$ are the Pauli matrices. Further, we have the following relations useful for further calculations

$$\left\langle l\left|H'\right|l'\right\rangle=H'_{ll'}=i\frac{eA}{c\hbar}gq\left[\begin{array}{l}e_{y'}\left(\eta\cos\theta-\sqrt{1-\eta^2}\sin\theta\right)+\\+(-1)^{l'}\left(e_{x'}\cos\theta+e_{z'}\sin\theta\right)\end{array}\right] \qquad (5)$$

$$\left|M_{2,\vec{k}+\vec{q};1\vec{k}}\right|^2=\left(\frac{eA}{c\hbar}\right)^2\left\{2\eta'\beta_V q\left[e_{z'}Q_{z'}\times\left(\beta_V\sqrt{1-\eta'^2}-2Ak_{z'}\right)\right]+\right.$$
$$\left.+\frac{\hbar^2}{2m_0}\left[\cos\theta e_{x'}e_{z'}+e_{z'}^2\sin\theta+i\left(\vec{e}\times\vec{e}'\right)_{x'}\left(\eta'\cos\theta-\sqrt{1-\eta'^2}\cdot\sin\theta\right)\right]\right\} \qquad (7)$$

$$\eta'=\eta\left(k_z\to k_z\right),$$

where $Q_{z'}=\frac{\left(1-\eta'^2\right)^{-1/2}}{2}\frac{\partial\eta'}{\partial k_{z'}}$, $A_{1,2}=\frac{\hbar^2}{2m_{1,2}}$, $m_{1,2}$ is effective mass of holes. It is seen from (7) that after angular integration, the quantity proportional becomes zero, i.e. in tellurium

$$A=\frac{A_1+A_2}{2}\left(l\neq l'=1,2\right),$$

this additional contribution does not arise to the linear PhDE due to non-vertical optical transitions, and only a circular PhDE [11] can arise and this contributionin Te disappears in the case $\beta_V k_z\|\Delta_2$. Then in the spherical approximation in the energy spectrum of the holes: $E_{l\vec{k}}=(-1)^l\Delta_2+A_lk^2$ the longitudinal current of the PhDE in tellurium (without taking into account the g-factor of the holes) is defined as

$$j_z=\sum_{l=1,2}(-1)^l I\frac{2e}{5}\frac{K_\parallel}{\hbar\omega}\frac{\hbar q}{m_l^*}\frac{A_l}{A_2-A_1}\left[1+\frac{2}{3}\left(\frac{\partial\ln\tau_l\left(E_l^\circ\right)}{\partial\ln E_l^\circ}-\frac{A_l}{A_2-A_1}\frac{\hbar\omega-2\Delta_2}{k_BT}\right)\right], \qquad (8)$$

where

$$K_{II}=K\left(\vec{e}\|C_3\right)=\eta_0\frac{e^2k_\omega^2\beta_V^2 f_{1k_\omega}\left(1-\exp\left(-\frac{\hbar\omega}{k_BT}\right)\right)}{3cn_\omega\hbar^2\omega\left(A_2-A_1\right)} \qquad (9)$$

is the light absorption coefficient in tellurium during the optical transition of holes between the subbands $m_1^{'}$ and $m_2^{'}$,

$E_l^\circ=E_l\left(k=k_\omega\right), k_\omega^2=\left(\hbar\omega-\Delta_2 2\right)\times\left(A_2-A_1\right)^{-1}$,

$\eta_0^2=\frac{4\beta_V^2k_\omega^2}{\hbar^2\omega^2}$, $f_{1k_\omega}=e^{\frac{\mu}{k_BT}}e^{\frac{\Delta_2-A_1k_\omega^2}{k_BT}}$,

$\tilde{k}_\omega^2=\frac{\sqrt{\left(A_2-A_1\right)^2k_\omega^4+4k_\omega^2\left(A_2-A_1\right)\Delta_2}}{4\beta_V^2}$.

For completeness of the problem, we give below an expression for the intersubband absorption coefficient of light when the "camels back" of the subband of the valence band in tellurium is taken into account, i.e.

$$E_{i\vec{k}}=A_\parallel k_z^2+A_\perp\left(k_x^2+k_y^2\right)+(-1)^i\sqrt{\Delta_2^2+\beta_V^2k_z^2} \qquad (10)$$

and in type $\vec{e}\|C_3$ in type

$$H'_{ll}=(-1)^l i\frac{eA}{c\hbar}g\frac{\hbar^2}{2m_0}qe_{y'}\left(\sqrt{1-\eta^2}\cos\theta+\eta\sin\theta\right) \qquad (6)$$

where

$$\vec{e}'=\left\{\cos\theta\cos\varphi,-\sin\varphi,\sin\theta\sin\varphi\right\},$$
$$\vec{q}'=q\left\{-\sin\theta,0,\cos\theta\right\},$$

$\eta=\beta_V k_z\left(\Delta_2^2+\beta_V^2k_z^2\right)^{-1/2}$, β_V is zone parameter of tellurium, $2\Delta_2$ is the energy gap at the point M of the Brillouin zone. Then the square of the matrix element of the interband optical transition wich depends (linear) on $\vec{q}$ is written as

$$K=\frac{e^2}{2\pi n_\omega c\hbar}\frac{k_BT}{\hbar\omega}\frac{\beta_V^2k_0^{`}}{A_\perp}\exp\left\{\frac{\mu+\frac{\hbar\omega}{2}-A_{II}k_0^{`2}+\Delta_2}{k_BT}\right\} \qquad (11)$$

where $A_{\text{II},\perp}=\frac{\hbar^2}{2m_{\text{II},\perp}}$, $k_0^{`}=\frac{\sqrt{\left(\hbar\omega\right)^2-4\Delta_2^2}}{2\beta_V}$, m_{II} and $m_\perp$ longitudinal and transverse effective masses of holes, $\propto$ is the Fermi energy, other quantities commonly known.

Figure 1 shows the spectral dependence of the absorption coefficient of linearly polarized radiation $\left(K/K_0\right)$ in in tellurium for two temperatures, where the following values of the band parameters are chosen: $\Delta_2=63{,}15\,MeV$, $A_\perp=0{,}326\cdot10^{-14}\,eV\cdot sm^{-2}$, $A_\parallel=0{,}363\cdot10^{-14}\,eV\cdot sm^{-2}$, $\beta_V^2=0{,}6\cdot10^{-15}\,eV^2\cdot sm^{-2}$, $K_0=\beta_V e^{\mu/k_BT}\left(2A_\perp\cdot274\pi n_\omega\right)^{-1}$.

It can be seen from (fig. 1) and (fig. 2) that with increasing temperature the extreme value of the light absorption coefficient in *p-Te* decreases by more than two orders of magnitude and shifts towards smaller frequencies.

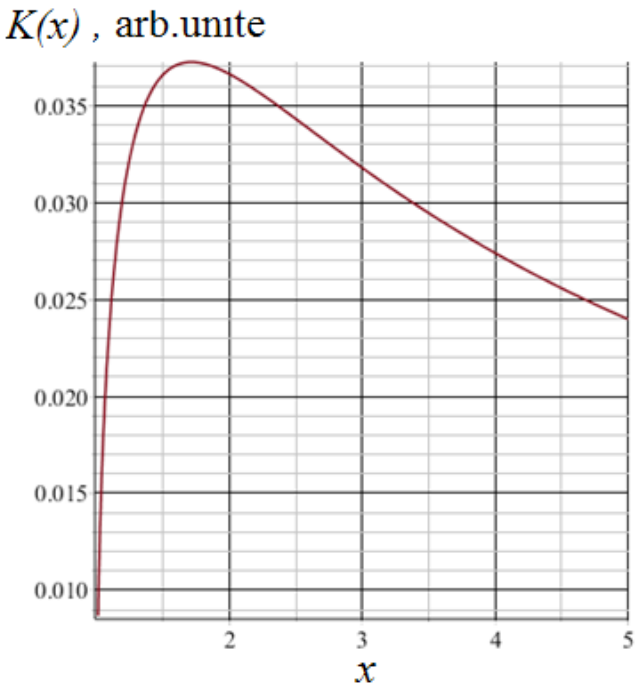

Figure1. The spectral dependence of the light absorption coefficient in p-Te for $k_B T / 2\Delta_2 = 0{,}2$, where $x = \hbar\omega / k_B T$. The values of the zone parameters are given in the text

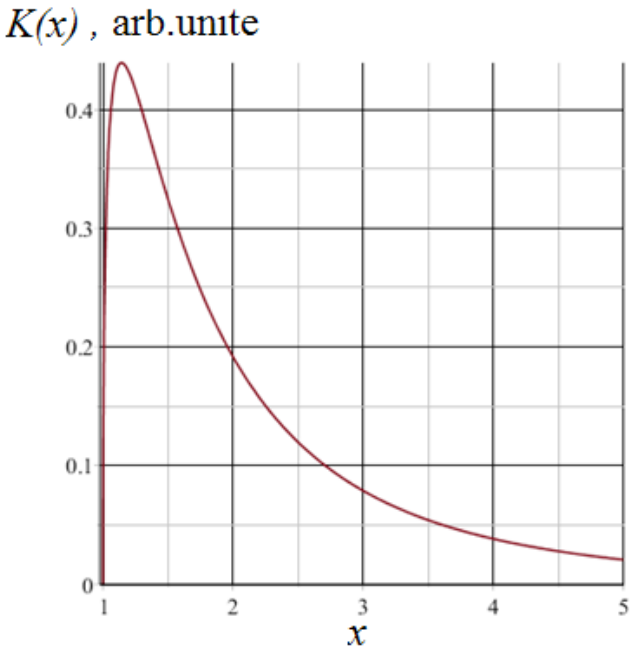

Figure 2. The spectral dependence of the light absorption coefficient in p-Te for $k_B T / 2\Delta_2 = 2$, where $x = \hbar\omega / k_B T$. The values of the zone parameters are given in the text

In the approximation (10), the contribution to the PhDE due to the account of (6) is described by the tensor (for $\vec{e} \| C_3$)

$$\sigma_{yyzx}^{(l)} = (-1)^l \frac{16\pi eI}{\hbar\omega} K` \frac{\delta k_B T \Delta_2 \hbar\omega g \tau_{lk_0} \hbar}{m_0 \beta_V^2 \left[(\hbar\omega)^2 - 4\Delta_2^2 \right]},$$

where δ is band parameter of in tellurium.

It can be seen from the latter that the contribution to the PhDE in in tellurium, which arises from taking into account the -g factor, increases with increasing temperature, the quantitative value of which depends on the value of δ and g factor.

Calculations show that the extreme value of the theoretical spectral dependence of the current of the PhDE is 1.2 times smaller than the experimental value. This, apparently, is connected with neglecting the anisotropy in the energy spectrum of the electrons. Naturally, in this case, the spectral and temperature dependences of the current of the PhDE must be calculated numerically. This case requires separate consideration.

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INVESTIGATION OF DIMENSIONAL QUANTIZATION IN A SEMICONDUCTOR WITH A COMPLEX ZONE BY THE PERTURBATION THEORY METHOD

Abstract: The problem of the energy spectrum and the wave function of electrons in subbands of the conduction band in n-GaP with allowance for the dimensional quantizationwais theoretically considered.

Keywords: energy spectrum, quantum well, wave function, dimensional quantization.

Recently, optical transitions between levels in a dimensional quantized well (DQW), which are used in infrared photoconverters [1], have attracted considerable attention. For semiconductors with a simple zone, the calculation of interlevel transitions for an DQW of an arbitrary potential was carried out earlier in [2, 3]. At the same time, the interlevel optical transitions in the DQW of hole conduction are of interest because of the nonzero absorption for light of arbitrary polarization, which have practical application [4]. A theoretical research of this type of problem is made difficult by the complexity of the band structure of a semiconductor. In particular, in [5–7] such a problem was solved numerically in the case of a rectangular DQW with a fixed thickness. However, even a small variation of the thickness or depth of the DQW can greatly change the final result, which makes it difficult to analyze intermediate calculations. In [8], on the basis of the perturbation theory, analytical expressions were obtained [9]. The energy spectrum of the holes was studied, and the intersubband absorption of polarized radiation in an infinitely deep semiconductor quantum well was studied. The calculations were carried out in the Luttinger — Cohn approximation [10, 11] for semiconductors with a zinc blende lattice.

However, a theoretical research of dimensional quantization in a potential well grown on a semiconductor base with a complex zone, one subzone of which has a "hump-like structure" (for example, n-GaP or p-Te) remains open, which was researched in this work.

Note that the research of a number of phenomena, in particular optical or photovoltaic effects in a dimensionally quantized well, requires knowledge of the energy spectrum and wave functions of electrons.

For a quantum well with potential $U(z)$, we represent the effective Hamiltonian of electrons in n-GaP as

$$\widehat{H} = \widehat{H}_0 + \widehat{R}_2 k_\perp^2, \tag{1}$$

where

$$\widehat{H}_0 = \frac{\Delta}{2}\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} - \begin{bmatrix} A_3 & 0 \\ 0 & A_1 \end{bmatrix}\frac{\partial^2}{\partial z^2} + U(z),$$

$$\widehat{R}_2 = \begin{bmatrix} B_3 & D\sin\varphi\cos\varphi \\ D\sin\varphi\cos\varphi & B_1 \end{bmatrix}, \tag{2}$$

$A_{3,1}, B_{3,1}, D, P$ are n-GaP band parameters, $k_\perp^2 = k_x^2 + k_y^2$, $\vec{k}_\perp = \left(k_x, k_y\right)$ (or $k_x = k_\perp\cos\varphi$, $k_y = k_\perp\sin\varphi$) is two-dimensional wave vector directed along the interface, $\vec{r}_\perp = (x, y)$. Below, we assume that the wave function of electrons in the DQW plane is $\Psi \propto \exp(i\vec{k}_\perp\vec{r}_\perp)$.

The unperturbed energy levels $E_\xi(0)$ and the wave function of electrons $\psi_\xi^{(0)} = \begin{bmatrix} \psi_3^{(0)} \\ \psi_1^{(0)} \end{bmatrix}$ in the subbands of the conduction band $X_\xi(\xi = 3,1)$ at $n-GaP$ are determined from the following matrix differential equation $\widehat{H}_0\widehat{\psi}_\xi^{(0)} = \widehat{E}_\xi\widehat{\psi}_\xi^{(0)}$, where $\widehat{E}_\xi = \begin{bmatrix} \tilde{E}_3 & 0 \\ 0 & \tilde{E}_1 \end{bmatrix}$. Then we have

$$\left\{\frac{\Delta}{2}\begin{bmatrix} \psi_3^{(0)} \\ -\psi_1^{(0)} \end{bmatrix} - \frac{\partial^2}{\partial z^2}\begin{bmatrix} A_3\psi_3^{(0)} \\ A_1\psi_1^{(0)} \end{bmatrix} + P\frac{\partial}{\partial z}\begin{bmatrix} -\psi_1^{(0)} \\ \psi_3^{(0)} \end{bmatrix} + U(z)\begin{bmatrix} \psi_3^{(0)} \\ \psi_1^{(0)} \end{bmatrix}\right\} = \begin{bmatrix} \tilde{E}_3\psi_3^{(0)} \\ \tilde{E}_1\psi_1^{(0)} \end{bmatrix}, \tag{3}$$

where the third term describes the transformation of an electron with mass $m_{1(3)}$ to mass $m_{3(1)}$.

From the last equation it is clear that there are two cases.

1-case. In this case, we will assume that the effective masses of the electrons in both subbands are the same, i.e. $A_3 = A_1 = A$. Then the last equation will be

$$\left\{\frac{\Delta}{2}\begin{bmatrix}\psi_3^{(0)}\\ -\psi_1^{(0)}\end{bmatrix} - \frac{\partial^2}{\partial z^2}\begin{bmatrix}A\psi_3^{(0)}\\ A\psi_1^{(0)}\end{bmatrix} + P\frac{\partial}{\partial z}\begin{bmatrix}-\psi_1^{(0)}\\ \psi_3^{(0)}\end{bmatrix} + U(z)\begin{bmatrix}\psi_3^{(0)}\\ \psi_1^{(0)}\end{bmatrix}\right\} = \begin{bmatrix}\tilde{E}_3\psi_3^{(0)}\\ \tilde{E}_1\psi_1^{(0)}\end{bmatrix}, \quad (4)$$

Then we have a system of equations

$$\begin{cases}-\frac{\partial^2\psi_3^{(0)}}{\partial z^2} - \frac{P}{A}\frac{\partial\psi_1^{(0)}}{\partial z} + \frac{1}{A}\left[U(z)-\tilde{E}_3\right]\psi_3^{(0)} + \frac{1}{A}\frac{\Delta}{2}\psi_3^{(0)} = 0,\\ -\frac{\partial^2\psi_1^{(0)}}{\partial z^2} + \frac{P}{A}\frac{\partial\psi_3^{(0)}}{\partial z} + \frac{1}{A}\left[U(z)-\tilde{E}_1\right]\psi_1^{(0)} - \frac{1}{A}\frac{\Delta}{2}\psi_1^{(0)} = 0.\end{cases} \quad (5)$$

Next, we make the notation of type $\psi_3^{(0)} + i\psi_1^{(0)} = \zeta^{(0)}$ and assume that $\tilde{E}_3 = \tilde{E}_1 = \tilde{E} = E(\vec{k}_\perp) - Bk_\perp^2$. Then we get the equation for $\zeta^{(0)}$

$$\frac{\partial^2\zeta_-}{\partial z^2} - i\frac{P}{A}\frac{\partial\zeta_-}{\partial z} - \frac{1}{A}\left[U(z)-\tilde{E}\right]\zeta_- + \frac{1}{A}\frac{\Delta}{2}\zeta_+ = 0, \quad (6)$$

If we assume that $U(z) = U_0 = const$ and make the following notation $\kappa_E^2 = \frac{1}{A}\left(U_0 - \tilde{E}\right)$, $\kappa_\Delta^2 = \frac{1}{A}\frac{\Delta}{2}$, $2\chi = \frac{P}{A}$, then we will have

$$\frac{\partial^2\zeta_-}{\partial z^2} - 2i\chi\frac{\partial\zeta_-}{\partial z} - \kappa_E^2\zeta_- + \kappa_\Delta^2\zeta_-{}^* = 0. \quad (7)$$

Solution (7) $\zeta_- = C\cdot\exp(\alpha z)$ is simplified if we assume that $\zeta_-(z)$ function is a real quantity, the characteristic equation for which has roots

$$\alpha_\pm = i\chi \pm \sqrt{-\chi^2 + 4\left(\kappa_E^2 - \kappa_\Delta^2\frac{C^*}{C}\right)} \quad (8)$$

To simplify the solution of the problem, we assume that $C = C^*$, $C-$ is a real quantity. Then

$$\alpha_\pm = i\chi \pm \sqrt{-\chi^2 + 4\left(\kappa_E^2 - \kappa_\Delta^2\right)} \quad (9)$$

and we have that

$$\zeta_-(z) = \exp(i\chi z)\left\{C_+\cdot\exp\left(z\sqrt{-\chi^2 + 4\left(\kappa_E^2 - \kappa_\Delta^2\right)}\right) + C_-\cdot\exp\left(-z\sqrt{-\chi^2 + 4\left(\kappa_E^2 - \kappa_\Delta^2\right)}\right)\right\} \quad (10)$$

If $\kappa_E^2 < \kappa_\Delta^2$. Than

$$\zeta_- = \exp(i\chi z)\left[C_1\cdot\cos\left(z\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right) + iC_2\sin\left(z\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)\right]. \quad (11)$$

Considering the boundary conditions of type $\zeta_\pm(z = -a/2) = 0$, $\zeta_\pm(z = +a/2) = 0$, if condition $\cos(a/2\chi) \pm i\sin(a/2\chi) \neq 0$ is satisfied, then the relationship between C_1 and C_2 is defined as $C_1 = \pm iC_2 tg\left(a/2\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)$. In this case, from the normalization condition

$$\begin{aligned}|C_1| &= \left|\sin\left(\frac{a}{2}\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)\right|,\\ |C_2| &= \left|\cos\left(\frac{a}{2}\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)\right|,\end{aligned} \quad (12)$$

and the expression for $\zeta_-(z)$ is

$$\zeta_-(z) = \exp(i\chi z)\times\left[\begin{array}{l}\frac{1}{2}\left[\sin\left(\left(z+\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right) - \sin\left(\left(z-\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)\right] +\\ +\frac{1}{2}i\left[\sin\left(\left(z-\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right) + \sin\left(\left(z+\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)\right]\end{array}\right]. \quad (13)$$

whence the electron wave functions are determined by the ratios

$$\Psi_1 = \frac{1}{2}\left\{\left[\cos(\chi z) - \sin(\chi z)\right]\cdot\sin\left(\left(z+\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right) - \left[\cos(\chi z) + \sin(\chi z)\right]\cdot\sin\left(\left(z-\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)\right\}, \quad (14a)$$

$$\Psi_3 = -\frac{1}{2}\left\{\left[\cos(\chi z) + \sin(\chi z)\right]\cdot\sin\left(\left(z+\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right) + \left[\cos(\chi z) - \sin(\chi z)\right]\cdot\sin\left(\left(z-\frac{a}{2}\right)\sqrt{\chi^2 + 4\left(\kappa_\Delta^2 - \kappa_E^2\right)}\right)\right\}. \quad (14b)$$

At $\psi_3^{(0)}(z = \pm a/2) = 0, \psi_1^{(0)}(z = \pm a/2) = 0$, we obtain expressions for the energies of the dimensionally-quantized states of electrons at the point X of the Brillouin zone, i.e. with y

$$\begin{aligned}E &= U_0 - \frac{\Delta}{2} - \frac{P^2}{16A} - A\pi^2\frac{(2n+1)^2}{4}a^2,\\ E &= U_0 - \frac{\Delta}{2} - \frac{P^2}{16A} - A\pi^2 n^2 a^2,\end{aligned} \quad (15)$$

where the first ratio corresponds to even to the inversion of the coordinates of states, and the second to odd states, an integer.

Note that in the case when $4\left(\kappa_E^2 - \kappa_\Delta^2\right) - \chi^2 > 0$, then the wave function can be represented as

$$\psi_3^{(0)}(z) = \exp(-z\chi)\times \times\left[\tilde{C}_1\cos\left(z\sqrt{4\left(\kappa_E^2 - \kappa_\Delta^2\right) - \chi^2}\right) + \tilde{C}_3\sin\left(z\sqrt{4\left(\kappa_E^2 - \kappa_\Delta^2\right) - \chi^2}\right)\right] \quad (16)$$

Then, from the normalization condition of the wave function, it is easy to obtain expressions for $\tilde{C}_1, \tilde{C}_3$ in the form

$$\begin{aligned}C_1^{-2} = &\frac{sh(a\chi)}{2\chi\left[\chi^2 + 4\left(\kappa_E^2 - \kappa_\Delta^2\right) - \chi^2\right]}\times\\ &\times\left\{4\left(\kappa_E^2 - \kappa_\Delta^2\right) + \chi^2\cdot\cos\left(a\sqrt{4\left(\kappa_E^2 - \kappa_\Delta^2\right) - \chi^2}\right) + \right.\\ &\left. + \chi\cdot\sqrt{4\left(\kappa_E^2 - \kappa_\Delta^2\right) - \chi^2}\cdot\sin\left(a\sqrt{4\left(\kappa_E^2 - \kappa_\Delta^2\right) - \chi^2}\right)\right\}.\end{aligned} \quad (17a)$$

$$C_3^{-2}=\frac{sh(a\chi)}{2\chi\left[\chi^2+4\left(\kappa_E^2-\kappa_\Delta^2\right)-\chi^2\right]}\times\left\{-4\left(\kappa_E^2-\kappa_\Delta^2\right)+\chi^2\cdot\cos\left(a\sqrt{4\left(\kappa_E^2-\kappa_\Delta^2\right)-\chi^2}\right)+\chi\cdot\sqrt{4\left(\kappa_E^2-\kappa_\Delta^2\right)-\chi^2}\cdot\sin\left(a\sqrt{4\left(\kappa_E^2-\kappa_\Delta^2\right)-\chi^2}\right)\right\}. \quad (17b)$$

2-case. Let $\sqrt{\chi^2-4\left(\kappa_E^2+\kappa_\Delta^2\right)}$ be a real value. Then the Schrödinger equation has the form

$$\begin{cases}\dfrac{\partial^2\zeta_1^{(0)}}{\partial z^2}+2\chi\dfrac{\partial\zeta_1^{(0)}}{\partial z}+\left(\kappa_E^2-\kappa_\Delta^2\right)\zeta_1^{(0)}=0,\\ \dfrac{\partial^2\zeta_2^{(0)}}{\partial z^2}+2\chi\dfrac{\partial\zeta_2^{(0)}}{\partial z}+\left(\kappa_E^2+\kappa_\Delta^2\right)\zeta_2^{(0)}=0,\end{cases} \quad (18)$$

whose solution we represent in the form

$$\zeta_1^{(0)}=\exp(-z\chi)\left[\begin{matrix}F_1\exp\left(z\sqrt{\chi^2-4\left(\kappa_E^2+\kappa_\Delta^2\right)}\right)+\\ +F_2\exp\left(-z\sqrt{\chi^2-4\left(\kappa_E^2+\kappa_\Delta^2\right)}\right)\end{matrix}\right]. \quad (19)$$

From the latter one can see if $\chi^2-4\kappa_\xi^2\rangle 0$, i.e. $\kappa_{E_\xi}\rangle\kappa_\Delta$, then (19) has the form

$$\zeta_\xi^{(0)}=\exp(-z\chi)\left[\begin{matrix}F_1\exp\left(z\sqrt{\chi^2-4\kappa_\xi^2}\right)+\\ +F_2\exp\left(-z\sqrt{\chi^2-4\kappa_\xi^2}\right)\end{matrix}\right], \quad (20)$$

where $\kappa_\xi^2=\kappa_{E_\xi}^2-(-1)^{(1+\xi)/2}\kappa_\Delta^2$. In this case, the probability density for finding electrons falls exponentially.

From the boundary condition $\left.\frac{\partial}{\partial z}\zeta_\xi^{(0)}\right|_{z=0}=0$ we have

$$\zeta_\xi^{(0)}=F_1\exp(-z\chi)\times \times\left[\exp\left(z\sqrt{\chi^2-4\kappa_\xi^2}\right)-\exp\left(-z\sqrt{\chi^2-4\kappa_\xi^2}\right)\right]. \quad (21)$$

and the condition $\left.\frac{\partial}{\partial z}\zeta_l^{(0)}\right|_{z=a}=0$ gives the ratio by which one lets determine the energy dispersion taking into account the dimensional quantization

$$\exp\left(2a\sqrt{\chi^2-4\kappa_l^2}\right)=\frac{2-\left(\frac{2\kappa_l}{\chi}\right)^2+2\sqrt{1-\left(\frac{2\kappa_l}{\chi}\right)^2}}{\left(\frac{2\kappa_l}{\chi}\right)^2}, \quad (22)$$

where $\kappa_{E_\xi}^2=\frac{1}{A_\xi}\left(U_0-\tilde{E}_\xi\right)$, $\kappa_\Delta^2=\frac{1}{A}\frac{\Delta}{2}$, $\tilde{E}=E-Bk_\perp^2$. Due to the lack of an experiment on dimensionally quantization in n-GaP, we do not carry out a numerical calculation (22).

3-case. In this case, we will not pay attention to the case where the conversion of an electron from one zone into another occurs, i.e. assume that $P=0$. Then when $U(z)=U_0=const$ we have the following system of equations

$$\begin{cases}\dfrac{\partial^2\psi_1^{(0)}}{\partial z^2}-k_{01}^2\psi_1^{(0)}=0,\\ \dfrac{\partial^2\psi_3^{(0)}}{\partial z^2}-k_{03}^2\psi_3^{(0)}=0\end{cases} \quad (23)$$

Here $k_{0\xi}^2=\frac{1}{A_\xi}\left[\tilde{E}_\xi-(-1)^{(1+\xi)/2}\frac{\Delta}{2}-U_0\right]$. Solution (23) is sought in the form

$$\psi_\xi^{(0)}=B_\xi e^{ik_{0\xi}z}+D_\xi e^{-ik_{0\xi}z} \quad (24)$$

where D_ξ, B_ξ are constants, determined by the boundary conditions of the problem under consideration. From the condition that the derivative of the wave functions to zero at the interfaces of the well interface, it is easy to obtain $E_\xi\left(k_\perp,n_\xi,a\right)$

$$E_\xi=Bk_\perp^2+\left(\frac{\pi\cdot n_\xi}{a}\right)^2A_\xi+(-1)^{(1+\xi)/2}\frac{\Delta}{2}+U_0\ \ (n_\xi=1,2,3,...). \quad (25)$$

Thus, it was shown that the dimensionally-quantized spectrum of electrons in a semiconductor, the conduction band of which consists of two subzones, between which there is an energy gap, consists of a set of dimensionally quantized levels that do not intersect each other due to the presence of an energy gap. Expressions are obtained for the wave functions and energy spectra of electrons for different cases, differing from each other by relations for the characteristic wave vectors, which, in turn, depend on the band parameters of the semiconductor and on the energy gap between the subbands of the conduction band.

In conclusion, we note that this problem can be solved by the perturbation theory method, where we can consider as a perturbation the terms in the effective Hamiltonian containing $k_\perp$, where it is necessary to expand the energy spectrum and the wave function of electrons in a two-dimensional wave vector. This case requires separate consideration, to which the following work will be devoted.

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Section 13. Philology

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PHILOSOPHICAL SPECTRUM POETRY OF DAVID GURAMISHVILI

Abstract: Davit Guramishvili is the son of the XVIII century, the futuristic history of Georgia is an integral part of his biography. The Kartl-Kakheti kingdom was so weakened that Lekes was inundated with Georgians and taken to captivity. Such fate was caused by Davit Guramishvili, a prisoner who escaped from the puppets, sometimes escaping Russia, and sometimes Ukraine.

D. Guramishvili was able to make the Bible a lecture by the Georgian word and to make his misfortune to poetry.

Guramishvili is a straightforward and honorable heir to Georgian hymnographers and Shota Rustaveli.

Far away from his homeland creates an extraordinary poetry called the "Davitiani" and the son of Erekle II, Mirian Batonishvili, who is visiting Russia, as a tribute to Georgia's unhappy son. The book was printed only a century later. So great treasure back home.

The article reviews the philosophical vision of David Guramishvili, which has not been the subject of discussion of Georgian science until now.

Keywords: Georgian language; Georgian poets, David Guramishvili.

1. Introduction

On the horizon of the XVIII century Georgian poetry solitary star twinkles fate of David Guramishvili. The life of Prince Guramishvili coincided with severe tests in the fate of the country: endless internal and external wars so weakened Kartli-Kakheti that Lezghins raided homes of Georgians and drove them into captivity. D. Guramishvili also gone into captivity, was thrown into a pit, where he spent several months on bread and water. David had a prophetic dream, thanks to which he managed to escape from captivity.

After that, where not only been a poet, but he was never able to return home. He died in Mirgorod, leaving no offspring, but acknowledging their child own hand-written collection of poems called "Davitiani". Son of King Irakli II, Prince Mirian, and brought this book to Georgia in 1787, but it was published only a century later. David Guramishvili represents a very unusual phenomenon in the Georgian poetic thought, being the direct heir and successor lines rustavelevskoy poetry.

The famous Georgian public figure Gerontius Kikodze wrote: 'Most of my adult life, David Guramishvili held on foreign soil. Despite this, he was a national poet, more national than other poets, who throughout his life not traveled outside the country. He said that he was unhappy because his homeland was unhappy. Thus, it seems to bequeath to future generations to care for the happiness of the homeland, if they want to personally be happy".

2. Analysis of Research

Poetry D. Guramishvili characterized by several philosophical dimension. One and probably the most important of these is the ability of the metaphysical vision which is characteristic only of deeply religious people. The philosophical works of David Guramishvili spectrum – is primarily Orthodox. By reviving the forgotten Georgian hymnographies, which had the age of several centuries, he gave her a new expressiveness and actually managed to create a poetic version of the Gospel:

vai ra kargi saCino, ra avad migiCnieso!
RvTis saidumlo gagtexes, gulSi ver dagitieso,
ocdaaT vercxlad gagyides, isic ki danabnieso,
dideba moTminebasa, Sensa, ufalo ieso!
Hey, how have you been good, but how bad you felt!
Crashed the mystery of God, in the heart could not hold,

Sell you 30 pieces of silver, and even that is lost,
Glory to Thy patience, Lord Jesus!) (Translation ours M.M.)

Guramishvili known that:

RmerTman rom kaci dabada, oTx nivTiT aRaSenao,
miwiT, wyliT, cecxliT, qariTa, CaberviT misca qSenao.
After giving birth to man, God created him out of four things,
Revived him by land, water, fire, wind … (Translation ours – M.M.)

In "Soul Stories" (which has not yet translated into Russian) poet clarifies

"dabadebiTgan me, kacis suli,
RvTis piriT gamo var gamosuli,
arsT nawilobiT ukvdav-uberi, miwas, wyals,
qars, cecxls Sig Canaberi.
es oTxi nivTi RmerTman Semzada,
kaci amisgan Seqmna, dabada".
"From birth I, the human soul,
Released from the mouth of God,
It was created out of land, water, wind, fire.
These four things God has prepared,
Created and became the father of this man.
(Translation ours – M.M.)

You can state categorically that the fixation of four elements (earth, water, air and fire) as the foundation for peace D. Guramishvili could not deduct in the writings of the founders of theology, in their teachings and sermons. It is obvious that he very deeply studied the works of ancient Greek scientists, philosophical views of leaders of Hellenistic culture, was also familiar with the legacy of writers and thinkers of ancient times. (Magradze: 322)

The same is confirmed by the use of a Guramishvili Greek names of winds, well known in mythology and literature:

jarT myvanebelTa, evros amirad
yvanda kekias mopirdapirad;
Semdegad mas lifsi, xefiros, fviniqsi,
boria, notos…
zafxulis amirad yvanda kekia,
sad evros idga nacarqeqia;
Semdegad argestis apili erRasti,
Traske livontos. (gv. 258)
A Kekya head in Summer.
Evros bragging cursed him for it.
Go to Kekiey, luckily, and
the Appeal was Ergasty,
Levantos and Argest (Translation ours – M.M.)

Zephyr from the Greeks is the northern or north-westerly wind, Phoenix – South-westerly wind, or wind Phoenicia, Northwind – a cold northerly wind, with whom we meet as early as Homer's Iliad:

Like the snow from the clouds, hail il cold collapsed, flies, kill clarifying air Borei (XV, 170–171, translated Veresayev)

As well Guramishvili familiar with the wisdom of King Solomon, know that:

solomon brZeni sibrZniTa Tavi ars yovlis brZnebisa,
bevri ram kargi daswera wignebi RvTis brZanebisa (gv. 45)
This is, of course, Bible, Solomon, and intellect Guramishvili also not in doubt.

68th row "Book A" reads:

filosofosi epikur gvauwyebs, amas gvpirdeba:
agebulebiT myofeli arodes gaRaribdeba,
Tu kaci ndomas mihyvebis, midReSi ar gamdidrdeba,
roca pataras iSovnis, merme dids maekideba (gv. 33).
Epicurus, the ancient philosopher, so this course:
Odarennvy from nature, the spirit of man is not impoverished.

The same, who is subjected to passion, will not know how to become rich,

Hardly managed the small, it for large to strive laughs.
(Translation ours – M.M.)

Last Taipa "barely tackled small, it is a big chase dare" is linked with the expression of Epicurus If someone is not enough small part, to him nothing could be enough.

Thus, Guramishvili was familiar with the teachings of Epicurus, who lived and worked in the IV century BC.

Another philosophical dimension (this is the reference point of poetry Guramishvili) reads as follows: human life and the life of the nation. At its thorny path of life Guramishvili saw the tragic fate of their homeland, and literary symbols are no longer needed. He contrasted each other misfortunes of King Vakhtang, his son, Bakar and Georgia:

vai, ra boZi waiqca, saxl-kari Tavs dagveqcao!
lxini, Sveba da siame sul Wirad gardagveqcao,
Cven ymani davrCiT, patroni wavida, Sors gagveqcao.
gafrTxildi, Senc ar dagveqce, RvTis maca, magra deq cao! (gv. 171)
Grief! The pillar of what fell down! Fall what hall wonderful!

Happiness gorem (advance repair train, adreptrain) was wrapped up, by grief it became general.

King, the children of his after leaving, went to sleep in the grave of close.

More strongly cost, as if you do not collapse, blue tent celestial!
(Translation ours – M.M.)

mefe mogvikvda, viqmeniT Cven mwared oxer-tiali!
miT dagvibnelda sawuTros SuqTa brwyinva da Wyrtiali;
mogvwyda wel-guli, SevqeniT, viT umxrod Citman, frtiali,
daviwyeT, vita wiwilTa ukruxobiTa, wkrtiali. (gv. 172)
Died King, and to us, to Georgians, was difficult loss.

Earth is covered by night the light, which shone to us once.
With smashed we swept, eaglets,
Began to squeak hopeless as without the hen chickens.
(Translation ours – M.M.)

D. Guramishvili poetry, which is a pretty big page in the life of Georgia, and reinforces the fact that the main criterion in his philosophical outlook has defined the principle of fixation of the truth:

aw rom avi ar vaZago, kargi rogor unda vaqo?
avs Tu avi ar uwodo, kargs saxelad ra davarqo?
kargs kacs viTar daukargo, rac ram sikarkace aqo?
avs kacs kargi viT uZebno, ormos Camsva, Tavs damarqo? (gv. 44)

How good to glorify, if bad not to scold?
If we evil in the evil do not place, that good to name?
It is possible whether good behavior in the worthy to take away?
Than to correct villain, it is better martyr to become!
(Translation ours – M.M.)

marTals vityvi, Seviqmnebi truilisa moambe rad?
veras uqeb saZagelsa, uferulTa pir-saferad.
me, Tu ginda, Tavic momWran, tani gaxdes gasaberad,
vinc ara hgavs kaxabersa, me ver vityvi kaxaberad. (gv. 44)

Speak I will be truth, not herald I to chimera.
Unworthy not to pray, I will not be humbled in [litsemere].
Let although the head remove from the arms of my –
at least not[say whom fell with Of Kakhaberi.
(Translation ours – M.M.)

So, we can clearly say that philosophy is a conviction Guramishvili crucified optimist.

3. Results and Discussion

We know that as soon as cold winter in the valley of the Georgian flower of the sun, it instantly freezes from the cold, but warm as instantly thawed, seeking a life. Such poetry Guramishvili. The main criteria for evaluating human are his mind, formed in whole, wisdom, and the didactic-moral question raised in Guramishvili philosopher-ski rank.

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Section 14. Philosophy

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INNOVATORY METHODS OF WORKING WITH UNORGANIZED YOUTH

Abstract: The article focuses on an innovative approach to employing young people who are uneducated and unemployed, with an urgent problem all over the world. The most important aspect of working with unorganized young people is that they are related to engaging in entrepreneurial activity. The author sought to reveal the philosophical essence of Uzbekistan's experience in this regard.

Keywords: youth, unorganized youth, innovative thinking, entrepreneurship, youth employment, cluster.

The Youth Union of Uzbekistan plays an important role in shaping the youth's innovative thinking and can play a specific role in mobilizing young people to implement these tasks in public life. The issue of unorganized youth is a matter of particular concern. Shavkat Mirziyoev, the President of the Republic of Uzbekistan, describes the unorganized youth as follows: "… unorganized youth, that is, those, who do not study, who do not have a regular engagement, who are inclined to negative effects … » [1]. Of course, these types of young people are also members of the community, to ensure their socialization, and to create innovative skills in them. Visited the Bukhara region and got acquainted with the activities of the Youth Center of the President of the Republic of Uzbekistan. Highly appreciating the work done, he gave instructions on the rational use of the opportunities created, the meaningful organization of the youth's leisure, the unification of unorganized youth [2]. An important aspect of working with unorganized young people is the existence of such cultural institutions as the second one is related to entrepreneurial activity.

By the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan № 834 from October 16, 2017, clusters for young entrepreneurs were established. According to this:

– production areas within the cluster territory will be rented only to young entrepreneurs, members of the Youth Union of Uzbekistan, at the «zero» rate of lease no more than 5 years before the establishment of an enterprise;

– rendering of practical assistance to young people in the clusters, providing consultations to youth, preparation of necessary documents related to entrepreneurship activity, free of charge;

– Employees of the business entity subject to placement within the cluster shall be filled up by persons under the age of 35 years and shall be at least 70 per cent of the total number of employees;

– state-owned property located in the territory of free-economic and small industrial zones, which are not in use, is rented at the "zero" rate of rent for no more than 5 years at the invitation of the city and district councils of the Youth Union of Uzbekistan [3].

It is also desirable to introduce the practice of granting privileged quotas for low-income uneducated youth in private educational centers to provide them with study and work based on an innovative approach and employment.

All of these activities will serve as an active link between young people's modernization processes in society and, ultimately, the development of innovative thinking. Psychologists, sociologists, pedagogues, and philosophers should work together to develop mechanisms for effective decision-making on the problem of the formation of an active position and youth in the young. Such a mechanism can enable each entity to implement innovative ideas and projects in practice and achieve its effectiveness. This leads to the realization of the potential of each subject. Efficiency of innovation activities will be as important and useful for senior and regular employees as it enhances the innovative activity of the team by improving the innovation environment.

The complexity of forming an innovative mindset in young people is that first, it is necessary to take into account the psychological features of young people. It is necessary to take into account the fact that they are not formed as a person, and secondly, the rapid adoption and acquisition of new information. Thirdly, the partiality of national and traditional values due to their age, fourthly, the impact of various influences on their minds, without innovation in modern globalization

and modernization. Bearing in mind the importance of educating young people in the spirit of nationalism and national values, we understand that the issue is really complex.

Factors influencing the formation of innovative thinking in young people: innovative environment, innovative opportunity, needs and demands for news, innovative culture. It is important for young people to be innovative in their ability to innovate, to be comfortable, modern. Formation of innovative thinking in young people can be considered as simplification aspects. Here are some of the innovative levels of consciousness: an innovative mind that rises to the level of daily psychology and rationality. Understanding the market economy and its emerging economic and social changes, the emerging innovation of society with the social consciousness of the society, and the proper representation and adaptation of these processes are slower than the development of innovations.

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Section 15. Chemistry

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A SERIES OF FIBONACCI NUMBERS AND CHEMICAL ELEMENTS AND MOLECULES

Abstract: The article discusses the structure of atoms of chemical elements in the light of the sequence of Fibonacci numbers. It is assumed that the first member of the series is the mass of the electron, and the second and third members of the series are, respectively, the mass of the proton and neutron. For example, the sixth member of the series is the lithium ion $^{5}Li^{+}$ or the beryllium isotope ^{5}Be. It is shown that the ratios of atoms in oxides of chromium of uranium and nitrogen are equal to the ratios of the Fibonacci numbers.It has been established that the potential number of fatty acids increases with the length of their chain in accordance with known Fibonacci numbers. It is shown that during the synthesis of oligo (3-hexylthiophene) the number of repeated units follows the Fibonacci numbers to length 21.

Keywords: Fibonacci series, atomic structure, chemistry, oxides of chromium and uranium, fatty acids, polymers.

Introduction

In the beginning of the thirteenth century, in the famous book Liber abaci, the mathematician from Italy, Leonardo Fibonacci, first introduced the regularity of numbers, in the series of which each number is the sum of the two preceding digits. The sequence of Fibonacci numbers is as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, etc.

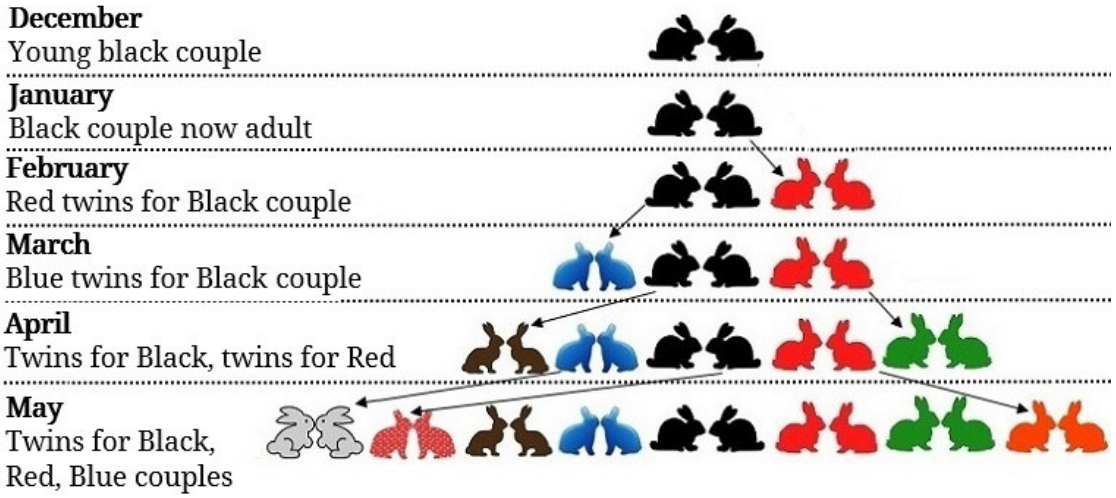

Figure 1. Fibonacci's Rabbit Problem

Fibonacci considers the development of population of rabbits, suggesting that: initially there is a newborn pair of rabbits (male and female); from the second month after their birth, rabbits begin to mate and every month produce a new pair of rabbits; rabbits never die (see figur 1). How many pairs of rabbits will be in a year?

More formally, the sequence of Fibonacci numbers F_n is given by a linear recurrence relation:
$F_0 = 0, F_1 = F_2 = 1, F_3 = 2, F_4 = 3, F_5 = 5, \ldots$ in general $F_{n+1} = F_n + F_{n-1;}\ n > 0$ [1; 2].

It is known that uranium forms a series of oxides: U_2O_5, U_3O_8, U_5O_{13}, U_8O_{21}, $U_{13}O_{34}$. The chromium oxides have the same composition: Cr_2O_5, Cr_3O_8, Cr_5O_{13}, Cr_8O_{21}. It turns out that the ratios of atoms are equal to the ratios of Fibonacci numbers [3].

The purpose of this paper is to review the structure of atoms of chemical elements and chemical compounds in the light of the laws of the Fibonacci number.

Results and discussion.

Consider the structure of atoms of chemical elements.

It is known that substances consist of atoms. The atom itself consists of a positively charged nucleus and a negatively charged electron cloud. In general, the atom is electrically neutral. The size of the atom is completely determined by the size of its electron cloud, since the size of the nucleus is negligible in compare to the size of the electron cloud. The nucleus consists of Z positively charged protons and N neutrons that do not carry a charge. Protons and neutrons are called nucleons, that is, core particles.

$$p^+ + e^- = n^0 + v_e$$

Thus, the nuclear charge is determined only by the number of protons and is equal to the ordinal number of the element in the periodic table. The positive charge of the nucleus is compensated by negatively charged electrons, which form an electronic cloud. The number of electrons is equal to the number of protons. The masses of protons and neutrons are equal (see Table 1.). The mass of the atom is mainly determined by the mass of its core, since the electron mass is approximately 1836 times smaller than the mass of the proton and neutron and is rarely taken into account in calculations.

$$A = Z + N$$

The appearance of the atoms of a chemical element with a nucleus consisting of a strictly defined number of protons and neutrons is called the nuclide. Different elements with the same total number of nucleons are called isobars, and with the same total number of neutrons are called isotones. Isotopes are atoms of the same element with the same number of protons, but with a different number of neutrons[4].

Table 1.– Elementary Particles of the Atom

Elementary particle	Symbol	Charge (C)	Charge (conventional units)	Actual Mass (g)	Relative Mass (amu)
proton	p	$1.66{\cdot}10 \times 10^{-19}$	+1	$1.672 \cdot 10 \times 10^{-24}$	1
neutron	n	0	0	$1.674 \cdot 10{\times}10^{-24}$	1
electron	e	$1.66{\cdot}10 \times 10^{-19}$	–1	$9.109 \cdot 10 \times 10^{-28}$	0

In our opinion, the first number in the Fibonacci series $F_0 = 0$, is the electron mass $m_e = 0$.

The second member of the series $F_1 = 1$ is the proton mass $m_p = 1$.

The third member of the series $F_2 = 1$ is the neutron mass $m_n = 1$ or a hydrogen atom ^1H,

$$F_2 = F_0 + F_1, n_0 = p + e- +. 1 = 0 +1.$$

The fourth member of the series $F_3 = 2$ is the sum of the masses of the proton and neutron, that is, the deuterium ion: $^2H^+ (D)^+$,

$$F_3 = F_1 + F_2 = 1 + 1 = 2$$

The fifth member of the series F4 = 3 is a tritium ion: $^3H^+ (T)^+$ or helium isotope ^3He,

$$F_4 = F_2 + F_3 = 1 + 2 = 3$$

The sixth member F5 = 5, is a lithium ion $^5Li^+$ or beryllium isotope ^5Be.

Systems of inorganic and organic chemistry are fundamental systems for building the macrocosm in which we exist. They are created according to certain rules and are of decisive importance in the subsequent construction of matter.

At the end of the 19th century the French scientist Proust came to the conclusion that the compounds have a strictly constant composition, independent of the conditions of their formation. Most compounds are stoichiometric. This means that the ratio between the number of atoms or ions in a compound is expressed by simple integers. And another French scientist Berthollet argued that chemical compounds have a variable composition, which depends on the conditions for their production and the mass of the reactants. It was denied that their compounds can have a strict, permanent composition. The non-stoichiometry of these compounds is due to the presence of defects in their crystal lattices. In the report of 1914, "The Connection and the Chemical Individual" N. S. Kurnakov suggested calling daltonids, and compounds of variable composition – berthollids[5]. The difference between daltonides and bertholids is that in the composition-property diagram for

daltonides there is a narrow interval of composition variation with unchanged properties, and for bertholids, a wide range. As already shown, there are series of oxides whose composition corresponds to the Fibonacci numbers. Thus, for chromium, the following compounds are known: CrO_2 CrO_3, Cr_2O_5, Cr_3O_8, Cr_5O_{13}, Cr_8O_{21}. A number of intermediate compounds are formed between the uranium oxides UO_2 and UO_3: U_2O_5, U_3O_8, U_5O_{13}, U_8O_{21}, $U_{13}O_{34}$. As we see, the ratios of atoms are equal to the ratios of Fibonacci numbers [3]. For nitrogen oxides, the oxygen coeficients also correspond to N_2O, NO, NO_2, N_2O_3, N_2O_5 Fibonacci numbers [6].

The authors of the work [7] have noted that the potential number of fatty acids increases with the length of their chain according to the famous Fibonacci numbers, when cis / trans isomerism is neglected. It is shown that it grows according to the famous Fibonacci numbers when cis/trans isomerism is neglected. Since the ratio of two consecutive Fibonacci numbers tends to the Golden section, 1.618, organisms can increase fatty acid variability approximately by that factor for per carbon atom invested. Moreover, it is shown that, under consideration of cis/trans isomerism and/or of modification by hydroxyl- and/or oxo- groups, diversity can be described by generalized Fibonacci numbers (e.g. Pell numbers). The recursive definition of Fibonacci numbers paves the way to construct all structural formulas of fatty acids in an automated way.

The paper[8] had been described a new synthetic approach to regioregular monodisperse oligo(3-alkylthiophene)s allowing for simple separation of regioregular material in gram quantities. The number of repeat units follows the Fibonacci numbers up to a length of 21. In a small adaption of this approach, introduction of a protecting group was used to synthesize an oligo(3-hexylthiophene) with 36 repeating units, the longest regioregular 3-hexylthiophene oligomer synthesized to date.

Conclusion

1. The structure of atoms of chemical elements in the light of the sequence of Fibonacci numbers is considered. It is assumed that the first member of the series is the electron mass, and the second and third members of the series are, respectively, the mass of the proton and neutron.

2. It was shown that the ratios of atoms in chromium oxides: CrO_2 CrO_3, Cr_2O_5, Cr_3O_8, Cr_5O_{13}, Cr_8O_{21}, uranium: U_2O_5, U_3O_8, U_5O_{13}, U_8O_{21}, $U_{13}O_{34}$ and nitrogen: N_2O, NO, N_2O_2, N_2O_3, N_2O_5 are equal of ratio of Fibonacci numbers.

3. It has been established that the potential number of fatty acids increases with the length of their chain in accordance with known Fibonacci numbers.

4. It is shown that in the synthesis of oligo (3-hexylthiophene) the number of repeated units follows the Fibonacci numbers up to length 21.

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PROPERTIES OF CLINKERS AND CEMENTS, OBTAINED ON THE BASIS OF FLOTATION OF WASTE OF MINING PROCESSING ENTERPRISES

Abstract: The possibility of obtaining Portland cement clinkers based on flotation waste from mining and processing plants LPP, CPP, FPP at T_{firing} 1380–1430 °C has been established, and the processes of hydration and hardening of the obtained cements and their physicomechanical properties have been studied.

Keywords: flotation waste, clinker, hydration, Portland cement.

The possibility of using flotation wastes of mining and processing industries as a clay component for cement production was considered in many papers [1–3], in which the authors noted great prospects for using waste as clay substitutes and activating clinker formation processes in the solid phase and with the presence of a liquid phase.

We have studied the properties of clinkers and cements synthesized on the basis of flotation wastes of mining processing plant of the Almalyk MMC, namely, flotation wastes of lead processing plants (LPP), copper processing plants (CPP) and fluorite processing plants (FPP).

Calculations of the chemical composition of clinkers were carried out at a constant silicate module of n = 2.1 and a varying saturation coefficient SC = 0.7–0.95. On the basis of the calculation of the raw mix according to the generally accepted method [4], mixtures with different contents of waste wastes were prepared (see table).

Table 1.– The chemical composition of raw mixtures of Portland cement clinker

№	Name of composites	SC	n	SiO_2	Al_2O_3	Fe_2o_3	CaO	MgO	SO_3	R_2O	LOI
1.	Mixture on the basis LPP	0.8	2.1	14.85	3.33	3.61	41.45	3.02	1.47	0.81	31.70
2.	Mixture on the basis LPP	0.9	2.1	13.91	3.18	3.57	42.06	2.89	1.38	80.77	32.31
3.	Mixture on the basis CPP	0.8	2.1	15.11	3.33	3.83	42.10	0.85	1.15	1.09	33.21
4.	Mixture on the basis CPP	0.9	2.1	14.18	3.13	3.61	41.30	0.86	1.13	1.10	33.77
5.	Mixture on the basis FPP	0.8	2.1	15.90	1.88	5.84	41.54	0.91	0.26	0.48	32.52
6.	Mixture on the basis FPP	0.9	2.1	14.00	1.78	5.34	42.50	0.92	0.24	0.45	33.26

The firing of raw mixtures was carried out in a salt furnace in an oxidizing environment at T_{firing}-1350–1450 °C. The chemical composition of the clinkers obtained (table 2) shows the compliance of the calculated and actual.

Table 2.– The chemical composition of clinkers on the basis of fleet waste (calculated and practical)

№	Name	Chemical composition,%			
		SiO_2	Al_2O_3	Fe_2O_3	CaO
1	*2*	*3*	*4*	*5*	*6*
1.	Clinker based LPP – calculated – practical	 20.512 1.12	 4.69 4.27	 5.27 5.31	 62.01 61.96

1	*2*	*3*	*4*	*5*	*6*
2.	Clinker based CPP – calculated – practical	 21.41 20.66	 4.73 4.83	 5.45 5.42	 63.36 63.11
3.	Clinker based FPP – calculated – practical	 21.99 21.22	 2.68 2.44	 7.94 8.21	 63.66 62.68

The study of the physicochemical properties of the clinkers obtained was carried out by X-ray phase, petrographic and alcohol-glycerate methods. Using the alcohol-glycerate method, it was found that the total absorption of CaO_{free} in raw mixtures is within 1370–1420 s at 30 minutes exposure at a given temperature. The lower temperature of the completion of the clinker formation process, T_{firing} 1350–1375c is inherent in FPP flock waste clinkers, which was mentioned in work [5] due to the mineralizing role of Ca fluoride, which stimulates the formation of the liquid phase at earlier stages of solid-phase synthesis, which in turn activates both the decarbonization of the carbonate component and the formation of clinker minerals.

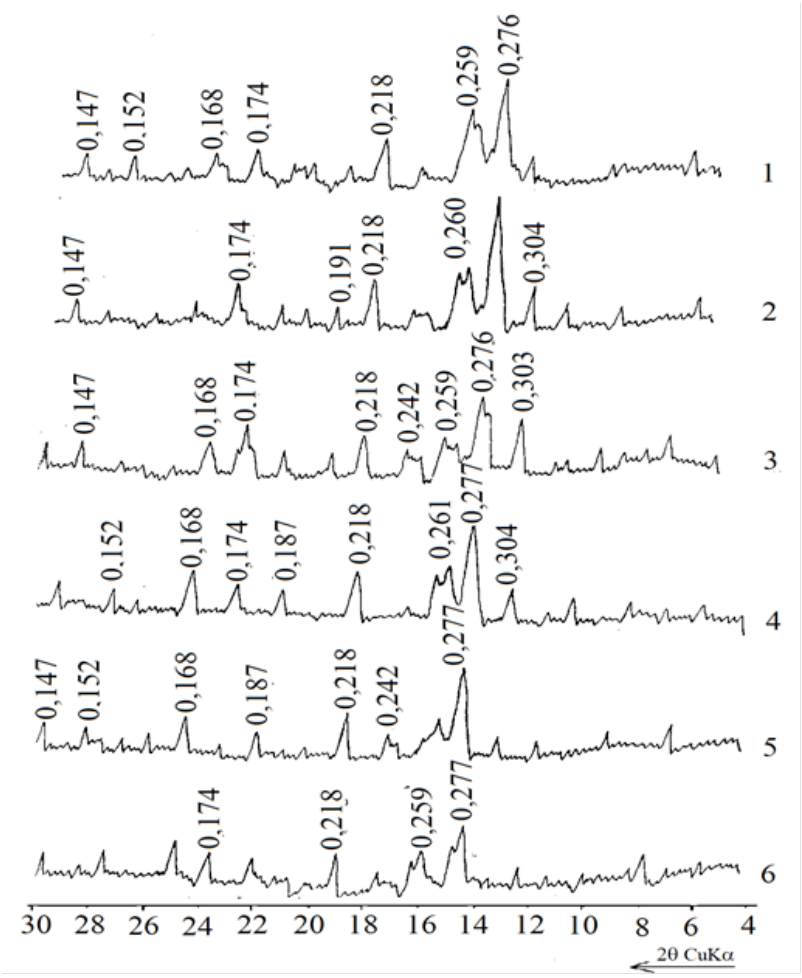

Figure 1. X-ray of clinkers on the basis of fleet waste:

1. LPP with SC = 0.8; 2. LPP with SC = 0.9;
3. CPP with SC = 0.8; 4. CPP with SC = 0.9;
5. FPP with SC = 0.8; 6. FPP with SC = 0.9;

X-ray phase analysis (Fig.1) of the clinkers under study revealed well-crystallized minerals in all clinkers; alite d = 0.303, 0.277, 0.274, 0.259 nm, belite d = 0.287, 0.279, 0.260 nm, tricalcium aluminate d = 0.270, 0.191, 0.155 nm. Small changes in the form of x-ray clinkers indicate the identity of the phase composition of the clinkers.

Data from petrographic studies suggest that the presence of various silica components in the raw material mixtures, as

well as the presence of non-ferrous metals in them, do not have a significant effect on the composition and crystallization of minerals. The main crystalline phase of the clinkers obtained is alite, and its crystals are of the same type and are represented mainly by hexagonal plates measuring 7–50 microns. The amount of alite, determined by the petrographic method, is 50–60% in all clinkers, which is consistent with the calculated data of the mineralogical composition (Table 3).

Table 3.– Mineralogical composition of clinkers on the basis of fleet waste (Estimated and practical)

№	Name	Mineralogical composition,%			
		C3S	C2S	C3A	C4AF
1.	Clinker based LPP – calculated – practical	 62.01 63.21	 16.36 16.27	 3.51 3.48	 16.02 16.81
2.	Clinker based CPP – calculated – practical	 59.31 62.31	 21.25 18.97	 3.26 3.41	 16.57 10.81
3.	Clinker based FPP – calculated – practical	 60.11 59.61	 15.76 17.21	 3.00 2.86	 21.13 20.51

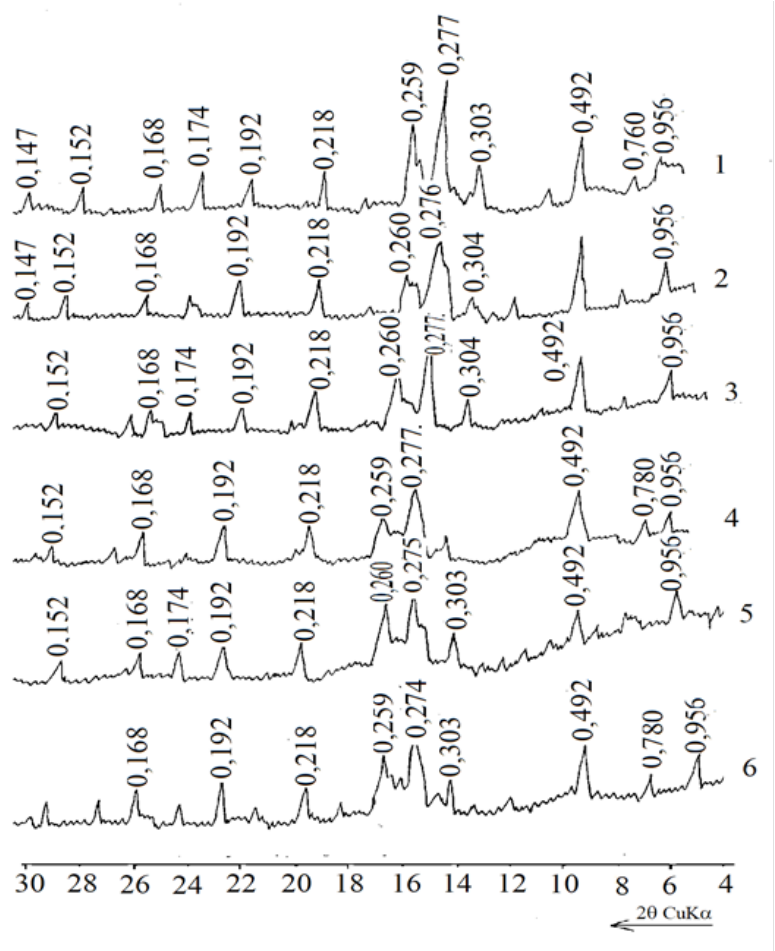

Figure 2. X-ray of cements with SC = 0.9

1. LPP – 1day.
2. LPP – 28 day.
3. CPP – 1day.
4. CPP – 28 day.
5. FPP – 1day.
6. FPP – 28 day.

According to the crystallization of alite, clinker with SC = 0.9 is allocated to the magnitude and quality of the crystals on the basis of the LPP flotation waste due to the presence of acid oxides and high basicity of the raw mix.

The presence of CaF2 (0.8–1%) in the raw mix with FPP flotation waste produced clinker with a low T_{firing} and good mineralization.

Chemical, petrographic, thermographic, and X-ray phase analysis methods were used to study the hydration of the clinkers obtained and, on their basis, it was found that it is characterized by the stadiality of mineralization of new phases that is usual for Portland cement.

Thus, in the initial periods of hardening, X-ray phase (Fig. 2) and petrographic methods indicate the formation of coarse-grained crystals of Ca oxide hydrate with d=0.493, 0.310, 0.263 nm and ettringite grains $3CaO\ Al_2O_3\ 3CaSO_4\ 31H_2O$ with the main diffraction maximum with d = 0.958 nm, the formation of which is more intensively for cements with SC = 0.9, as well as small flaked crystals of calcium hydroaluminate $3CaO\ Al_2O_3\ CaCO_3\ 11H_2O$ with a diffraction maximum of d = 0.780 nm.

Calcium hydroaluminate is the main mineral providing the initial strength of the cement stone on the first day of hardening and is formed in large quantities in clinkers capable of giving a large supersaturation of the liquid phase in CaO-alitic clinker.

The mineral phases of ettringite and calcium hydrocarbonate are more pronounced in the clinker images with LPP and CPP and SC = 0.8.

In clinics with LPP, CPP, FPP 28 daily hardening, in addition to the previously identified minerals, the formation of calcium hydrosilicate (1.7–2.2) $Cao\ SiO_2\ 2H_2O$ d = 0.307 is noted; 0.280; 0.183 nm, characterized by qualitative crystallization and being, as is well known, the main component of the strength of cement stone after 28 days of hardening. In this case, the quantitative formation of new crystalline phases prevails in the clinkers based on the flotation waste of LPP and CPP, which naturally depends on the mineralogical composition of the raw mixtures.

The results of X-ray phase analysis and petrographic analysis are confirmed by the data of thermographic studies, as the dehydration of calcium hydrosilicate corresponds to the endothermic effect at 140–180 °C, which reaches a considerable amount after a day of hardening, and with an increase in the hydration period of all cements, this effect increases. On the thermograms of hydrated cements, the endothermic effect at 760–780 °C corresponds to the decarbonization of $CaCO_3$, which is formed by the interaction of hydration products with carbon dioxide of air. Characteristic for thermograms of all cements is that there is no significant difference in the process of their hydration. The data of chemical analysis of hydrated cements (Table 4) also indicate an increase in the content of $Ca(OH)_2$ by the 28th day of hardening.

Table 4.– The content of $Ca(OH)_2$ in hardening cement paste (%)

Cement	Terms of hardening (in days)						
	1	3	7	28	90	180	360
Cement LPP	4.9	6.5	9.2	13.4	12.9	12.4	11.9
Cement CPP	5.0	6.6	9.3	13.5	13.0	12.0	11.9
Cement FPP	4.7	6.3	9.1	13.2	12.7	11.8	11.5

The decrease in the $Ca(OH)_2$ content with an increase in the hydration period (90, 180, 360) is due to the action of CO_2. It should be noted that the nature of the change in the content of $Ca(OH)_2$ in the hydrated cement is identical for all the samples studied.

The study of the process of hydrolysis of all cements (Table 5) showed that, reaching a maximum value after three days of hydration, the concentration of CaO in solutions subsequently decreases somewhat. This can be explained by an increase in the degree of crystallization of the tobermorite phase.

The practical absence of differences in the content of $Ca(OH)_2$ in the liquid phase of hydrated same time studied cements, characterizes a small difference in the phase composition of the products of their hydration.

Table 5.– The results of the study of the hydrolysis of cements

Cement	CaO g/l				
	3	7	28	90	180
Cement LPP	1.404	1.328	1.245	1.075	1.000
Cement CPP	1.376	1.348	1.274	1.052	1.041
Cement FPP	1.306	1.284	1.247	1.044	1.191

As a result of the conducted research, the possibility of obtaining clinkers of optimal mineralogical and crystallographic compositions based on the used flotation waste LPP, CPP, FPP as a silica-containing component of raw mixtures, at optimal conditions and firing temperature, was established.

The difference in the mineralogical composition of the FPP waste flooder for acid oxides makes it possible to use this waste not only as a complete substitute for loess, but also as an additive with pronounced mineralizing properties.

Physical and mechanical tests of cements, ground with 4% gypsum, showed that they are not inferior in strength and time of setting (Table 6) to their factory counterparts with brand strength of 500.

Table 6. – The results of physico-mechanical tests of cements based on flotation waste

Name of cement	Setting time, hour.		Strength in MPa			
			Bending		Under compression	
	starting	ending	3 days	28 days	3 days	28 days
Cement LPP	1–45	3–15	2.7	5.2	31.7	58.02
Cement CPP	1–35	3–15	2.2	4.8	27.3	52.0
Cement FPP	1–45	3–20	2.1	4.3	19.5	50.0

Thus, the test results showed that the reactivity of raw mixtures containing, as a silica waste, LPP, CPP and, to a lesser extent, FPP, is not inferior to natural silica-containing raw materials.

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USE OF DUST OF GAS CLEANING OF METALLURGICAL PRODUCTION IN THE COMPOSITION OF CERAMIC MASS FOR FACING TILES

Abstract: The article presents the results of a study on the use of iron-containing waste – dust of gas cleaning of metallurgical industries in the composition of ceramic masses for the development of the composition of facing tiles. It is established that when gas cleaning dust is introduced as a raw material component of a mixture for the development of the composition of ceramic masses, it is possible to obtain facing tiles that meet the requirements of the current standard.

Keywords: ceramic, facing tile, metallurgical waste, dust of gas cleaning, sun dune sand, pegmatite, bentonite, kaolin, composition, chemical, mineralogical, physical and mechanical properties, X-ray phase.

Currently, great importance is attached to the recycling of waste from various industries in order to solve environmental problems by obtaining useful products. One of the directions of utilization of such wastes is iron-containing dust of gas purification of metallurgical enterprises for preparation of ceramic mass with the purpose of obtaining facing tiles.

It should be noted that the main raw materials for the production of facing slabs are clayey and filling components, in the form of low-melting and refractory clays, kaolins, quartz sands, pegmatites, feldspars, as well as wastes of various industries [1; 2].

As a result of geological exploration conducted on the territory of Uzbekistan, the reserves of a number of large deposits of non-metallic raw materials for the production of ceramic materials for various purposes have been determined and evaluated. Including clarifies the possibility of using a number of industrial wastes of various industries, in the composition of the charge for the production of ceramic materials for construction purposes [3; 4].

In this paper, we present the results of a study on the design and development of the composition of ceramic masses for facing slabs on the basis of domestic raw materials, using a non-traditional waste – the gas cleaning dust of electric steelmaking furnaces DSP-100 of the Uzbek Metallurgical Combine (UMC). Gas cleaning dust is an iron-containing product of steelmaking production, captured by a filter during the purification of gases coming from electric steelmaking furnaces of DSP-100 of the Uzbek Metallurgical Combine (UMC). According to the fractional composition, this waste is a fine dispersible bulk material, in the form of a grayish-brown and grayish-black color.

The dust of gas purification, which is formed during the purification of gases from electric steelmaking furnaces DSP-100 UMC, does not emit toxic substances, does not form toxic compounds in air and wastewater, is fire and explosion-proof and belongs to the group of non-combustible materials.

In Table 1 and Table 2, respectively, the results of the chemical analysis of the raw materials used and the technical parameters of the gas cleaning dust are developed to develop the composition of the ceramic masses for the facing tiles.

Table 1.– Chemical compositions of raw materials used

Name of raw materials	Oxide content (mass.%)									
	SiO_2	Al_2O_3	Fe_2O_{3total}	TiO_2	CaO	MgO	K_2O	Na_2O	SO_3	LOI
Chirakchys pegmatite	80.17	11.52	0.81	0.75	1.50	0.39	1.20	1.11	1.40	0.95
Logons bentonite	56.60	16.05	5.24	0.57	2.81	1.60	3.97	1.94	0.13	11.04
Angren secondary kaolin	67.40	18.28	1.12	0.37	1.70	0.20	0.70	0.45	0.10	9.17
Yazyavans sun dune sand	57.40	10.78	3.43	0.43	6.15	2.72	2.63	2.15	0.34	9.65

Table 2.– Characteristics dust of gas cleaning

Name indicator	Value
Mass fraction of hygroscopic moisture,%, no more than	20.0
The content of the sum of iron oxides (Fe_2O_{3total}),%, not less than	45.0
The content of alkali metal oxides (Na_2O+K_2O),%, no more than	14.0
The content of the sum of sulfuric acid oxides (SO_3),%, no more than	2.0
Particle size: passage through a grid № 5,%, not less than	100.0
Specific effective activity of natural radionuclides, A_{effect}, Bq / kg, not more than	370

X-ray study of crystalline phases dust gas cleaning was carried out on a powder diffractometer XRD-6100 (Shimadzu, Japan), a controlled computer, using CuKa α radiation (β-filter, Ni, 1.54178 mode of current and voltage tube 30 mA, 30 kW). The constant speed of the detector's rotation is 4 deg / min in increments of 0.02 deg. (ω/2θ–coupling), the scanning coal varied from 4 to 80 degrees.

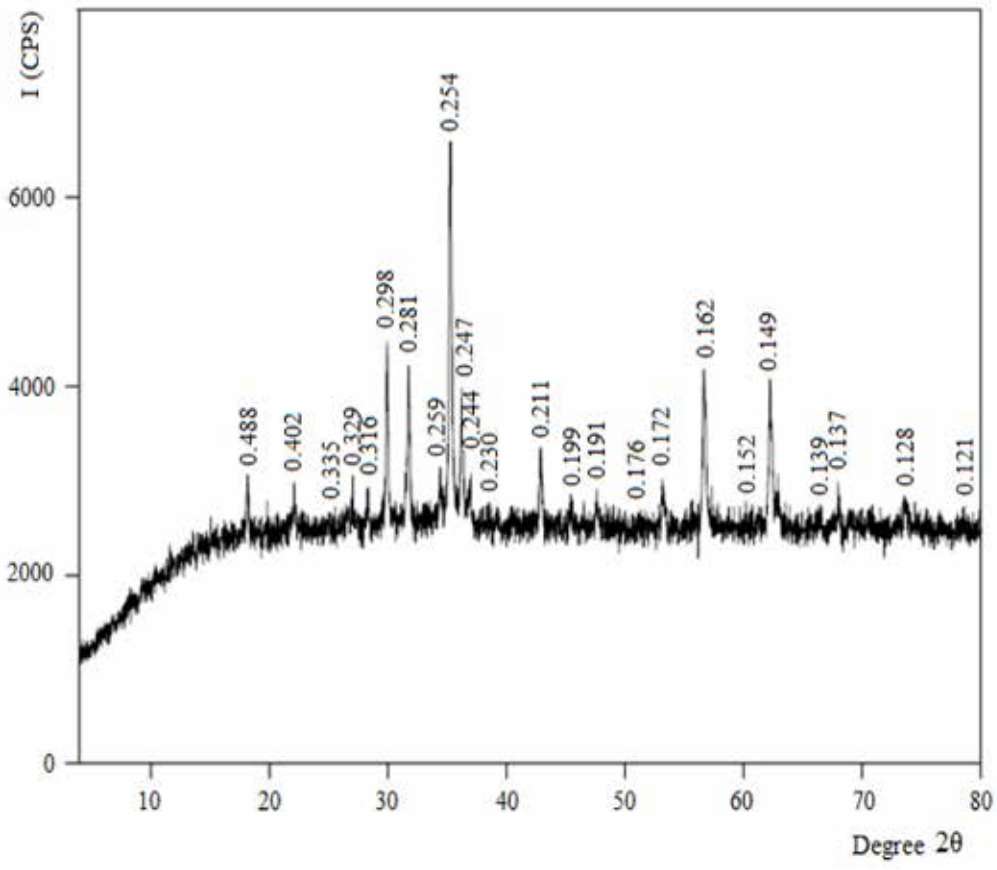

Figure 1. XRD of iron-containing dust of gas cleaning of metallurgical plant

The figure shows the X-ray diffraction patterns of the iron-containing dust of the gas cleaning of the metallurgical plant. As can be seen from the figure on the X-ray diffraction pattern of the gas scrubbing dust, the diffraction maxima, which are related to minerals of γ-hematite (γ-Fe_2O_3) (d = 0.254, 0.298, 0.211, 0.172 nm)α – hematite (γα-Fe_2O_3) (d = 0.254, 0.152 nm), wüstite (FeO) (d = 0.247, 0.211, 0.152 nm), as well as peaks with a lower intensity, related to fayalite minerals (Fe_2SiO_4) (d = 0.247, 0.281 nm), quartz (d = 0.335, 0.230, 0.199, 0.137) and pyrite (FeS_2) (d = 0.162, 0.244 nm)

Further on the basis of Chirakchys pegmatite, Logons bentonite, Angren secondary kaolin, Yazyavans sun dune sand, uses dust collectors. The compo-sition of the charge on the basis of the new formulation is shown in (Table 3).

Table 3. – Composition of the raw materials mix of ceramic masses for facing tiles

Name of raw materials	Name of samples, composition of charge, mass%							
	NDG–0	DG–1	DG –2	DG –3	DG –4	DG –5	DG –6	ODG–7
Chirakchys pegmatite	35	30	25	20	15	10	5	25
Logons bentonite	5	5	5	5	5	5	5	3
Angren secondary kaolin	40	40	40	40	40	40	40	42
Yazyavans sun dune sand	20	20	20	20	20	20	20	15
Dust of gas cleaning	–	5	10	15	20	25	30	15

To study the physico-mechanical properties of the samples of the facing plates on the basis of the investigated charges, the adopted techniques of ceramic technology were used [5]. First, the starting materials were finely milled in a wet method in a ball mill with an uralite lining and grinding bodies. Furthser, they were mixed with dust by gas scrubbing and co-milled with clay and deoxidizing components for 8–10 hours at a slurry humidity of 48–50% in a laboratory ball mill.

At the same time, the fractional composition of the slip was characterized up to the dispersion; the remainder on the sieve No. 0063 is not more than 2%. The prepared slip was passed through a No. 05 sieve and then subjected to dehydration in gypsum molds. After dewatering to molding humidity, 6.5–7.0% of the mass was sieved through a sieve through No. 2. According to the standard, the dispersion of the granulometric compositions of the press powder was determined.

The plasticity of the ceramic masses was determined from the difference between the absolute moisture content of the masses corresponding to the upper yield point and the rolling edge.

Forming of ceramic masses for facing tiles was carried out by pressing the masses of a prototype measuring 300 × × 200 × 7 mm on a press "SACMI-980" at a pressing pressure of 23.0–24.0 MPa. The mechanical strength of the dried tiles at a temperature of 100 °C was an average of 4.8–5.2 kg cm^2. The molded tiles were fired at a temperature of 1145 °C on a conveyor-roller line for a total duration of 40 minutes.

The results of a visual inspection of the burnt prototypes showed that all samples were well sintered, had no cracks and deformations. Especially the samples of DG-5 and DG-6 were densely sintered after firing. The obtained results of testing the physical and mechanical properties of the experimental samples are given in (Table 4).

Table 4.– Physico-mechanical properties of samples

Mass name	General shrinkage,%	Water Absorption,%	Strength at bending, MPa	Hardness by Mohs
БПГ-0	2.8	15.4	15.2	5
ПГ-1	3.2	15.0	15.4	5
ПГ-2	3.8	14.9	16.2	5
ПГ-3	4.0	14.6	16.7	5
ПГ-4	4.5	14.2	17.2	5
ПГ-5	2.8	13.7	17.5	6
ПГ-6	3.4	13.0	18.6	6.5
ПГ-7	3.8	14.8	16.9	5.5
according to GOST 6141–91	is not regulated	not more than 16.0	not less than 15.0	5

According to [6], ferruginous compounds, in particular iron oxide and pyrite, react chemically with aluminosilicate minerals and very much contribute to the crystallization of anorthite, mullite and fayalite as well as the formation of a silicate melt, in which iron oxide acts as a modifier to reduce viscosity. As a result, intensive formation of aluminosilicate minerals occurs, giving the finished shard necessary strength and hardness.

The results of the laboratory tests showed that the physicomechanical and technological characteristics of the sintered prototypes are high enough for all compositions containing gas purification dust in an amount of up to 15% by mass and without it satisfy the requirement of the current standard. It should be noted that samples containing more than 15% by weight of gas cleaning dust, despite high strength and low water absorption, were deformed and cracked, i.e. characterized by a short interval of sintering.

Thus, it has been established that when dust is introduced as a raw material component of a mixture to develop the composition of ceramic masses, it is possible to obtain facing tiles that meet the requirements of GOST 6141–91.

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Section 16. Economy and management

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EFFICIENCY OF INTERNAL AND EXTERNAL CONTROL SYSTEMS IN BANKS OF SECOND LEVEL

Abstract: Financial crises of recent years have highlighted several weaknesses within the risk management, control and bank governance, auditing and financial oversight. This has led to an increased review of relevant roles and interactions of bank supervisors and external auditors who are key contributors to the market discipline. Auditors ensure that financial information is transparent and reliable while supervisors provide confidence in financial systems. On the other hand, auditors and auditors also allow market players to make decisions based on this information and contribute to financial stability. In 2014, the Basel Committee on Banking Supervision investigated the interaction between overseers and external auditors, enabling their relationships to improve the quality of banks' audit, financial statements and effective supervision of the banking system. This paper aims to provide an overview in what is happening with the audit in the Albanian banking system by highlighting the topics and issues that have been constantly subject to discussion between the auditors.

Keywords; Internal Audit, External Audit, banking system, auditing, banking supervision, internal control.

Introduction

The Internal Audit Process is responsible for "interpreting and collecting evidence of selected business facts", enabling managers to keep track of significant business developments, activities and results from varied and voluminous transactions (Mautz [5]). Complexity and increasing volume of transaction complexity, remoteness of owners / managers from the source of transactions and of any party reporting, technical and accounting expertise to review business activities in an understandable way, the need for an organizational status to ensure independence and objectivity, as well as the procedural discipline, all contributed to the creation of Internal Audit within the companies.

However, Rule 203 of the Code of Professional Conduct states that in unusual situations, the violation of a generally accepted accounting principle does not necessarily require a negative opinion on the principle in question. However, to justify an unqualified opinion, the auditor should state and explain, in a separate paragraph or section in the audit report, that observance of the principle would produce an erroneous result in that situation. Under certain circumstances, the CPA may want to emphasize specific issues with respect to the financial statements even though it or it intends to express an unqualified opinion on the statements. Normally, these explanations should be included in a separate paragraph in the report. Examples of disclosures that the auditor can report as an emphasis of an issue may include the following:

- Existence of related party in transactions;
- Important events occurring after the balance sheet date;
- Description of accounting issues that affect the comparability of financial statements with those of the previous year;
- Material uncertainties.

The main auditor who gives the opinion on the financial statements is called the principal auditor according to AICPA's audit standards and the engagement team partner according to AICPA's audit standards. The other auditor performs work on the financial information of a component that is called a component auditor according to AICPA's audit standards.

It is essential that auditors and readers of audit reports understand the circumstances when a report is unqualified

or inappropriate and cases when a certain type of audit report issued under each circumstance. In studying audit reports that are part of an unqualified report, there are three closely related topics: conditions that require a departure from an unqualified opinion, types of opinions different from the unqualified opinions and materiality. When the auditor has not accumulated sufficient evidence to conclude whether the financial statements have been declared in accordance with the proper financial reporting, there is a limitation on scope. There are two main causes of scope limitations: customer – imposed restrictions and those caused by circumstances beyond client control or the auditor. An example of client restriction is the refusal to allow the auditor to confirm material receivables or to physically examine the inventory. An example of a limitation caused by the circumstances is when the auditor is not assigned until after the end of the customer's year. It may not be possible to physically observe inventories, confirm receivables, or perform other important procedures after the balance sheet date (Levine, Siegel, Qureshi, & Dauber, [4]).

Internal audit should conduct periodic audits and review all the processes and procedures that banks apply for the continuous provision and control of the physical and information security system. The Bank's internal regulatory framework should be fully in line with those of the national regulations in force, such as the Central Bank's specific regulation on "Minimum Security Requirements in the Banking and Financial Activities Areas and for Monetary Value Transport" as well as in accordance with the structure, objectives, organization's activity and the best practices applied in this field. Lack of respect for these procedures in many cases leads to great operational losses. That is why auditing physical and informal security is an important task, as a third defensive line. Of course, cooperation with the second line of defense (such as Security, Operational Risk, Fraud and Prevention, Human Resources, Compliance etc.) should be a focus on everyday business. Experience has shown that strong co-operation of these structures has produced very good results in creating a safe environment (Eden & Moriah, [3]).

It is also required to keep in mind that banks evolve and consequently their security structures will change. Considering this, security auditing is not just a task, it is also a constant effort to improve the protection of IT and physical security. Security is defined by frameworks, processes, and procedures, but in the end it is a challenge for each member of the organization. Although Internal Audit, like any other Bank structure, already has a broad knowledge base in this area as well as security incidents, there are still many challenges, as many new methods or schemes of fraud are was used today. This is because self-confidence is affected by the human factor, which is unpredictable as well as the daily developments of technology.

That is why audits in this area and risk assessments as well as the recommendation of measures for their administration and mitigation will always be a challenge. These risks need to be constantly monitored in order to comply with security standards and to maximally prevent, in time, all threats that may arise in the Bank (Revista Shkenca dhe Jeta, [6]).

The Corporate Governance Improvement Committee's principles emphasize that banks should have an internal audit function with sufficient authority to reflect the real situation of what is happening within the system. A robust internal control system, including an independent and effective internal audit, is part of sound banking governance. Bank supervisors should be vigilant with regard to the effectiveness of the internal audit function of the bank, that policies and practices are followed closely and that management takes appropriate and timely corrective action in response to internal audit findings identified by the auditors the interior. An internal audit function provides vital assurance to the board of directors of a bank and high management in terms of the quality of the internal control system of the bank. In doing so, the audit function helps to reduce the risk of loss and reputational damage to the bank (Basel Committee on Banking Supervision [1]).

Supervisors and auditors possess a lot of skills and specific knowledge on how control is carried out. External auditors can take part in the supervisory process by performing additional work at the request of supervisors, providing more reasonable or limited assurance in a range of areas such as internal controls, IT systems or risk management. External auditors contribute to strengthening oversight proce- dures.

However, audit information has not always been revised during regular bank inspection and supervisors do not always have a good understanding of what an external audit involves and how they can rely on the work of auditors. Practices differ in terms of the purpose of the work of auditors, the extent of the auditors' contributions to the oversight process, and the type of insurance they provide (Centre for Financial Reporting Reform Governance Global Practice [2]).

Conculsions

Referring to the internal audit in second tier banks in Albania (data obtained from internal reports in this sector) is concluded as follows:

- Audit reports are communicated once a year in a summarized and general way. While throughout the calendar year, employees are briefed on specific issues that affect their interests, while re-emphasizing the importance of following recommendations for negative findings in the audit report.
- Audit reports are generally logical and coherent, contain complete supporting information and each finding is accompanied by relevant recommendations. However, there are

those who are dissatisfied with the way in which the report is written, considering that they are not based on practicality, the prohibition on non-important issues does not appear in time as it is not preceded by problems that have been identified as negative findings, etc.

• Negative findings in the audit report indicate that there have been problems during the audit or describe situations that need to be corrected. Regarding their frequency or quantity, they say that there are many of them regarding the human factor and the uncertainty of the proceeds that need to be followed. In the entirety of the violations expressed by them (often influenced also by the position or information they have), we mention examples of practice of negative findings as follows: Lack of physical evidence in the registration of transfers, opening of the branch door before the official opening hours the lack of original orders in the transactions executed, the changes in its operations, and so on.

• For all cases of finding violations or negative findings, the recommendation is the implementation of the internal procedures of each bank and the maintenance and follow-up of laws for banking institutions in Albania.

• Most banking units include in their activity all areas of responsibility of the banking group they represent.

• Almost all the external audit reports of banks that have been studied have been conducted by the largest accounting companies operating in Albania (one of the BIG FOURs), which gives a greater reliability to the audit report and bank performance.

• External audit of all banks taken in the study is carried out only on the Bank's Financial Statements. All reports on the bank's financial position, whether by KPMG, E & J, PWC, or DELOITTE, have a uniformity in their realization. They all note the policy pursued by the bank for FP and make a summary of the bank's financial situation by not leaving the framework.

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DEVELOPMENT OF HIGHER EDUCATION AND FORMATION STAGES OF THE MANAGING THE HIGHER SCHOOL IN THE KAZAKHSTAN

Abstract: In the article the history of forming the first higher schools on the Kazakh territory on the basis of archives documents, textbooks and other articles and books is investigated. The author has reported the history of educational institutions and the periods of managing them as a separate process in the chronological order using the data of historical documents. Also he observed the changes and promotions in managing the education system of Kazakhstan using objectives of the President, State programs.

Keywords: Kazakh National Educational institute, Lisbon convention, Corporative managing system.

Introduction

The topicality of the articles is defined with the importance of improving the quality of higher education. The decentralization of managing the higher education and widening the academic freedom of higher educational institutions is one of the ways of increasing the quality of higher education. Getting the freedom of higher educational institutions and decreasing the control from the state's side are confirmed with the Bologna process to which Kazakhstan entered in March 2010. Nowadays the development of education in Kazakhstan is in the period of passing the higher educational institutions to the independent system. The researches of the recent years show the importance of independence at the world level in the development of universities.

In the Conclusion of the article having been the independence and competition in one channel gives the opportunity the universities to improve. Also the recent history and today's development of Kazakhstan educational system are concluded well, new ideas on its future development are proved with detailed examples.

Aim of the research is to discover the decentralization periods of Kazakhstan higher educational system through the analysis of normative documents in the home educational system, to observe historically, to define the improving independent ways and peculiarities of modern higher educational institutions and to found the passing to the independence of higher educational institutions.

1. Formation of the educational system in Kazakhstan during the Soviet government

On 26th August of 1920 after publishing the decree "On forming Kazakh Autonomic Soviet Socialistic Republic" of the National Commissars Soviet of all Russia Central Executive Committee and the Russian Societ Federative Socialist Republic, in October at the Kazakh Soviet Constituent Congress "The Declaration of the workers' right of the Kazakh Autonomous Soviet Socialistic Republic" was adopted [1, 251–252]. One of the problems which was mentioned in the Declaration was related to the national educational activity [2, 175].

On October in 1920 the National Educational Commissariat of the Kazakh Autonomous Soviet Socialistic republic was formed. Having begun its formation basis from the dependence on the Kazakh regioanl military-revolutionary Committee the national educational Comissariat also began its organizational activity from depending on three big authoritative administrative. They were: 1) Main management of social upbringing which took the responsibility for the upbringing, 2) Main political educational commissariat which led the political-educational activities, 3) The Professional education Management which was responsible for the professional-technical educational activities. Except these managements the following the fourth section which was responsible for the science and art – the Academic Center appeared [3, 15–16].

In 1922–23 academic years the Academic Center fulfilled many measurable activities concerning the providing the national schools with textbooks, program, 14 textbooks published in the mother tongue. Among them "Physics", "Grammar", "School hygiene and others [4].

Among the higher educational institutions which opened on the territory of Kazakhstan was Kazakh National educational institute in Orenburg opened in 1919. The institute prepared school teachers. In 1921 140 learners studied there. According to the academic plan the study in the institute was held only in the Kazakh language. The institute teachers and students took an active part in destroying the illiteracy in the country. In 1925 the institute was moved to Kyzylorda. In the 30th due to the increasing the pedagogical and teacher's institutes in the Republic on 15th of October in 1933 it was closed [5, 194].

In 1920 there were Bokei Kazakh institute for giving the education to people, Semei National educational institute. The first year only 9 learners entered the Bokei Kazakh institute, and it couldn't justified itself, that' why it was changed into the teacher's course. On the first of March of 1922 on the

decree of the Kazakh National Commissariat the Orenburg polytechnic institute (Eastern institute) was opened. At the beginning of the year 50 learners were accepted, at the end of the year there only 20 of them stayed. Also among the teachers there was only one person who had a higher education, the Kazakh Autonomous Soviet Socialistic Committee on the basis of the decree of the central Executive Committee it was again closed. The following new institute was the National practical educational institute in Orenburg. Having confirmed its Charter in 1921 the National practical educational institute had begun to work since 1922. There the people who had nearly years of experience were registered as the listeners. According to it the main method of holding the lesson was as a conference of teachers which was held 2–3 times in a moth. Its calling as "Practical" was connected with it [3, 15].

If in 1921/22 academic years in the Republic Kazakh, Tartar Russian and 4 mixed types of institutions worked which gave the people the knowledge, and in 1927 in the Kazakh Autonomous Soviet Socialistic Republic 4 educational institutions, 1 pedagogical higher educational institution (Tashkent), 14 pedagogical technical schools worked.

On the 2nd of July of 1926 on the basis of the decree of the national Comissars' Soviet of the Kazakh Autonomous Soviet Socialist Republic the Tashkent Kazakh educational institute was changed into the Kazakh pedagogical institute. On the 23rd of March of 1927 one decree of the government of the Union of Soviet Socialist Republics was published again. There the moving of the Kazakh pedagogical institute from Tashkent to Almaty and then it would be reformed as the university was mentioned. Also a great attention was paid to being several pedagogical faculties in its structure [3, 16].

In autumn of 1928 the formed and raised Kazakh State University turned into the main center of preparing the pedagogical staff for short period of time. In two years it was reformed again as Kazakh pedagogical institute, in 1953 it was given the name of Abai Kunanbayev.

In 1929 in Alma-Ata the zooveterinary institute, and in 1930 – agricultural began to work. In 1931 in Alma-Ata the first medical institute in the Republic was opened. Teacher training and teacher's institutes in Uralsk, Semipalatinsk, Aktyubinsk, Petropavlovsk, Chimkent and Kostanay were opened. In 1934 in the capital there was opening of two new higher educational institutions – Mining and metallurgical institute and the Kazakh state university named after S. Kirov (nowadays Al-Farabi KAZSU). In 1938 at KAZSU the Kazakhstan's first postgraduate study was opened.

The hard work on elimination of illiteracy which was held in 20th and 30th began to give the results. On a census of 1939, among the population of Kazakhstan there were 76,3% literate people. Pedagogical staffs were prepared in KAZSU, 13 – in teacher training and teacher's colleges and 23 -in pedagogical schools.

In 1943 the teacher training college of foreign languages, the Chimkent technological institute of construction materials, in 1944 – Conservatory and Women's teacher training college in Alma-Ata began to work. In post-war time in 1950 the Karaganda medical institute, in 1951 the Semipalatinsk zooveterinary institute, in 1953 Karaganda Mining institute was opened [6, 17].

In the Republic three main types of higher schools were founded: university, polytechnic institute and branchy higher education institutions. Also according to the requirements of economy preparing the specialists was improved. However if we take into consideration the wide land of the Republic and the number of people, it is without saying that higher education institutions are not many [7, 65].

If we stop at analyzing the problems of forming the structure of higher school management, the majority of higher educational institutions of the Republic was under the dependence of different Ministries and managing structures, at its turn it caused difficulties in solving many problems of higher school life. So, from the forming the Kazakh State university till 1946 the Union of Soviet Socialist Republics (USSR) was under the dependence of All-Union committee on the problem of higher schools.

In 1946 due to reforming the Committee on the problems of higher schools into the Ministry of higher schools of USSR the university directly passed to the independence of the Ministry of higher schools of USSR. Medical institutions submitted to the Ministry of public health, veterinary institutes – to the People's commissariat of agriculture and cattle-breeding in 1946 of LSSR, and in 1946–1954 it submitted to the Ministry of agriculture. Agricultural institutes submitted to the Ministry of higher school of LSSR from 1946 till 1953, and since 1953 it passed to the submission of the Ministry of Culture. So during the mentioned years in the Republic there were no unique administrative and methodological center on managing [7, 63].

Khruschev's ideas of approaching the intellectual and physical work and strengthening the relations between the school and production had led to carrying out the radical reform of education at the end of the 50th and beginning of the 60th. In 1958 the allied law duplicated in 1959 by the republican Law "About Strengthening the relations of School with Life" was adopted. According to it, instead of seven years' and ten years' education a compulsory eight years' education was entered on completion of which graduates had to be obliged to work for three years at the plants or in agriculture, combining the work with a study, or to study at high polytechnical schools with inservice training. Entering the higher educational

institutions was caused by a production experience, but not by the theoretical training of entrants. In Kazakhstan transition to a new system was completed in 1962–1963.

This reform caused ambiguous consequences. Fluctuation of staff at the industry was strengthened where the number of workers – "tranzitnik" had been increased on the way to higher educational institutions. The prestige of the higher education fell, scientists and the intellectuals were used at physical, unproductive works at the sacrifice to their professional activity. In 1964 some points of this reform were reconsidered.

In 1959, for centralization the management of higher educational institutions of the republic, the state committee was formed which was reformed then in the Ministry of the higher and secondary special education of Kazakhstan. The number of higher educational institutions increased. If in the fifties in the republic there were 26 higher educational institutions, then by 1980 their number had been increased to 55 [6, 21].

2. Higher education of the Independent Kazakhstan and its managing system

When Kazakhstan got its independence 61 higher educational institutions worked and only two of them were universities.

From 1991 till 2001 owing to the greatly development of private sectors higher education; institutions increased to 3 times, and their number went up to 182. But for these ten years there was no adequate increase in number of high school professors, associate professors, the educational areas, the equipment, libraries, scientific and publishing activity, etc. Having been formed market of labor couldn't give accurate orientation for high school system on a range, quantity and qualification characteristics of specialists. Therefore since 2001 the network of higher educational institutions steadily fell. Now in Kazakhstan 125 higher education institutions function: 9 national, 31 state, 16 incorporated, 54 private, 13 not civil, 1 autonomous, 1 international university.

In 1991–1994 the legislative base (Laws of RK "About the Higher Education", "About Education") was actively worked out. In 1994 the first GOSOVO was approved. Since 1995 the first Kazakhstan educational standards were being accepted. In 1996 a new edition of the Qualifier (list) of specialties of the higher education was approved. In 2001 according to the International Qualifier of an education system a new Qualifier of preparation directions and specialties of the higher education was worked out and entered [8, 302].

In 1991 the first International Kazakhstan-Turkish University of Hodge Ahmed Yassavi was opened. The head of state emphasized more than once that it had to become "the educational center of the Turkic world" [9]. In 2000 the Kazakhstan-British Technical University and Lomonosov Moscow State University branch were opened.

The beginning of integration of the higher education of the country into the world educational space was promoted by signing the Lisbon convention by Kazakhstan in 1997 [10].

The appeal of higher educationa; system is characterized by a high level of internationalization. In developed countries the quota of foreign students in higher educational institutions is 17–18% in average. In Kazakhstan for the last 15 years this indicator had grown by 1,7 times. The most part of foreign students studies in Kazakhstan on the basis of intergovernmental agreements with the National Republic of China, the Russian Federation, Mongolia, Uzbekistan, Tajikistan, Ukraine, Azerbaijan and the Islamic Republic of Afghanistan, etc. For 15 years the number of the Kazakhstan citizens studied abroad had increased by 26 times.

The significant role in full entering the independent Kazakhstan into the world educational community was played by the unique Bolashak program. The international grant was initiated by the Head of state in 1993 [11]. Leading universities of the USA, Great Britain, Germany and France accepted the Kazakhstan youth. In total for these years the international grant of Bolashak was awarded to more than 12000 Kazakhstan citizens.

In March, 2010 Kazakhstan officially joined the Bologna declaration among the CIS countries first and became the 47th member of the European zone of higher education. The higher school of the country passed to a three-stage bachelor degree-magistracy-doctoral studies model.

The significant role in improving the quality of the higher school of Kazakhstan is assigned to the system of management. In 2016 the mechanism of selectivity of rectors of state universities was introduced. It became the first step in providing the transparency of activity of higher educational institutions (open competitive selection with participation of the university supervisory board). Earlier the first heads of higher educational institutions were appointed by MES PK. MAUN RK'S decision. The key in competitive selection was the protection of the university development strategy by the applicant. Joint decision is made by the republican contest committee with participation of the deputy prime minister of RK. Since 2016 the practice of rectors' annual reports of national higher educational institutions before the public had begun.

Questions of corporate control system formation are considered topical for the higher school of the country. In 2016 observant and the boards of trustees functioned in 84 higher educational institutions (9 national, 31 state, 1 international, 16 incorporated and 27 private). Representatives of MIO, the branch ministries and the public are included in their staff. The significant role in formation of a new generation of top managers of the higher school and introduction of the principles of corporate management is given to Nazarbaev University. Cours-

es of retraining and professional development of administrative structure of higher educational institutions of the country had begun since 2014. Training in Fund of leadership in the higher education (Great Britain), the Asia-Pacific university Ritsumeykan (Japan), the Higher school of education of Pennsylvania University (USA), etc. was organized for them [8, 330].

All above-stated measures made a positive impact on Kazakhstan model development of higher and postgraduate education. The number of the Kazakhstan higher educational institutions in the international rating of QS has increased. If at the initial stage Kazakhstan was represented only by 2 higher educational institutions (2011), then in 2016 there were already 8 [8, 306].

3. Conclusion

The main direction of all reforms which were held in the sphere of education in our country is to increase the quality of education, to prepare the specialists who had higher qualification, competitive in the world market, who could meet the requirements modern qualifications according to his sphere.

In order to correspond to these requirements we should pay much attention to widening the academic and managing personality of the higher educational institutions for the purpose of carrying out the State President's Message "Kazakhstan's way – 2050: One aim, one interest, one future" which was adopted on the 17th of January of 2014, Nations' plan – 100 concrete steps of fulfilling the state leader N. Nazarbayev's five institutional reform.

With 78 step of the Plan of the nation "stage-by-stage expansion of the academic and administrative independence of higher educational institutions taking into account the experience of Nazarbayev University. Transformation of private higher educational institutions to non-profit organizations according to the international practice" was foreseen.

For realization of the given step the concrete measures and expansion ways of academic and administrative independence of higher educational institutions are foreseen. In particular, according to the State program of development of education and science of the Republic of Kazakhstan for 2016–2019 (further – State Program), stage-by-stage introduction of experience of Ltd "Nazarbaev University" concerning the academic and administrative autonomy in civil higher educational institutions is continued.

Today the competition between the universities, both in the countries, and between the states, underwent changes, it was filled with a new content. "The academic globalization" induces the universities to be more enterprising and to take an active part in the fight for students, the most successful teachers, to compete for grants on scientific researches. In order to be able to react adequately to needs of modern world higher educational institutions in the conditions of competition must have an administrative and academic independence in realizing their activity in the sphere of education and investigations.

The systems of the higher education of many countries, more often note that for maintaining the international reputation in a new competitive environment a big flexibility, aiming at generation of a new knowledge by the universities, susceptibility to innovations and ability to reproduce them that wasn't considered earlier as the main key to success was required.

The accepted Sate Program as a priority defined democratic processes in structural and meaningful architecture of the higher education. At the same time, the control system of the higher education is characterized by excessive centralization and sometimes a petty regulation of activity of higher education institutions.

It should be noted that only in the conditions of certain independence responsibility is possible. The present condition of national higher educational system causes need of increasing in social responsibility of higher educational institutions for results of its activity, for quality of training the specialists, for forming younger generation's modern outlook which has to be spiritually-morally rich, professionally competent, intelligently creative, innovatively susceptible and tolerant.

And also development of corporate governing bodies gives the chance of introducing the new mechanisms of appointment and release of administrative board of higher educational institutions, determination of their powers term, introducing the practice of accountability to society and formating the transparent budget. Today in 28 higher educational institutions the supervisory boards function. The supervisory boards include the questions of target use control of the budgetary funds and means received from additional sources, coordination of the report project on the development plan implementation, the preliminary approval of annual financial accounts, making decision on distribution of the sponsor's and charitable help and means received from the additional sources, including a part of the pure income which has remained at the disposal of the state enterprise, etc.

As the international experience testifies, the efficiency of higher education directly is defined by the decentralized control system. In this regard establishing the reasonable correlation of competences of the sphere of higher education between the authorities, structures and higher educational institutions is provided. At the level of the Government the main directions of social and economic policy of the state, including the education and sciences will be defined. The authorized body in the sphere of education and sciences will be engaged in the adoption of regulations on realization of the state educational policy. All questions concerning the management of operational activity and solving the current problems will be delegated to the higher educational institutions.

The academic independence assumes endowing the higher educational institutions with powers in defining the questions of admitting the students, establishing the correlations between the faculty and the quota of students, defining the structure and contents of educational programs, curricullum and academic programs of disciplines.

Within each specialty the number of educational programs and their name independently is defined by a higher educational institution. So, higher educational institutions can work out independently various educational programs according to the requirements of labor market at the expense of a component of choice. It increases the academic independence and mobility of higher educational institutions, it allows to consider peculiarities of labor market of the concrete region in the corresponding specialists.

In the conditions of market states of economy, fast removability of information in the sphere of scientific achievements, techniques and technologies, the principle of training during all life has to work. It is necessary to train the universal specialists possessing the broad basic preparation and key competences characteristic for the higher education. In ¾ parts of the European space countries of the higher education training during life is recognized as the mission of higher educational institutions.

Thus, higher educational institutions, acting as the suppliers of educational services, have to become the producer of competitive educational programs, updating them on a constant basis taking into account requirements of students and employers to skills and competences. The student oriented training and educational programs adapted under the labor market inquiries, strengthening the cooperation with the enterprises will promote the improvement of quality of preparation and improvement of employment of graduates with a reference point on passing the qualification test which is held by the professional community.

It means that while forming the educational programs the learners' interests must be taken into consideration. While determining his individual trajectory of training the student can choose as the disciplines directly connected with his chosen specialty and the additional disciplines which aren't connected with specialty.

Higher educational institution, realizing educational programs, creates an educational environment, and provides with the corresponding resource in a certain direction of preparation. As it has been noted, the three-level model of teaching corresponds to a fundamental education with a broad basic preparation and key competences. Therefore the educational environment and resource providing have to cover completely all directions of preparation. In this regard licensing of educational activity will be carried out on the scientific sphere and/or the directions of preparation.

In other words, the higher educational institution obtains the license for holding the educational activities on concrete scientific area and/or the direction of preparation within of which it can independently open the corresponding specialties and/or educational programs.

In its turn the authorized body in the sphere of education will carry out the introducing the Register of educational programs that will allow to conduct pointed training taking into account the real needs of the region. At simultaneous holding ranging and the rating of educational programs the increase of their competitiveness and elimination from the register of educational programs non-core or unclaimed by the market will become possible.

Respectively the student's quota will be formed not on specialties, but according to the educational programs on the basis of their competition and need of regions and labor market.

In general from expansion of academic and administrative independence the followings are awaited:

– giving the higher educational institutions the independence in realizing the academic policy;

– introducing the financial independence of higher educational institutions, including expansion of opportunities and minimizing the procedures of property management, formation of the transparent budget of higher education institutions;

– increasing the responsibility and accountability of higher education institutions to society;

– creating the innovative infrastructure of higher education institutions and decreasing the bureaucratic barriers for bigger transparency and efficiency of commercial activity.

The role of the higher education constantly evolves in the world. Today the world community lays great hopes on the universities, demanding from them the performance of a wide range of tasks promoting the growth of economy and forming the society of knowledge. Along with the traditional educational, scientific-investigative and innovative activity, the universities are called for broad participation in the development of the country and providing the continuous growth of its intellectual and innovative potential.

The activity of higher educational institutes and the managing model of them gain a corporate character regarding the expansion of collective nature practice of decision-making by university community and increasing the responsibility of the universities for achieving the goals.

With a change of a role of higher educational institutions in many countries also the nature of their relations with the authorities and society is transformed. The state control is deregulated step by step. For the last decades large-scale reforming of managing the higher education, both on system, and at the institutional level, for the purpose of giving a big-

ger freedom, dynamism, flexibility and efficiency which act as some kind of criterion of competitiveness of separately taken system of the higher education is practically observed almost around the world.

In the work of the famous scientist Jamil Salmi in the sphere of education " The Challenge of Establishing World-Class Universities" (2009) the best practice of creating the world class universities is presented, ways of their development on the basis of administrative and financial methods are described. The author proves that a number of higher educational institutions in the world could become the research universities of a world class thanks to the existence of three key factors: 1) a high concentration of talent (faculty- and students); 2) abundant resources to offer a rich learning environment and to conduct advanced research; 3) favorable governance features that encourage strategic vision, innovation, and flexibility and that enable institutions to make decisions and to manage resources without being encumbered by bureaucracy.

Within the Lisbon declaration (2007) the European Association of Universities distinguishes the following 4 characteristics of autonomy allowing to open most fully a concept of autonomy in higher educational institutions and, as a result, to correspond to the best international standards:

1. Academic autonomy.

The criterias of the academic autonomy are opportunities independently: to define the total number of students (proceeding from the resources of the University); to make a selection of students; to introduce educational levels (a bachelor degree, a magistracy, doctoral studies); to open/close programs; to independently choose a control system of education quality, mechanisms of quality control; to define the content of educational programs.

2. Financial autonomy.

The criterias of financial autonomy are opportunities to independently determine duration and types of public financing; to keep surplus; to borrow money; to have own buildings; to take a tuition fee of students, including foreign learners.

3. Organizational autonomy.

The criterias are opportunities to independently define the rules of appointment and criteria of administrative board; to dismiss workers of administrative board; to define a term of power; to include and select external members in governing bodies; to define the academic structure; to create the juridical persons.

4. Autonomies in the sphere of personnel policy.

The criterias of autonomy in the sphere of personnel policy are opportunities to independently define procedures of hiring, dismissal, promotion, sizes of the salary of the leading, academic, administrative personnel.

Analyzing the international experience, it is possible to note the following norms of foreign experience allowing to implement them in the national legislation.

For example, on the basis of the Swedish model of the higher education the following aspects of autonomy are represented (by types) which are expedient for application in the Kazakhstan educational space:

– academic: equal attention to both the educational process, and the scientific-investigative activity of a higher educational institutions; a high degree of freedom (scientific-investigative activity, admission of students, educational programs), which goes with the control of quality and effectiveness of using the resources by the universities from the Government's side; students' direct participation in solving the academic questions (educational programs, procedures of providing the quality) at an accurate regulation of activity of student's association; separate regulation of awarding the qualifications of specialized higher education institutions; a possibility of curriculum working out of higher educational institutions and independent suppliers of the courses which have the right to award qualifications, for awarding the joint degrees;

– administrative: independence of higher education institution at establishing the procedure of electing the members of managing council (board of trustees) and defining the internal organization; accountability of the vice-chancellor (rector) to board of governors;

– financial: legislative fixing of the right of higher educational institutions on commercial educational activity: one of the priority purposes of the universities is the implementation of "the third stream" activity (extraction of incomes besides traditional pedagogical and scientific activity); the right of regional executive authorities (municipalities/county councils) on the organization of courses and educational programs and participation in their development by higher education institutions.

On the basis of the Finnish model of higher education the following aspects of autonomy which are considered as expedient for using in the Kazakhstan educational space are represented (by types):

– academic: independence of higher education institutions at establishing the criteria of admitting the students; possibility of receiving the highest university degree without a condition of existence of the lowest university degree in separate branches if it is expedient from the point of professional requirements;

– administrative: existence of authorized body on the example of collegial/multimandatory administrative body in higher educational institutions of Finland for the purpose of regulating the activity of the trustees board; possibility of creating the legal entities;

– financial: the developed financial mechanisms of the state support of the higher education; possibility of implementation of commercial activity (educational courses). Especially it is topical the for pedagogical higher educational institutions – the existence of number of training schools for the pedagogical practice in the higher educational institutions based on experience of Finland, it is possible to fix legislatively.

Thus, the offered recommendations will allow higher educational institutions to correspond to the international criteria of autonomous activity.

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