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WINTER RESISTANCE OF THE APPLE-TREE VARIETIES IN THE SOUTH OF RUSSIA

Abstract

***Objective*:** revealing the apple-tree varieties, promising for growing in the south of Russia.

***Methods*:** In winter period in normal conditions and in model experiment, in frost penetration (25 ° C) the content of bound water was determined in the shoots of apple-tree by a weight method, that of starch – by a spectral method, phenolcarbonic acids, malondialdehyde – by a capillary electrophoresis method on Kapel 105 M tool, anaerooxydase activity – by a spectral method, anaerooxydase isoenzyme composition in water-salt-soluble protein fraction – by a vertical electrophoresis method. When making the anatomical preparations, the methods of conventional botanical microengineering were used.

Results: the most significant indicators, characterizing the varieties' resistance to the low-temperature stress, determining the frost tolerance of apple-tree varieties were studied. The domestic varieties (Soyuz, Rodnichok), as well as Erli Mac variety of American selection were revealed to store up more starch, making them more resistant to the low temperatures. The correlation dependence between the content of bound water and that of osmoprotectors (saccharose, proline), phenolcarbonic acids (chlorogenic and caffeic), pigments (anthocyans and chalcones) in the apple-tree shoots was established. The parameters such as anaerooxydase activity, and phenolcarbonic acids, malondialdehyde contents were used to reveal the apple-tree varieties' resistance to the low-temperature stress. The electrophoretic spectrum of the proteins' water-salt-soluble fraction with anaerooxydase activity was studied for the apple-tree varieties. A model experiment determined the proteins, having

the molecular weight of 50 and 60 kDa and exhibiting anaerooxydase activity to appear in protein spectrum, as the shoots of the apple-tree varieties under study are exposed to the cold stress.

Scientific novelty

The physiological-biochemical and morphoanatomic criteria were established for the frost-tolerance of the apple-tree varieties of home (Prikubanskoye, Rassvet, Fortuna, Soyuz, Rodnichok), Polish (Ligol) and American (Idared, Erli Mac and Dayton) selection.

The proteins, appearing in the shoots of the apple-tree varieties under study when exposed to the low-temperature stress, were revealed to have the molecular weight of 50 and 60 kDa and exhibit anaerooxydase activity.

Practical implications

Soyuz, Rodnichok and Erli Mac varieties were established to be tolerant to the low temperatures effect and promising for selection process and growing in the south of Russia.

Keywords: apple-tree; variety; frost tolerance; oxidative stress, protein spectrums; anaerooxydase.

Introduction

The issues of the apple-tree plants higher resistance to abiotic and biotic stress-factors of environment were high on the list in solution of the high-productive fruit coenoses engineering problem. They became mostly dramatic in the recent years in the terms of the local changes in climate [1, 2].

The exposure to the natural stressors brings to the sharp decrease in productivity and fruits quality, and more often than not to the death of plants of the fruit crops. If affected by the stress factors, the intensive varieties may realize only 15–30 percent of potential productivity [1].

That is why only the varieties, combining the high quality with adaptedness to conditions of the region, may be successfully grown on a rather wide scale basis [3, 4]. The natural and climatic conditions of the south of Russia favour the cultivation of the fruit crops, but obtaining the steadily high yields is restricted by the impact of unfavourable environmental factors, such as winter frosts, especially after the long-time warm weather, and summer droughts. Therefore the varieties, both locally selected, and introduced ones, adapting to the cultivation region conditions take on particular significance. In this context the importance of selection, as a basic method to improve the commercial range of apple-tree culture grows [3, 5].

In this regard it is particularly topical not only to single out the promising genotypes, but to determine the expressivity of genetic systems, in other words the ability to realize the potentialities of genotype in the changing conditions of environment. The study of the physiological-biochemical criteria of adaptability will permit to find out the varieties resistant to abiotic factors of winter period in the south of Russia.

The objective of work is to study the physiological-biochemical and morphoanatomic parameters of resistance of the apple-tree varieties different in ecological-geographical origin to the stress winter period conditions in the south of Russia.

Methods of investigations

The investigations were carried out on the basis of Pilot production farm "Centralnoye", Federal State Budgetary Scientific Institution North Caucasian Federal Scientific Centre for Horticulture, Viticulture and Wine making, Krasnodar. The physiological-biochemical regularities of the apple-tree adaptation were studied on the varieties as follows:

– Idared (USA), Ligol (Poland), Prikubanskoye (Russia, NCRRIH&V) planted in 2010 on CK 4 parent stock with 0.9 × 4.5 planting system;

– Rassvet (2п = 2x), Fortuna (2п = 2x), Soyuz (2п = 3x), Rodnichok (2п = 3x) (Russia,

NCRRIH&V) planted in 2000 on M 9 parent stock with 2 × 5 planting system;

– Erli Mac (2π = 2x) (USA), Dayton (2π = 2x) (USA) planted in 1998 on M 9 parent stock with 2 × 5 planting system.

To estimate the apple-tree plants frost tolerance in the shoots both in the usual conditions, and under the low-temperature stress in the model experiment at the temperature of minus 25 ° C, they determined water status with the use of methodology [6], content of starch [7], phenolcarbonic acids, malondialdehyde – by the capillary electrophoresis method on Kapel 105 M tool [8], activity of anaerooxydase – by a spectral method [9], isoenzyme composition of anaerooxydase in the water-salt-soluble protein fraction – by a vertical electrophoresis method [10]. When making anatomic preparations, the methods of conventional botanical microengineering were used [11].

The measurement data were processed with the use of conventional methods of variation statistics [12].

Results of investigations and discussion

As distinguished from winter period of 2014–2015, 2015–2016, the 2016–2017 winter was colder, the minimum air temperature lowered down to minus 17–16–14 °C, respectively, the maximum temperature reached 12–22 °C, the temperature drop made 15–35 °C. The increase in the maximum air temperature from December of 2014 (12 °C) through December of 2017 (16 ° C) by 4 ° C and minimum air temperature from – 9 up to – 4 °C, characterizes climate warming. The high air temperature and the large depth of rainfall in November of 2016 promoted the later entrance of the apple-trees of the varieties under study into the state of winter dormancy. It was a reason for the apple-tree plant to be out of the state of true dormancy. This fact may become a reason of their lower resistance to the damaging factors of winter period.

The starch content in the shoots of plants is among the winter resistance indices of the apple-tree varieties (Fig.1). The decrease in temperature involves an intensive hydrolysis of starch in the fruit trees, as a result of which the starch turns into the fats and osmotically active compounds, first of all into the different sugars, being the protective agents (they diminish the processes of proteic substances denaturation, when freezing, and stabilize the structure of protoplasm) [13].

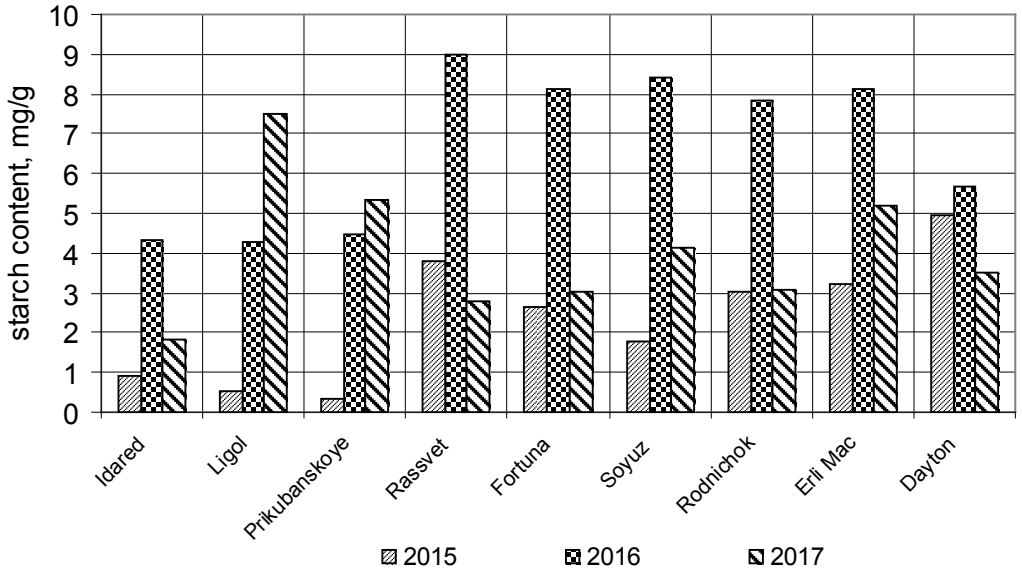


Figure 1. The dynamics of starch content in the shoots of apple-tree varieties in 2015–2017 December

During the winter period in December of 2015–2017 the lesser accumulation of starch in the zone of fine-cellular shoot core was shown by Idared, Ligol, Prikubanskoye varieties in 2015, in 2016 – by Idared, Ligol, Prikubanskoye varieties and in 2017 – by Idared, Rassvet, Fortuna, Rodnichok varieties (Fig. 2).

Transversal section of shoot Longitudinal section of bud Starch grains

Figure 2. Morphoanatomic structure of the one-year shoots and the buds of Idared apple-tree variety in December of 2015

Thus, depending on the weather conditions, the different varieties accumulate starch in the shoots variously, that may stem from their photosynthetic activity under the conditions of the previous drought of summer period [14].

The histochemical and morphoanatomic research of the one-year shoots of the apple-tree varieties under study showed them to be in the state of induced dormancy for the analyzed period of 2015–2017 in December, that is confirmed by the method of the cut branches sprouting (in all variants of experiment all the buds began to grow). The morphoanatomic examinations of the fruit buds on the annual increment showed them to be in the state of induced winter dormancy. The fruit buds are at the Vr stage of organogenesis – the formation of archesporial tissue in anthers (Fig. 2).

The intravital anatomic investigations for the tissues of the one-year shoots and the buds of the apple-tree varieties under study, conducted in February of 2016, showed them to be in the state of induced dormancy. The transversal sections of shoot in the core zone show the multiple plasmodesmata (intercellular cytoplasmic cords between the cells), proving the activity of metabolic processes in the plant cells. In Soyuz and Rodnichok triploid varieties the starch content in the zone of fine-cellular shoot core significantly lowered in response to its hydrolysis, and made 4.4 and 4.3 points respectively. The hydrolysis of starch was noted to be delayed in diploid varieties, its quantity varied from 4.4 to 4.6 points. For example, the starch content of Rassvet, Erli Mac, Idared, Prikubanskoye diploid varieties in the zone of the fine-cellular shoot core made 4.6 points, that in Fortuna variety – 4.5 points, characterizing it as a winter-hardy one, in Dayton and Ligol diploid varieties – 4.4 points (medium winter-hardy).

Thus, in February conditions of 2016 Soyuz and Rodnichok triploid varieties, proved themselves to be highly winter-hardy according to the physiological-biochemical and histochemical data.

The most important biochemical markers of the plants frost-tolerance are the content indicators of such osmoprotectors as proline and saccharose (15–17).

The study for dynamics of the change in bound water content and such stress-protectors, as proline and saccharose, in December of 2014–2016, as exemplified by Idared, Ligol, Prikubanskoye varieties, showed the resistance of the Idared apple-tree plants be determined by saccharose content to the greater extent (K_{correl}.= 0.89), and by proline – in Prikubanskoye variety (K_{correl}.= 1.0). As for Ligol variety, both proline and saccharose participate in the maintenance of water economy, but the relation between the bound water content and these osmoprotectors

is not significant (K_{correl} = 0.55 and 0.61). At the time of freezing through the shoots in a model experiment in December of 2014–2016 the relationship between the change in the content of bound water and that of saccharose, proline, phenolcarbonic acids was established. The maximum coefficient of correlation was noted between the content of bound water and that of proline (K_{correl} = 0.97), anthocyans (0.92), chalcones (K_{correl} = 1.0), which is due to inhibition of the free-radical processes under oxidative stress, characterizing the change in permeability of the cell membranes [18]. The anaerooxydase activity of the studied apple-tree varieties varies in the range from 12.02 to 28.15 sec^{-1}(Fig. 3).

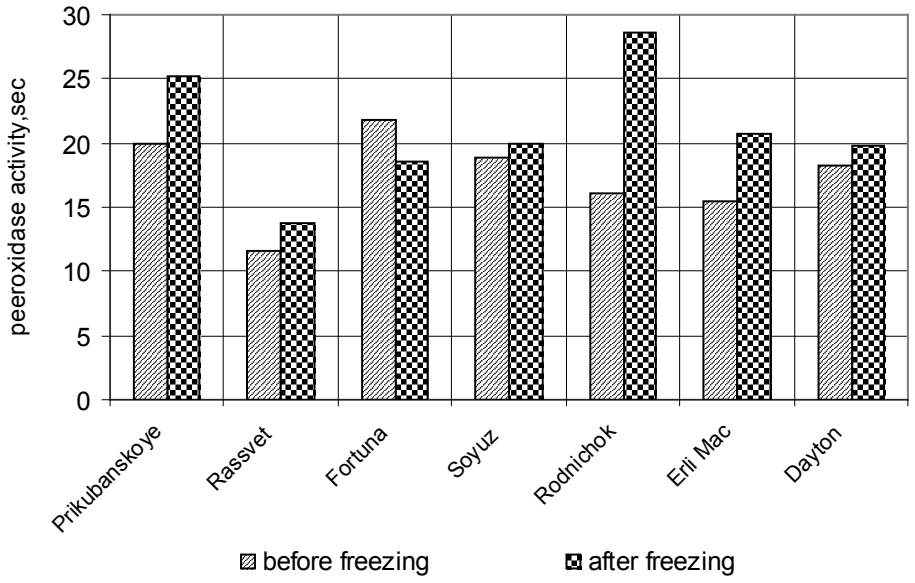


Figure 3. Anaerooxydase activity in the shoots of apple-tree in December of 2017

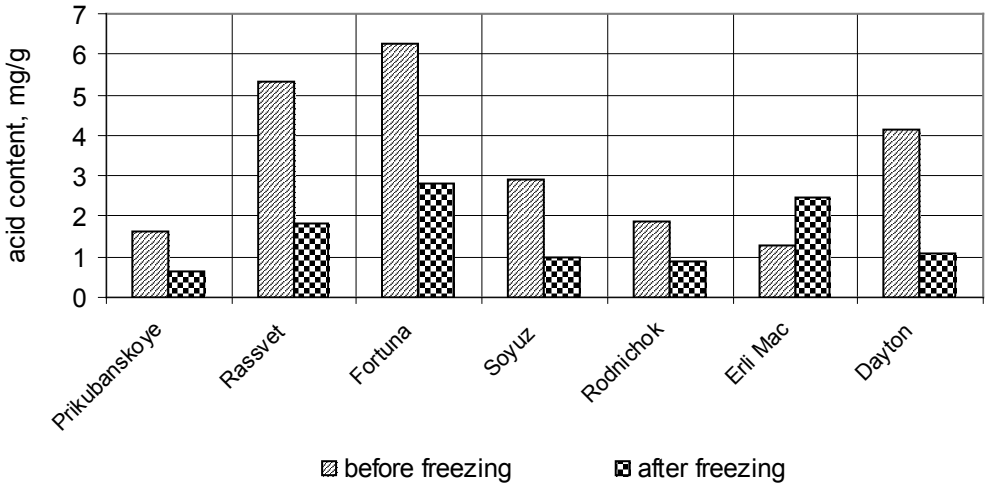


Figure 4. The phenolcarbonic acids content in the shoots of apple-tree in December of 2016 before and after freezing

In this case the lesser anaerooxydase activity before the shoots are frozen through is noted for Rassvet, Rodnichok and Erli Mac varieties and the higher one for Soyuz, Prikubanskoye, Fortuna and Dayton varieties, and after freezing the shoots the lesser one – in Rassvet, Fortuna, Dayton varieties and greater – in Prikubanskoye, Soyuz, Rodnichok, Erli Mac varieties, that agrees with the higher content of phenolcarbonic acids before the exposure of Rassvet, Fortuna, Dayton varieties to the cold stress. (Fig. 4), and lesser one – of

Prikubanskoye, Rodnichok, Soyuz, Erli Mac varieties, to characterize the specificity of variety and it may involve the differences in the spectrums of proteins, featuring the anaerooxydase activity.

To characterize the degree of oxidative stress development and functioning of the plants' antioxidant defence in the apple-tree shoots, the content of malondialdehyde was determined [19–21]. It appears in organism, when the active forms of oxygen degrade the polyunsaturated fatty acids and serves as one of important indicators for degree of the stress-factor damaging action (Fig. 5.)

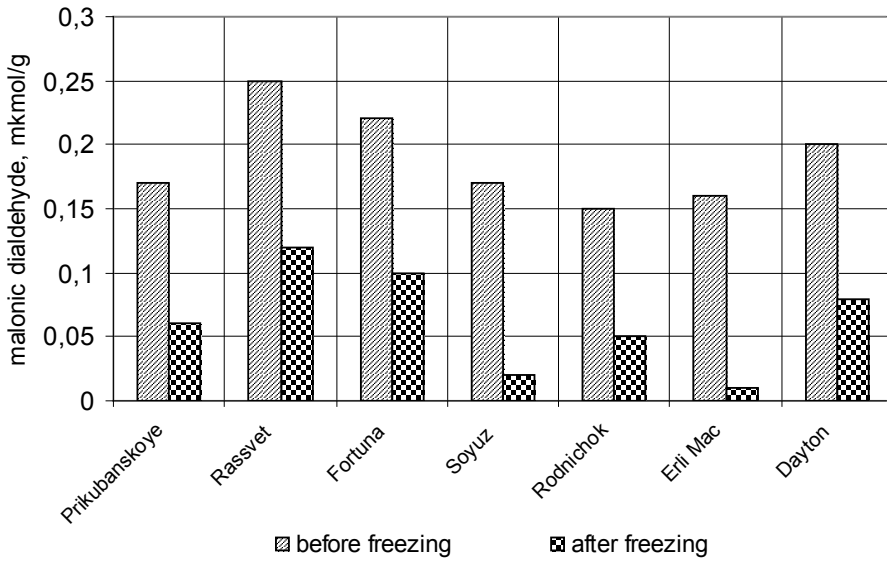
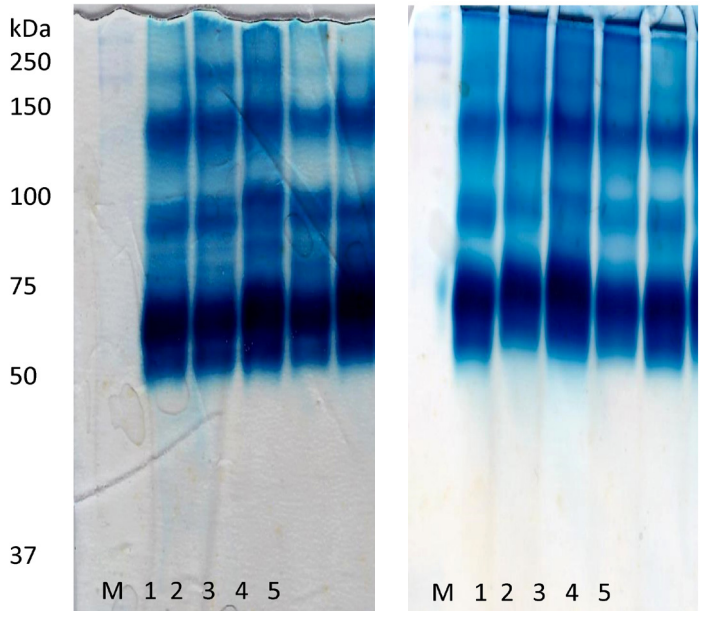


Figure 5. Malondialdehyde content of the apple-tree shoots in December of 2016 before and after freezing



1 – Prikubanskoye, 2 – Soyuz , 3 – Rodnichok, 4 – Fortuna , 5 – Rassvet

Figure 6. The electropherogram of the water-salt-soluble fraction of the proteins featuring the anaerooxydase activity of the apple-tree varieties before and after freezing the shoots in December of 2016

The malondialdehyde content of Rassvet, Fortuna, Dayton varieties both before and after freezing was established to be higher, as compared with other apple-tree varieties under study. To characterize the genetic systems' expressivity of the studied apple-tree varieties adaptation to the low temperatures in the state of true dormancy, the cold stress proteins, showing the anaerooxydase activity, were studied (Fig. 6).

The protein complex with anaerooxydase activity of the apple-tree varieties under study was established to be represented by the proteins of 250, 150, 100, 90, 75, 60, 50 kDa molecular weight. Prikubanskoye, Soyuz, Rodnichok varieties differ from other studied apple-tree varieties by the presence of protein of 90 kDa molecular weight and larger proteins content with molecular weight of 100 kDa, that can be ascribed to their ecological-geographical origin. The proteins with 60 kDa molecular weight are abundant in Rodnichok, Rassvet varieties, as distinguished from other varieties under test.

When freezing through the shoots of apple-tree in a model experiment, Prikubanskoye, Soyuz and Rodnichok varieties show the rise in the content of proteins with molecular weight of 50 kDa. Thus, one may suppose, that the proteins of cold stress in the studied varieties, when exposed to the low-temperature stress, are represented by the proteins with molecular weight of 50 and 60 kDa, featuring the anaerooxydase activity.

Conclusions

The most significant parameters, characterizing the apple-tree varieties' resistance to the low-temperature stress, determining their frost tolerance, were studied. The domestic varieties (Soyuz, Rodnichok), as well as Erli Mac variety of American selection were revealed to store up more starch, making them more tolerant to the low-temperatures effect. The correlation dependence between the content of bound water and that of osmoprotectors (saccharose, proline), phenolcarbonic acids (chlorogenic, caffeic) pigments (anthocyans and chalcones) in the shoots of apple-tree was established. The parameters such as anaerooxydase activity and phenolcarbonic acids, malondialdehyde content were used to reveal the apple-tree varieties' resistance to the low-temperature stress. The apple-tree varieties' electrophoretic spectrum was studied for the water-salt-soluble fraction of the proteins, exhibiting anaerooxydase activity. It was established in a model experiment, that the proteins, having the molecular weight of 50 and 60 kDa and exhibiting anaerooxydase activity, appear in a protein spectrum on exposure of the studied apple-tree varieties to the cold stress.

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FEATURES OF COPPER AND BORON ON THE NUMBER OF SIMPODIA OF COTTON COMPOSITION IN THE PERIOD OF MASS BUDDING

Abstract: One of the significant reserves of increasing the yield of cotton is the use, when cultivating this culture, of the factors that ensure maximum preservation of fruit organs on the plant, a large number of which, under unfavorable conditions, fall, causing significant damage to the crop. Increasing the yield of agricultural crops, including cotton, has been and remains one of the most important tasks of biological science and the practical activities of workers in the agro-industrial complex. The article gives data on the effect of copper and boron on the number of sympodial branches at different times of growth and development of cotton varieties. Phenological observations showed that the number of simpodia increases with a certain regularity as the plant grows. The obtained data indicate that the C-65 24 variety has the most number of simpodia and buds in comparison with other varieties.

Keywords: microelements, fruit formation, sympodial branches, budding, cotton varieties, shrub, fall of fruiting organs, growth and development.

Introduction. At present, the urgency of the problem of increasing the yield of cotton has increased even more because of the limited possibilities for expanding irrigation areas, mainly because of the scarcity of water resources that are of particular importance for irrigated farming zones. Consequently, the task of increasing the production of raw cotton can and should be solved mainly by increasing the yield of cotton by developing agrotechnical measures, increasing soil fertility, chemicalization, breeding and seed production. In this connection, it is necessary to solve a number of scientific and production problems aimed at further increasing the production of raw cotton.

Objective of research. Biochemical and physiological features of growth and development of cotton fruit-bearing organisms touch upon a wide range of questions on the interaction between plants and various environmental conditions. These questions are so vast that previous studies, naturally, could not give their exhaustive solution.

As our experiments have shown, during the formation and ripening of the fruit-bearing organisms of cotton, a whole variety of protein substances, characteristic of a mature fruiting organ, is synthesized and accumulated.

One of the significant reserves of increasing the yield of cotton is the use, when cultivating this culture, of the factors that ensure maximum preservation of the fruit organs on the plant, a large number of which, under unfavorable conditions, fall, causing significant damage to the crop. The study of cotton bearing and factors causing the fall of fruit organs, increasing the yield of crops, including cotton, has been and remains one of the most important tasks of biological science and the practical activities of

workers in the agro-industrial complex. Getting a high yield with good quality is the main condition for further progress in agricultural productivity.

Objects and methods of research. In recent years, intensive research has been conducted to detect natural growth regulators and to study their role in the processes of formation and fall of fruit elements in cotton. It has been ascertained that auxins, gibberellins and abcisic acid are, to some extent, regulators of the fall of the fruiting organs of cotton (Liopold, 1864, Hall, 1958, Prusakovo, 1968; Imamaliev, 1977).

As the growth and development of the fruiting organ is clearly traced accumulation of a pool of free amino acids. Their greatest content was noted in the fruiting organs of 10–15 days old. Analyzing the role of free amino acids in the fruiting organs, it should be emphasized that there is a close and clearly delineated link, consisting of a mutually conditioned change, a correlative relationship with the processes occurring in the valves and developing seeds of the cotton fruiting organs. These changes determine the features of the metabolism of the fruiting organs and their individual parts.

It should be emphasized that the main theoretical principle in the solution of the main task of cotton growing – maximum preservation of fruit elements on the bush is the obligatory registration of all conditions for cultivation of crops, the obligatory coordination of biological features of plants with environmental conditions and their mutual subordination and interaction.

Technique of conduction the experiment

The development of this topic is conducted at the Department of Botany and Cell Biology of the Faculty of Natural Sciences of TSPU named after Nizami with varieties Namangan-34, C-65 24, Omad and Bukhara-102, bred in the Uzbek Research Institute of Cotton Selection and Seed Growing and the Uzbek Research Institute of Cotton Growing of the Ministry of Water and Agriculture of the Republic of Uzbekistan. These varieties are included in the state register of prospective varieties of the Republic of Uzbekistan.

The experiments were carried out in vegetative and field conditions on the basis of the two abovementioned institutions in accordance with the generally accepted methodology.

Results and their discussion. Studies of recent years have shown that the process of proliferation of fruit elements is closely related to fruit formation and depends on many internal and external factors.

Internal factors include genetic and physiological-biochemical features of the plant organism.

It is known that the physiological and biochemical processes in the cotton fruit bodies form the quality and yield of raw cotton.

The attention paid by the government to the development of basic research opens up new opportunities in applying scientific achievements in cotton growing.

In studying the features of fruit formation biology and morphology of these varieties were studied, but also the possibility of increasing yields.

It is known that the number of buds formed depends also on the number of fruit branches (simpodia) on the bush. Obviously, the more the number of simpodia, the more buds, flowers and bolls will be formed.

The number of simpodia increases with a certain regularity as the plant grows.

The obtained data showed that the dynamics of growth and development in varieties Namangan-34, Bukhara-102, Omad and C-65 24 are not the same. Each variety has on time maxima and minima of the formation of fruit branches (simpodia), buds and flowers. The maximum number of simpodia in the Namangan-34 variety was 11 on the 10th day of accounting, for the Omad grade on the 35th day 14 pieces, for the Bukhara-102 grade on the 35th day 17 pieces, for the grade C-6524 for the 30th day 17 pieces. The dynamics of the formation of the minimum number of simpodia by varieties was as follows: the Bukhara-102 and the C-65 24 were on the 5th day of recording, the Omad variety on the 10th day, and the Namangan-34 grade on the 35th day of registration.

In addition, when introducing a double copper norm and a single boron norm in Namangan-34 and C-65 24, the height of plants and the number of opened bolls increase. The Bukhara-102 variety clearly shows the positive influence of single-rate boron on the height of the plant, while in Omad variety increases the number of open bolls.

Phenological observations showed that the number of simpodia increases with a certain regularity as the plant grows. The control variants show that in Namangan-34, in the first 5 days of registration, the number of simpodia per plant was, on average, 7.5 pieces, and on the 45th day, i.e. in 40 days the number of them was 11.8 pcs. In the C-65 variety 24, the number of simpodia in the first counting period was 8.4 pcs., and after 40 days – 12.4 pcs. per one plant.

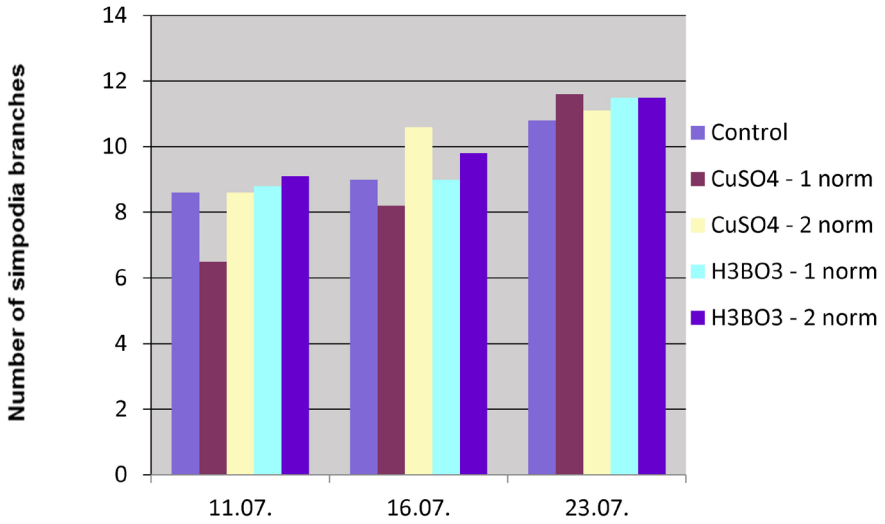

Figure 1. Features of copper and boron on the number of sympodia of cotton composition in the period of mass budding of C-6524

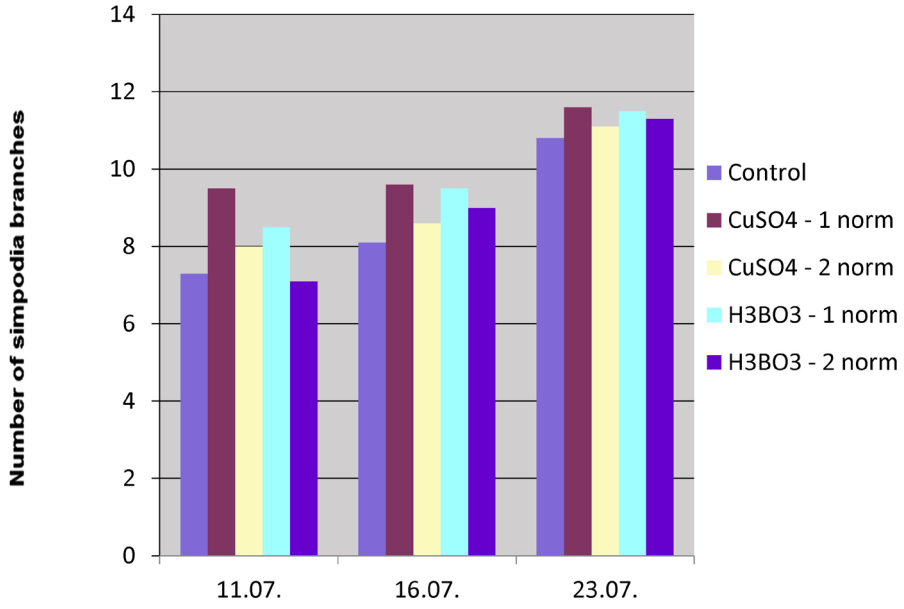

Figure 2. Features of copper and boron on the number of sympodia of cotton composition in the period of mass budding of Namangan –34

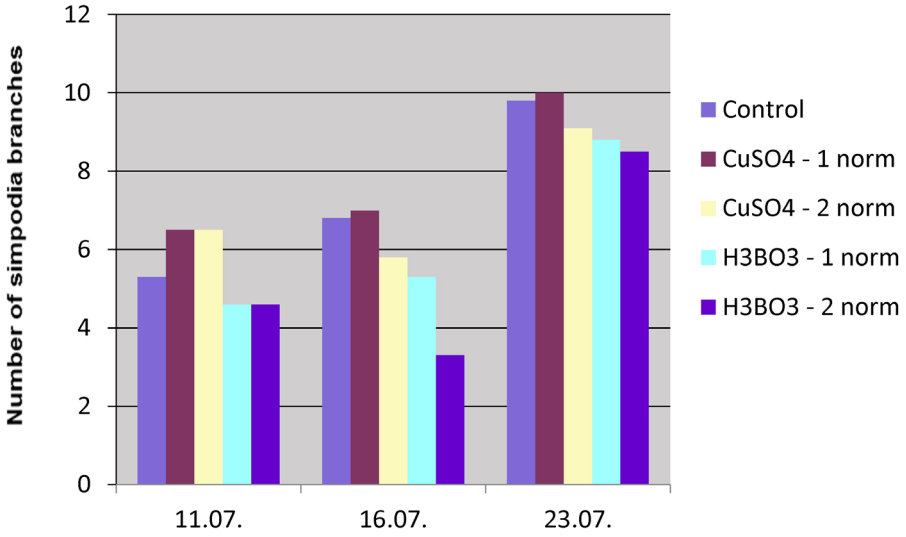

Figure 3. Features of copper and boron on the number of sympodia of cotton composition in the period of mass budding of Buhoro-102

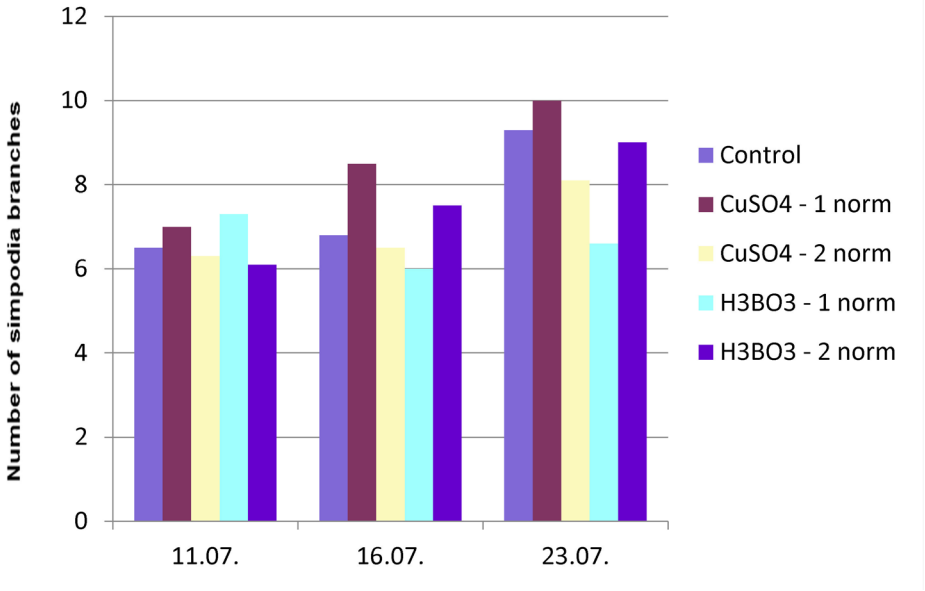

Figure 4. Features of copper and boron on the number of sympodia of cotton composition in the period of mass budding of Omad

The lowest number of simpodia was in Bukhara-102: 5.4 and 9.8 pcs. accordingly, even in the low-growth Omad variety, the number of fruit branches was 6.5 pieces, the first 5 days of recording, and by the 40th day it almost equaled that of Bukhara-102 and was 9.6 pieces per plant. The growth rate of the variety, therefore, the formation of fruit branches in the process of vegetation slowed down. The number of buds per plant in Namangan-34 was in the first term of registration 3 pcs. the maximum, on day 20–11 pcs., and by the end of the budding phase was 1.5 pcs. In the C-65 variety 24 the number of buds was 3.5 pieces, and by the end of the budding phase, 1.8 pcs. on one plant. In the Bukhara-102 variety, 1.9 and 1, respectively, in the low-growth Omad variety, the number of buds was 2.5 pcs at that time and 1.7 pcs. per 1 plant (Figure 1–2–3–4).

The obtained data indicate that the C-65 24 variety has the most number of simpodia and buds in comparison with other varieties. In order of decreasing the number of simpodia and buds, the remaining varieties are as follows: Namangan-34, Omad and Bukhara-102. As the growth and development to the flowering phase in the recording period, the maximum number of flowers per plant in Namangan-34 is on August 22, and for C-65 24, Bukhara-102 and Omad on August 18: in all varieties of approximately 2 flowers per plant on average.

The microelements of boron in the form of H_3BO_3 and copper in the form of a salt of $CuSO_4$ were added to the basic fertilizers and studied the physiological and biochemical effect on the formation of fruit branches and organs. Apparently, they positively influence the formation and growth of the sympodial branches of all varieties.

Thus, the action of microelements depends not only on the dose of application, but has a genetic specificity. The same pattern of boron activity was noted for the Omad variety, but one norm of this trace element proved to be more effective.

Based on the results, it should be noted that under the influence of microelements, the number of simpodia increases in all varieties of cotton.

It was found that the influence of copper on the number of sympodial branches of cotton of the studied varieties was larger compared to boron both in the beginning and in the period of mass budding. Under the influence of copper at a dose of one norm, the number of simpodia increased on average per plant in the order of decreasing effect of Namangan-34, C-65 24, Bukhara-102 and Omad. Under the influence of boron in a dose of 2 norms, the number of simpodia also increased, especially in Namangan-34 and C-65 varieties 24. During the period of fruit formation, the regularity of the influence of trace elements on the number of simpodia persisted.

Conclusions. Thus, a positive effect on growth and development was expressed in an increase in the number of simpodia in plants in experimental versions, in all the periods studied. During the vegetative period, a greater positive effective influence of copper on the rates of fruit formation was noted. The action of boron on the formation of the capsules was greater in comparison with copper. Also, varieties have not the same need for trace elements and different ability to absorb and transform them, which ultimately affected the yield. The greatest positive effect of copper and boron in optimal doses had to improve the yield of Namangan-34.

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CREATION OF THE INFINITE ALGEBRAIC *K* – FUNCTORS OF THE P. II

Abstract: At the solution of various problems of algebraic topology it is useful to have a design of the classifying space [1, 103–109].

In language of simplicial sets creation of a functor from category of nilpotent subalgebras is carried out to category of conditionally minimum flags. Theorems are proved: about existence of a minimum flag in a set *K* – admissible flags, about nilpotent subalgebras and their corollary.

Keywords: simplex, algebra, subalgebras, flag, module, homomorphism, isomorphism.

Let A – an associative ring with identity, A^N – the free A – the module over a ring A, then tops in $G_N(A)$ we will call various decomposition A^N – the free N – the measuring module in the ordered direct sum of projective submodules: $A^N = P \oplus Q$, where P,Q – projective submodules of the module A^N, $(P,Q) = a$ we will designate as tops – there are zero-dimensional simplexes in sets $G_N(A)$ and $V_{N,K}(A)$ [2, 81–83].

Let's use some concepts and the definitions given in [5, 13–16], which will be necessary at the proof of the theorem formulated in work [3, 567–572].

Theorem 1. The set D_k^* has a minimum flag.

Proof

We will deliver to each flag $F \in D_k^*$ in compliance integer function $f(e_1,...,e_k,P_1,...,P_{l+1})$ as follows: if N – length of a flag F and $e_j \in F_i, e_j \notin F_{i+1}$, then, $f(e_j) = N - i$ $(A^N = F_0)$ similarly if $P_k \in F_i, P_k \notin F_{i+1}$, that $f(P_k) = N - i$. On the contrary, on each such function it is possible to restore the flag F defining it unambiguously.

Let $N_1 = \max\limits_{\substack{i=1,...,k \\ j=1,...,l+1}} \{f(e_i), f(P_j)\}$, then the arbitrariest module, $n = 0,1,...,N_1$ of a flag F is defined so: $F_{N_1-n} = \oplus\limits_{i,j}\{e_i, P_j : f(e_i) \le n, f(P_j) \le n\}$.

Let's define on a set of all integer functions $\tilde{D}_k^*$ of flags $F \in D_k^*$ integer function: $\mathrm{f}_{inf}(e_i) = \inf\limits_{\mathrm{f} \in \tilde{D}_k^*} \mathrm{f}(e_i), \mathrm{f}_{inf}(P_j) = \inf\limits_{\mathrm{f} \in \tilde{D}_k^*} \mathrm{f}(P_j)$. Let's designate the flag corresponding to the constructed function f_{inf} through we F_{inf}. Will show that $F_{inf} \in D_k^*$.

Let's consider the arbitrariest vector e_j, we will take such integer function f, as $\mathrm{f}(e_j) = \mathrm{f}_{inf}(e_j)$ and $F = \{A^N = F_0 \supseteq F_1 \supseteq ... \supseteq F_m \supseteq 0\}$ – a flag corresponding to function f. Let $\mathrm{f}(e_j) = i$, then $e_j \in F_m, e_j \notin F_{m-i+1}$. If shows $\{e_k\}$ and P_n the arbitrariest modules from F_{m-i+1}, then $\mathrm{f}_{inf}(e_k) \le \mathrm{f}(e_k) < i, (P_n) \le \mathrm{f}(e_n)$. This

reasoning that $e_j \in F_{N_2-i}, e_j \notin F_{N_2-i+1}$ in a flag $F_{inf} = \{A^N \supseteq ... \supseteq F_{N_2-i} \supseteq F_{N_2-i+1} \supseteq ... \supseteq F_{N_2} \supseteq 0\}$, the similar reasoning is fair for the arbitrariest module $P_k, k = 1,...,l+1$, then we $F_{inf} \in D_k^*$.

Will show minimality of a flag F_{inf} in D_k^*.

Let $F_{inf} = \{A^N \supseteq ... \supseteq F_i \supseteq F_{i+1} \supseteq ... \supseteq 0\}$ the flag be not minimum, i.e. it is possible to delete from it some module $F_i \neq i$ so that the received flag $F' = \{A^N \supseteq ... \supseteq F_i \supseteq F_{i+1} \supseteq ... \supseteq 0\}$ will be an element of a set we D_k^*. Will designate the function corresponding to a flag F' through f', then function is not minimum. Really, on elements $e_j, P_s \in F_k, e_j, P_s \notin F_{k+1}$ in a flag $F_{inf}, k > i, \mathrm{f}'(e_j) < \mathrm{f}_{inf}(e_j)$, $\mathrm{f}'(P_s) < \mathrm{f}_{inf}(P_s)$. The Received contradiction proves minimality of a flag F_{inf}.

Remark 1. If the module Q in flags $F \in D_k^*$ is fixed, then the flag F_{inf} is, apparently, the single minimum flag for a set D_k^*.

Let's consider some definitions according to work [5, 13–16].

Definition 1. Let (P_1, Q) and (P_2, Q) tops in $G_N(A)$, then exists φ – a homomorphism A - modules: $\varphi : P_1 \to Q$: $P_1 \oplus Q \to P_2 \oplus Q$ and any element $x \in P_1$ passes into an element $x + \varphi(x) \in P_2$, then the module P_2 is calleda module projection P_1 on display φ along the module Q.

Definition 2. Linearly serially finite sets of tops $(a_0, a_1, ..., a_n)$ in $G_N(A)$ and $(b_0, b_1, ..., b_n)$ in $V_{N,K}(A)$ is called nilpotent and K – nilpotent respectively [4, 20–22]. The nilpotent algebra $NA(a_0, a_1, ..., a_n)$ is generated by operators $\varphi_i, \psi_i, i = 1,...,n$, which define display: modules P_0, Q_0 tops a_0 in modules P_i, Q_i tops a_i.

Let σ substitution at a set of tops $a_0, a_1, ..., a_n$, interchanging the position only of two tops a_0, a_i, similarly through σ we will designate substitution at a set of tops $b_0, b_1, ..., b_n$, interchanging the position only of two tops b_0, b_i, then theorems [3, 567–572] which proofs we will provide are fair.

Theorem 2. Let $NA(a_0, a_1, ..., a_n)$ a nilpotent subalgebra for a nilpotent set of tops $(a_0, a_1, ..., a_n)$ from $G_N(A)$ and Σ_{n+1} a permutation group $n+1$ of elements, then for any substitution $\sigma \in \Sigma_{n+1}$ equality is fair: $NA(a_0, a_1, ..., a_n) = NA(a_{\sigma(0)}, a_{\sigma(1)}, ..., a_{\sigma(n)})$.

Theorem 3. Let $NA_k(b_0, b_1, ..., b_n)$ K – a nilpotent subalgebra for K – a nilpotent set of tops from $V_{N,K}(A)$ and Σ_{n+1} a permutation group $n+1$ of elements, then for any substitution $\sigma \in \Sigma_{n+1}$ equality is fair: $NA_k(b_0, b_1, ..., b_n) = NA_k(b_{\sigma(0)}, b_{\sigma(1)}, ..., b_{\sigma(n)})$.

Proofs

Let $\varphi_i' : P_i \to Q_i$ a homomorphism of modules that the module P_0 is a module P_i projection along the module Q_i, similarly $\psi_i' : Q_i \to P_i$ – a homomorphism of modules that the module Q_0 is a module projection Q_i along the module P_i at this homomorphism, then by analogy:

$\varphi_j' : P_i \to Q_i$, $\psi_j' : Q_i \to P_i$, $j = 1,...,n$, $j \neq i$ are defined as such homomorphisms of modules, that the module P_j is a module projection P_i along the module Q_i, at a homomorphism φ_j', and the module Q_j – a module Q_i projection along the module P_i at a homomorphism ψ_j'. Can easily be proved, that homomorphisms φ_i', ψ_i' as follows are expressed through φ_i, ψ_i:

$$\varphi_i' = \left[1 - (1+\varphi_i)\cdot(1-\psi_i\cdot\varphi_i)^{-1}\right]\cdot(1-\psi_i),$$

$$\psi_i' = \left[1 - (1+\psi_i)\cdot(1-\varphi_i\cdot\psi_i)^{-1}\right]\cdot(1-\varphi_i).$$

It is possible to check that display of the module P_0 in the module P_j along the module Q_i on display $\varphi_i : P_0 \to Q_0$ is expressed on a formula: $1 + (1+\psi_i)\cdot(1-\varphi_j\cdot\psi_i)^{-1}\cdot\varphi_j$. Display φ_j' of the module P_i in the module P_j along the module Q_i is composition of display φ_i' of the module P_i in the module P_0 along the module Q_i and display: $1 + (1+\psi_i)\cdot(1-\varphi_j\cdot\psi_i)^{-1}\cdot\varphi_j$ the module P_0 in the module P_j along the module Q_i:

$$1 + \varphi_j' = \{1 + \left[1 - (1+\varphi_i)\cdot(1-\psi_i\cdot\varphi_i)^{-1}\right]\cdot$$
$$\cdot(1-\psi_i)\}\left[1 + (1+\psi_i)\cdot(1-\varphi_j\cdot\psi_i)^{-1}\cdot\varphi_j\right]\cdot(1+\psi_i).$$

Display $1+\varphi_j'$ is written down in coordinate modules P_0, Q_0 of the module $A^N = P_0 \oplus Q_0$. Action of display $1+\psi_i$ on module elements P_0 identically. Display $1+\psi_i$ transfers module elements Q_0 to module elements Q_i, so action of displays:

$1+(1+\psi_i)\cdot(1-\varphi_j\cdot\psi_i)^{-1}\cdot\varphi_j, 1+\left[1-(1+\varphi_i)\cdot(1-\psi_i\cdot\varphi_i)^{-1}\right]\cdot$ $\cdot(1-\psi_i)$ sets an identity mapping on the module Q_i, i.e. display φ'_j displays the module Q_i in zero.

Replacing displays φ_i,φ_j to displays ψ_i,ψ_j and ψ_i,ψ_j on φ_i,φ_j in a formula for $1+\varphi'_j$, then

$$1+\psi'_j=\left\{1+\left[1-(1+\psi_i)\cdot(1-\varphi_i\cdot\psi_i)^{-1}\right]\cdot(1-\varphi_i)\right\}\cdot$$
$$\cdot\left[1+(1+\varphi_i)\cdot(1-\psi_j\cdot\varphi_i)^{-1}\cdot\psi_j\right]\cdot(1+\varphi_i).$$

Let $NA'(a_i,...,a_0,..)$ the subalgebra generated by homomorphisms: $\varphi'_i,\varphi'_j,\psi'_i,\psi'_j,\ j=1,...,n,\ j\neq i$. K – the nilpotent subalgebra $NA_k(b_0,b_1,...,b_n)$is generated by operators $G_i,\varphi_i,\psi_i,\ i=1,...,n,$ who define displays of modules $P_0=\{u_1^0,...,u_k^0\},Q_0$ in modules $P_i=\{u_1^i,...,u_k^i\},Q_i$. Let σ – substitution at a set of tops $(b_0,b_1,...,b_n)$, which rearranges in places only two tops we b_0,b_i. Let's designate through operators $\varphi'_i,\psi'_i,\ G'_i$ who translate modules P_i,Q_i tops b_i in modules P_0,Q_0 tops b_0. These operators are defined similar to operators $\varphi_i,\psi_i,\ G_i$. Through $\varphi'_j,\psi'_j,\ G'_j, j=1,...,n, j\neq i$ we will designate operators who define displays of modules $P_i=\{u_1^i,...,u_k^i\},Q_i$ of top $b_i=(u_1^i,...,u_k^i,Q_i)$ in $P_j=\{u_1^j,...,u_k^j\},Q_j$ modules of top $b_j=(u_1^i,...,u_k^i,Q_j)$. Operators $\varphi'_i,\psi'_i,\varphi'_j,\ \psi'_j,\ j=1,...,n,\ j\neq i$ coincide with similar operators for a subalgebra $NA'(a_i,..,a_0,..)$. The operator G'_i is the difference of two operators: the operator who transfers basis $u_1^i,...,u_k^i$ of the module P_i to basis $u_1^0,...,u_k^0$ of the module P_0 and the operator $1+\varphi'_i$, where the operator φ'_i designs the module P_i on the module P_0 along the module Q_i. It is easily possible to check that the operator G'_i says through operators φ_i,G_i,ψ_i :

$$G'_i=(1-\varphi_i)\cdot G_i\cdot(1+\varphi_i)-\psi_i\cdot\varphi_i\cdot(1+G_i)\cdot(1+\varphi_i).$$

The operator G'_i is the difference of operators: the operator of the module $P_i$translating basis $u_1^i,...,u_k^i$ in basis $u_1^j,...,u_k^j$ of the module P_j and the operator $1+\varphi'_j$, where the operator φ_j designs the module P_i in the module P_j along the module Q_i, therefore he says through operators $\varphi_i,\psi_i,G_i,\varphi_j,\ \psi_j,G_j, j=1,...,n$ on a formula: $1+G'_j=(1+G_j)\cdot(1+\varphi_j)\cdot(1-\varphi_i)\cdot(1-G_i)$,

$\{1+\left[1-(1+\varphi_i)\cdot(1-\psi_i)\right]\cdot(1-\psi_i)\}^{-1}$,
$\left[1+(1+\psi_i)\cdot(1-\varphi_j\cdot\psi_i)^{-1}\cdot\varphi_j\right]^{-1}$.

Представим, операторы $\varphi'_i,\psi'_i,\varphi'_j,\ \psi'_j,G'_i,G'_j$ через линейные части от операторов $\varphi_i,\psi_i,\varphi_j,\ \psi_j,G_i,G_j, j=1,...,n, j\neq i$: $\varphi'_i=-\varphi_i+...$, $\psi'_i=-\psi_i+...$, $\varphi'_j=-\varphi_i+\varphi_j+...$,

$\psi'_j=-\psi_i+\psi_j+...$, $G'_i=G_i+...$, $G'_j=G'_j-G_i+...$

Let's present, operators $\varphi'_i,\psi'_i,\varphi'_j,\ \psi'_j,G'_i,G'_j$ through the linear parts from operators $\varphi_i,\psi_i,\varphi_j,\ \psi_j,G_i,G_j, j=1,...,n, j\neq i$: $\varphi'_i=-\varphi_i+...$, $\psi'_i=-\psi_i+...$, $\varphi'_j=-\varphi_i+\varphi_j+...$, $\psi'_j=-\psi_i+\psi_j+...$, $G'_i=G_i+...$, $G'_j=G'_j-G_i+...$

It is easy to prove that transition $\varphi_i,\psi_i,\varphi_j,\ \psi_j$, from forming generating a subalgebra $NA(a_0,a_1,...,a_n)$ to new forming $\varphi'_i,\psi'_i,\varphi'_j,\ \psi'_j$, sets an isomorphism of a subalgebra $NA(a_0,a_1,...,a_n)$, the similar statement is fair for K – a nilpotent subalgebra $NA_k(b_0,b_1,...,b_n)$, generated by homomorphisms $\varphi_i,\psi_i,G_i,i=1,...,n$.

Corollary 1. (theorem 2.) Let the investment $(a_{i_0},...,a_{i_k})\subset(a_0,a_1,...,a_n)$ of nilpotent subsets of tops from $G_N(A)$, then be available an investment of nilpotent subalgebras: $NA(a_{i_0},...,a_{i_k})\subset NA(a_0,a_1,...,a_n)$.

Proof

Let's rearrange tops $a_0,a_1,...,a_n$ so that tops $a_{i_0},...,a_{i_k}$ were the first in this list of tops, i.e. it is possible to assume that inclusion takes place (after a feather – numbering of tops):
$(a_0,a_1,...,a_k)\subset(a_0,a_1,...,a_k,a_{k+1},...,a_n), k<n$. To each deletion $a_i, i>k$ of top in a nilpotent set of tops $a_0,a_1,...,a_i,...,a_n$ there corresponds deletion of couple of generating homomorphisms φ_i,ψ_i in nilpotent algebra $NA(a_0,a_1,...,a_i,...,a_n)$ and therefore takes place, an investment of nilpotent subalgebras:

$$NA(a_0,..,\widehat{a}_i,..,a_n)\subset NA(a_0,..,a_i,..,a_n).$$

After deletion sequentially of tops $i=k+1,...,n$ we will receive an investment of subalgebras: $NA(a_{i_0},...,a_{i_k})\subset NA(a_0,a_1,...,a_n)$ the similar corollary can be proved for K – nilpotent subalgebras:

Corollary 2. (theorem 3.) Let $(b_{i_0},...,b_{i_k})\subset(b_0,...,b_n)$ the investment K – nilpotent

subsets of tops from $V_{N,K}(A)$, then be fair an investment K – nilpotent subalgebras:

$$NA_k\left(b_{i_0},...,b_{i_k}\right) \subset NA_k\left(b_0,...,b_n\right).$$

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ABOUT SOME TASKS OF THE THEORY OF NUMBERS

Abstract: The decision is provided in the present article, belonging to Goldbach Euler's problem, put by them in 1742.

Famous mathematicians were engaged in this task Bukhshtab, LiNIK, etc. Bukhshtab solved a for $N = p_1 + p_2 p_3 p_4$
the author solves for $N = p_1 + p_2$

Keywords: any even number is representable in the form of the sum of two prime numbers.

I. Generalization of Dirichlet`stheorem on primes in arithmetic progressions

Lets consider equation (1)

In follows we need the generally known Lemma (Dirichlet).

In arithmetic progressions

$$ax + b, (a,b) = 1 \qquad (1)$$

there are infinitely many prime numbers

Remark 1

lets examine the equation (1) and consider the cases

1a

a_1, a_2 are odd numbers, b_1, b_2 numbers of different parity

There are no solution if p_1, p_2 are od premes

1b

a_1, a_2 are odd numbers, b_1, b_2 numbers of different parity a solution is possibie

1c

a_1, a_2 even numbers, b_1, b_2 od numbers a solution is possible

2a

a_2 even, a_1 odd, b_1 is any numbers, b_2 odd a solution if p_1, p_2 are odd primes

2b

a_2 even, a_1 odd, b_1 is any number, b_2 even

No solution is possible if p_1, p_2 are odd primes

Remark 2

Lemma (Dirichlets) deals with one arithmetic progression

Lets generalize Lemma Dirichlets for two arithmetic progressions simultaneously there are.

In this form if In cases 1b,1c,2a we hypothesize-equation (1) has infinitely many solutions in prime numbers by fixed

$$a_1, a_2, b_2, i$$

By

$$a_1 = a_2 = 1, b_1 - b_2 = 2k \quad b_1 b_2$$

numbers of the same parity

We have

$$p_1 - p_2 = 2k \qquad (2)$$

Or hypothesis (1)

$$a_i > 0, \quad b_i \neq 0, \quad (a_1, b_1) = 1,$$
$$i = 1,2...$$
$$b_i -$$

of the same parity so there are infinitely many natural numbers x for which

$$a_i x + b_i, \quad (i = 1,2)$$

are simultaneously primes see the proof Theorem 1.

It holds Theorem 1. Remark 1 implies that in cases 1a, 2b for the equation (1).

In cases 1b,1c,2a in arithmetic progressions

$$a_i x + b_i, \quad (i = 1,2)$$

1. There are no natural numbers x for which are simultaneously primes

or

$$a_i x + b_i, \quad (i = 1,2)$$

2. There are infinitely many natural numbers x for which, are simultaneously primes

$$a_i x + b_i, \quad (i = 1,2)$$

The proof.

The first part of the theorem1 results from the remark1.

Lets proced to the proof of the second part of the theorem1.

From the conditions of the theorem follows

$$p_1 = a_1 x + b_1, \quad (a_1, b_1) = 1, \quad b_1 \neq 0 \qquad (3)$$

$$p_2 = a_2 x + b_2, \quad (a_2, b_2) = 1, \quad b_2 \neq 0 \qquad (4)$$

From (3) and (4) follows

$$x = \frac{p_1 - b_1}{a_1} \qquad (5)$$

$$x = \frac{p_2 - b_2}{a_2} \qquad (6)$$

From (5) and (6) we have

$$a_2 p_1 - a_1 p_2 = b_1 a_2 - a_1 b_2 \qquad (7)$$

from hypothesis for the equation (1) in cases 1b, 1a, 1c, 2a and (7) ensus theorem

At $a_1 = a_2, \quad b_2 = b_1 \neq 0.$ we have $p_1 = p_2$

Or Lemma (Dirichlets) Lest consider the equation

$$p_1 - p_2 = 2k \qquad (8)$$

p_1, p_2 – are primes, k is any fixed natural number. We hypothesize-equation (8) has infinitely many solutions in prime numbers by any fixed k. See also [1, p. 367]

Theorem 2 holds

In progressions (3) and (4) in cases 1b, 1c, 2a there are infinitely many primes. The Proof. From (3) and (4) follows

$$p_1 + p_2 = (a_1 + a_2)x + b_1 + b_2 \qquad (9)$$

$$p_1 - p_2 = (a_1 - a_2)x + b_1 - b_2 \qquad (10)$$

Assume the contrary progressions (3) and (4) contain a finite number of primes. Then from (9) and (10) follows that x is a limited number what contradicts the definition ofprogression (3) and (4).

The theorem is proved.

II. Problem of Goldbach-Euler or problem of twin prim

Theorem 3 holds (Khusid)

All solutions of the equation

$$p_1 + p_2 = N \qquad (11)$$

with primes p_1, p_2 are expressed by formulas

$$p_1 = N/2 + k \qquad (12)$$

$$p_1 + p_2 = (a_1 + a_2)x + b_1 + b_2 \qquad (9)$$

$$p_2 = N/2 + k \qquad (13)$$

Where k = 1,2, 3…

N = 6, 8, 10…

The prove:

From (11) follows

$$p_1 + p_2 - 2p_2 = N - 2p_2 \qquad (14)$$

or

$$p_1 - p_2 = N - 2p_2 \qquad (15)$$

Assume

$$N - 2p_2 = 2k \qquad (16)$$

or

$$p_2 = N/2 - k \qquad (17)$$

From (11), (17) follows

$$p_1 = N/2 + k \qquad (18)$$

From(17), (18) we have

$$p_1 - p_2 = N/2 + k - N/2 + k = 2k \qquad (19)$$

$$p_1 + p_2 = N/2 + k + N/2 - k = N \qquad (20)$$

$$k = 1,2,3... \; N = 6,8,10...$$

(19),(20) is a special case (9),(10) atx = N/2,

$$a_1 = a_2 = 1$$

$$b_1 = k, \quad b_2 = -k$$

Theorem 4

Hypothesis of Goldbach-Euleris correct andhypothesis of primes is correct too.

Definition:

Two primes p_1, p_2 are called twins of k-order if

Two primes p_1, p_2 are called twins of k – order if

$$p_1 - p_2 = 2k \qquad (21)$$

Example

3, 7; 7, 11 are twins of the second order

3, 5; 5, 7 are twins of the first order or normal twins erc.

Lets proceed to the proof:

From (12), (13), (19), (22), (21) of the theorem 2 follows that for any fixed k numbers from (19)

There are infinitely many N from (20), and this proves the theorem.

Example:

If $k = 1,$ then (17), (18) looke like this:

$$p_1 = N/2+1 \quad (22)$$

$$p_2 = N/2-1 \quad (23)$$

From(23),(24) wehavefollowing chart

Table 1.

k	N	p_1	p_2
1	8	5	3
	12	7	5
	24	13	11
	36	19	17
	60	31	29

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Setion 3. Mechanical engineering

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STUDY OF HEAT PROCESSES OF ROCK CUTTING (ROCK CUTTERS) TOOL

Abstract: The results of the carried out researches show that increase of the exploitation characteristics of the down-hole cutting tools depend on the cutting ability of the tool. The set up task requires all – round researches of the forces influencing the cutting capacity of the tool. It is known that cutting edges (components) of the rock cutting tool are faced with composition material. Carried out researches showthat efficiency of the cutting ability also depends on the position of the rollers (edges) and wear resistance the cutting tool. Rational distribution of the forces on the roller can significantly influence the bit sinking-drifting too. That is why study of the revealing and character of various factors and their complexes affecting heat regime of cutting tool is of great interest.

For the reliability of the set up task the research simulating the rock cutting process in the drilling has been carried out under the laboratory conditions. As a result of the research rational characteristics affecting more favorable conditions of the bit sinking have been determined. The obtained results allow to recommend rational form of the facing of the cutting edges (rollers) in designing and manufacturing of the bit.

Keywords: rock cutting, load, stress, cutting elements, drilling bit, rock.

Introduction: One of requirements made to the bit cutting ability is the biggest sinking along the rock depending on the condition of the strength of cutting tool in the drilling process [1–4].

Study of the laws of heat formation and heat distribution on the edges of cutting tool helps to reveal essence of many phenomena accompanying drilling processes and make more effective technical decisions.

Solution of this task and gelling more precise results in small expenditure can by achieved experimentally.The goal of the experimental research is establishment relations between various factors revealing objective regularities characterizing influence of many data on the studied process.

The main part: Process of cutting the rock s multifactor. That's why research is expedient to carry out applying methods of rational planning of the experiment.

Choice of a number the necessary factors for carrying out experiments by this method is enough for

solution of the set up task with the required accuracy. This method allowed to cut down the volume of experimental research to 25.

The system of interorthogonal cubes has been used for main factors defining heat regime of rock cutting process. Research of heat regime of rock cutting instrument has been carried out under the laboratory conditions simulating drilling process.

For defining sizes of the model corresponding to the natural one scale factors have been determined [1].

Models of the bit have been subjected to the testing in various drilling regimes. In this case the following regime parameters have been changed: rotation frequency of the bit (rad/sec); diameter of model samples of the bit (mm); axial loading on the bit (KH); relation of rock hardness and bit materials, the time of the contact of the bit with the rock (sec.) the types of the cooling medium and their density (kg/m^3), pump feeding for liquid consumption (m^3/sec); and compressor feeding for air consumption (m^3/sec) (table 1).

This installation has a significant advantage in comparison with other ones which were tested. It allows to control feeding of flushing fluid air and to measure the temperature rather precisely. The installation has also been equipped with measuring devices, its assembling and disassembly don't cause any difficulties [2].

The results of the experimental researches carried out on the installation have corresponded to the development of the algorithm prognosing the character of the formation of artificial temperature field of the bit. The obtained information was used to estimate the role of each of the considered parameters in the formation of temperature field allowing to classify them due to their significance.

Achievement of the goal has been obtained at the expense of the use of the method of samples recognition based on the use of one – dimensional nonlinear transformation [3]. Due to this method the prognoses has the following form:

$$\varphi_1 = f\left(X_1, X_2, X_3 .... X_n\right) = Z\left[\sum_{i=1}^{n} \varphi_i\left(X_i\right)\right] \quad (1)$$

Where φ_i – are one dimensional monotone functions

X_i – are variable initial parameters

Z – is output parameter of the function.

Table 1.

Factors	Levels of factors				
Bit rotation (X_1)rad/sec.	3.3	4.7	6.6	8.4	12
Diameter of bit model (X_2) mm	26	32	35	50	55
Axial (longetudince) loading (X_3) kH	0.98	2.0	3.15	4.68	6.4
Relation of rock hardness and bit material (X_4)	0.30	0.45	0.60	0.75	0.90
Contact time of the bit with the rock (X_5), sec	60	120	120	248	300
Types of the cooling medium and their density (X_6), kg/m^3	Air 1000	Water 1300	Aero-water 1600	Drilling 1900	Dry 2200
Pump feeding (fluid consumption) (X_7), m^3/sec	0.0031	0.0047	0.0064	0.0075	0.010
Compressor feeding (air consumption) (X_8), m^3/sec	0.0004	0.0006	0.0008	0.0010	0.0011

As a result of the research dependence between value φ on values X_i table 10 has been determined, as the graphics of function $\varphi_i\left(X_i\right)$ is of great interest in the set up task (fig. 1)

The form of these functions allow both qualitatively to evaluate the character of the influence of variables X_i on the prognosized value – the temperature in the zone of interaction of the bit with the rock. It is supposed that change of each variable is considered in an invariable values of the rest variables.

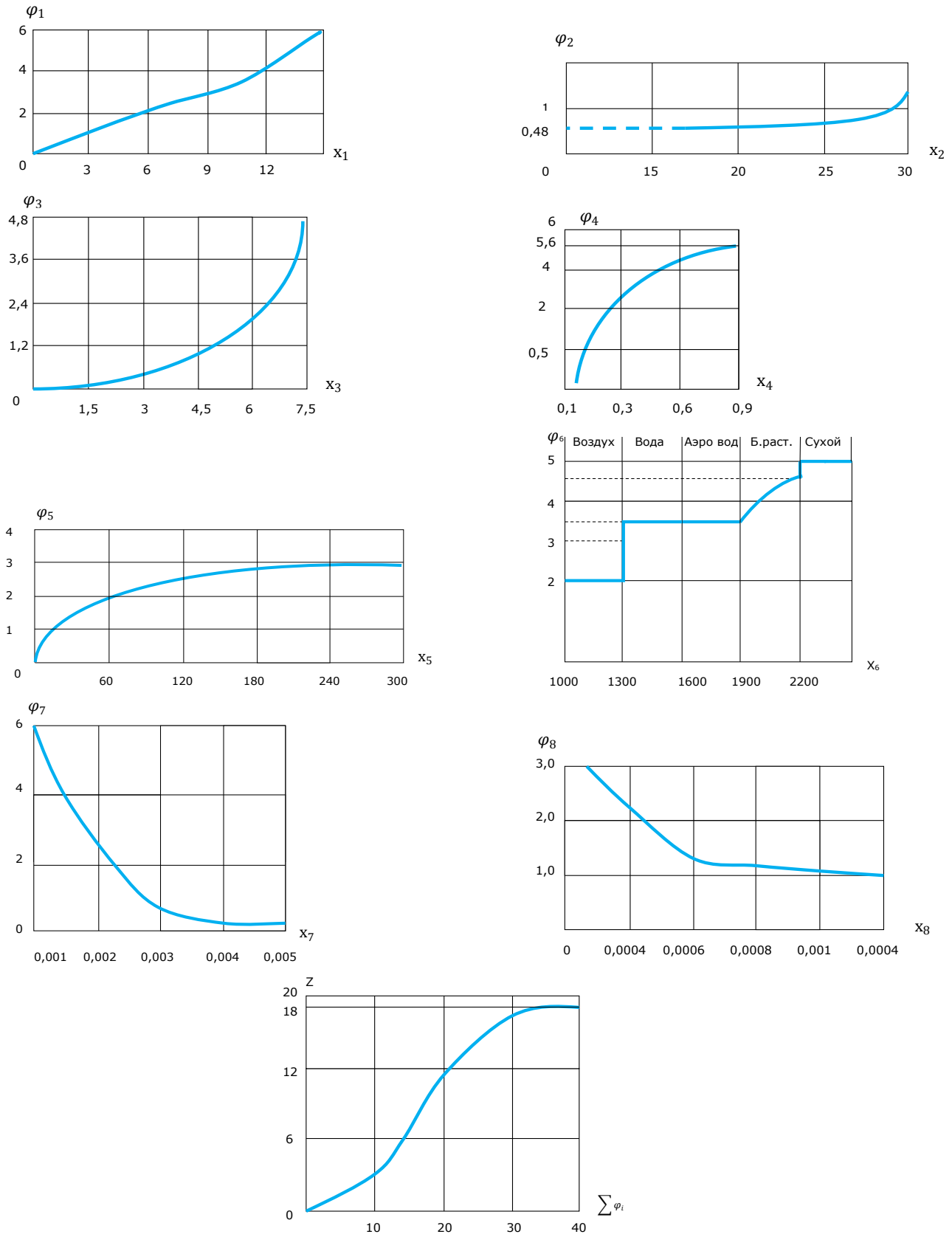
φ1
6
4
2
0
3
6
9
12
x1
φ2
1
0,48
0
15
20
25
30
x2
φ3
4,8
3,6
2,4
1,2
0
1,5
3
4,5
6
7,5
x3
φ4
6
5,6
4
2
0,5
0,1
0,3
0,6
0,9
x4
φ5
4
3
2
1
0
60
120
180
240
300
x5
φ6
Воздух
Вода
Аэро вод
Б.раст.
Сухой
5
4
3
2
1000
1300
1600
1900
2200
x6
φ7
6
4
2
0
0,001
0,002
0,003
0,004
0,005
x7
φ8
3,0
2,0
1,0
0
0,0004
0,0006
0,0008
0,001
0,0004
x8
Z
20
18
12
6
0
10
20
30
40
∑φi

Figure 1.

As it is seen from figure 1 functions $\varphi_1 = f(X_1)$ estimated according to a special computer program were rather different due to their scope – from minimum to maximum. It means that all factors taken for the research influence significantly on the prognosis and that is why exception of any of further consideration would be incorrect decision. Although the degree and character of this influence are different and it is confirmed by the behavior of the functions.

However the given graphics have a number of common features. As a rule, they are considerably non- linear and have zones of sensibility, where change of the data doesn't influence on the prognosis (fig. 1)

Not the least practical condition while using this method was the prognosis has been carried out on the basis of only graphics of the functions Z and $\varphi i(Xi)$.

The prognosis is carried out due to the following sequence. According to the graphics of variability of the studied factors the functions $\varphi i(Xi)$ are determined.

$(i = 1,2,3,\ldots n)$, then due to $\left|\sum_{i=1}^{n} \varphi i(Xi)\right.$ output function Z is determined, then due to $Z\left[\sum_{i=1}^{n} \varphi i(Xi)\right]$

The temperature is calculated. During the process the weight of separate factors in the formation of quantative indices of temperature field are determined.

Availability of such information allows to work out complex arrangements (constructive, geologic – technical and technological) on the reduce of influence of temperature factor in the process of drilling and cutting the rock in making deep wells. In it is turn it allows to synthesize optimal decisions on the increase of work resource of the bit in well bottom, reduce of the volume of dissent-lift operations and decrease of the cost indices of well drilling.

Conclusion

1. The obtained results allow to prognosis temperature loading of well bottom tools in their exploitation process.

2. Prognosis values can be basic for making decisions on the decrease of temperature loading of the tool by controlling the process parameters.

3. The results of the research can be used in the construction of oil and gas wells of various orientations.

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HEAT PROCESSES ON THE CONTACT AREA OF THE DOWN-HOLE MILLING TOOLS

Abstract: Influence of the convection heat exchange in the contact area of down- hole milling tool on the cutting ability has been investigated.

Keywords: Cutting edges of the mills, milling tool, heat exchange.

Introduction: It is known that high temperature occurring on the cutting surface accelerates the wearing process of the tool and reduces work efficiency [1].

Set up task: Study of the heat conductivity distribution on the surface of down-hole milling tool.

Task solution: Theoretical researches of the milling conditions on the community basis of heat conductivity laws. Heat distribution formed on the surface of mill-metal is described by two equations of heat balance and heat conductivity. For milling equation of heat balance is presented in the form:

$$Q_0 = Q_\partial + Q_T + Q_{O.C} + Q_{cut} + Q_{well} = Q_1 + Q_2 + Q_{ch} + Q_e (1)$$

Where Q_0 istotalheat. Q_{cut} – is equivalent heat spent on metal cutting

Q_T – is equivalent heat corresponding to the friction on the contact surface of the tool;

$Q\partial$ – is equivalent heat, corresponding to deformation of the cutting layer;

$Qs.c.$ – is equivalent heat corresponding to the burnishing of chips;

Q_{well} – is equivalent heat of the well total heat Q_0 in any way transfers to the mill (1) Q_1, then to the processed metal (2) Q_2, chip Q_{ch} and environment Q_e (fig.1).

Heat separated from the active area is equivalently spent on milling and determined due to the formula:

$$Q_0 = \frac{\delta F_z v}{427S} \quad (2)$$

Where F_z – is tangential main force of milling v – is rotation frequency of the mill σ – is a coefficient considering uneven distribution of specific force on the contact area S – is total contact area of mill with milling material.

For simplifying the task with the known approximation let's consider the heat exchange in the objects of mill (1) and metal (2). That's why interacting objects- mill and processed metal are presented in the form of cylinder. Consequently these two factors are thermally connected in the direction of Z axis with columns of drilling and break-down pipes having relatively unlimited dimensions on the contact surface (in the horizontal direction it has restriction). In these conditions due to V. V. Tompson, influence of heat exchange of external surfaces of the mill and processed material can be disregarded. Mathematical description of temperature field of the considered conditions of the milling of metallic objects can be presented on the basis of general laws of heat conductively. To determine the reliability of theoretical data, ex-

periments were carried out. Samples of the circular mill used as a composition material and processed material have been prepared. Experimental installation and model samples used for research process have been described in [2]. The processed sample 2 made from steel 40XH has been equipped with the heads of thermocouples in various radii and distances from axis *Z* and *X* correspondingly (fig.1).

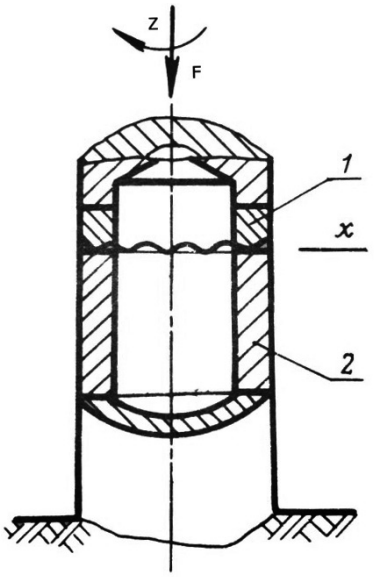

Figure 1. Calculated heat scheme of milling (chromium-nickel alloy)

Artificial thermocouple chromel – copper has been used in the milling process to measure the temperature. While processing the sample milling plane was approaching the junction and thermocouples recorded the temperature. The research results have been presented in the graphics (fig. 2). Milling regime has been corresponded to the model conditions of the milling process: specific loading on the mill is 20kH, rotation frequency of the mill is 185 rot/min. Location of thermocouples in the sample allowed quantitively to valuate temperatures change depending on the radius. This change is not significant (total 11%) [3]. The obtained regime data allow scientifically to justify the construction of the cooling system of down – hole mills. Divergence between theoretical and experimental data (no more 11%) testified accuracy of theoretical decisions mentioned above.

Conclusion

1. Carried out researches on the milling process allow to evaluate heat processes taking place on contact surfaces of mill-metal.

2. The obtained experimental data allow scientifically justifying the construction of the cooling system of down-hole mills.

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Section 4. Technical science

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INVESTIGATION OF AQUEOUS SYSTEM FROM METHYL ACETATE, MONOETHANOLAMINE, UREA AND AMMONIUM NITRATE

Abstract: Physicochemical justification of liquid fertilizer process based on urea-ammoniac saltpetre by introduction in its composition of physiologically active substance.

Keywords: methyl acetate, mono ethanol amine, N – acetylethanolamine, urea, ammonium nitrate, solubility chart, "composition-property" graph.

Introduction

At JSC "Navoiazot" in the production of synthetic food acetic acid, as a by-product a volatile fraction with composition (mass.%): acetic acid 26.0–27.0; formic acid 4.0–8.0; methyl acetate 1.0–2.0; the rest is water is formed [1]. In the production of one ton of acetic acid, 0.87–0.90 kg of such waste is generated. At JSC "Navoiazot" acetic acid of the order of 8.0–10.0 thousand tonnes is produced in a year. Thus, the enterprise generates 7.0–7.2 tons of volatile fraction per year. The volatile fraction contains monocarboxylic acids, which can be used to prepare physiologically active substances by treating it with monoethanolamine. The resulting physiologically active substances are modified complex preparations possessing highly effective stimulating properties that promote agricultural crops growth and evolution.

The work [2] is devoted to the study of the interaction of monoethanolamine with inorganic acids and their salts while the results of studies using concentrated solutions of acetic acid, formic acid and monoethanolamine at 20 °C in [3] and in aqueous solutions are given in [4, 5]. However, the interaction of monoethanolamine with methyl acetate in aqueous solutions has not been studied yet. The system "methyl acetate-monoethanolamine-water" [6] was studied to establish the mechanism of their interaction process.

Materials and methods

In this article visual and polythermic, isomolecular, IR spectrum, analytical and NMR methods were used. Measurement of solution viscosity was conducted by capillary viscometer VPJ-2, refractive index by refractometer RF 454 BM, relative density by picnometre, pH medium by pH-metre METLER TOLEDO FE20(FQLl).

Results and discussion

The isotherms of the refractive index, density, viscosity and pH of the medium are characterized by inflection points corresponding to 20 and 50% concentrations of the monoethanolamine solution (Fig. 1).

Analysis of the isotherms allows us to conclude that the reaction in an aqueous solution of monoethanolamine with methyl acetate the compound N – acetyl ethanolamine is formed, which was synthesized on the basis of concentrated monoethanolamine and methyl acetate. Elemental analysis for the content of carbon, hydrogen and nitrogen is carried out for the synthesized compound.

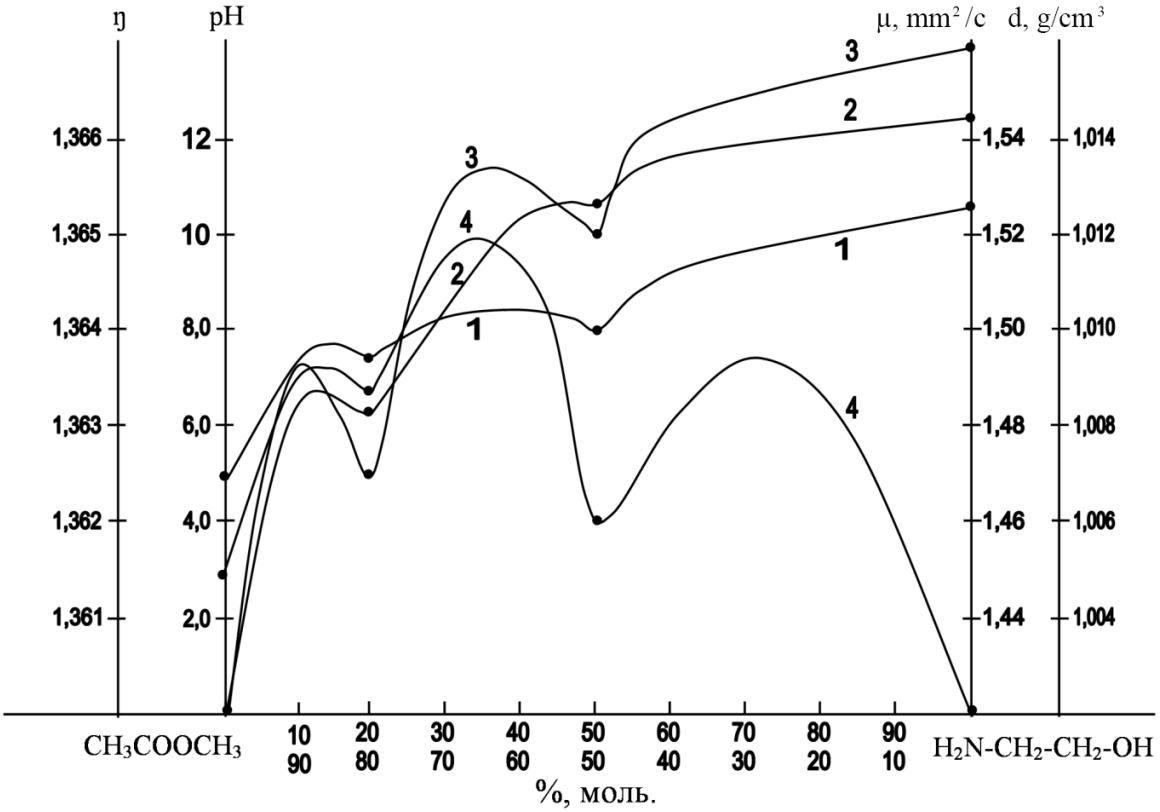

Figure 1. System of methyl acetate-monoethanolamine-water (1) – pH of the medium; (2) – is the viscosity; (3) – is the density; (4) – is the refractive index

Table 1. – According to the chemical analysis for $CH_3CONHC_2H_4OH$:

It was found, mass.%:			
C	O	N	H
40.10	40.05	11.18	7.09
It was calculated, mass.%:			
C	O	N	H
40.30	40.30	11.80	7.60

To determine the identity and phase structure of the N – acetyl-ethanolamine compound, we studied its IR spectrum (Fig. 2). A comparative analysis of the IR spectrum of the compound $CH_3CONHC_2H_4OH$ and the starting materials monoethanolamine and methyl acetate shows that the formation of the N – acetyl ethanolamine compound results in a change in the above-mentioned IR fusion of the compound.

The IR spectrum of the resulting compound showed the following absorption bands: γ (OH)= = 3354 cm^{-1}; γ(NH) = 3354 cm^{-1}; γ (CH_2) = = 2878 cm^{-1}; γ(C = O) = 1639 cm^{-1}; δ (NH) = = 1564 cm^{-1}; δ(CH_3, CH_2) = 1376 cm^{-1} and

1306 cm^{-1}; γ(C-N) = 1308 cm^{-1}; γ(C-O) = 1308 cm^{-1}; γ(C-O) = 1669 cm^{-1}; Short-wavelength mixing of the γ(C = O) and δ(NH) absorption bands of the starting materials and the lack of absorption bands in the product is characteristic of the ester formation of the amide fragment observed in the resulting compound. That is, the resulting compound N – acetyl ethanolamine is an individual substance with the chemical formula $CH_3CONHC_2H_4OH$ (Fig. 2).

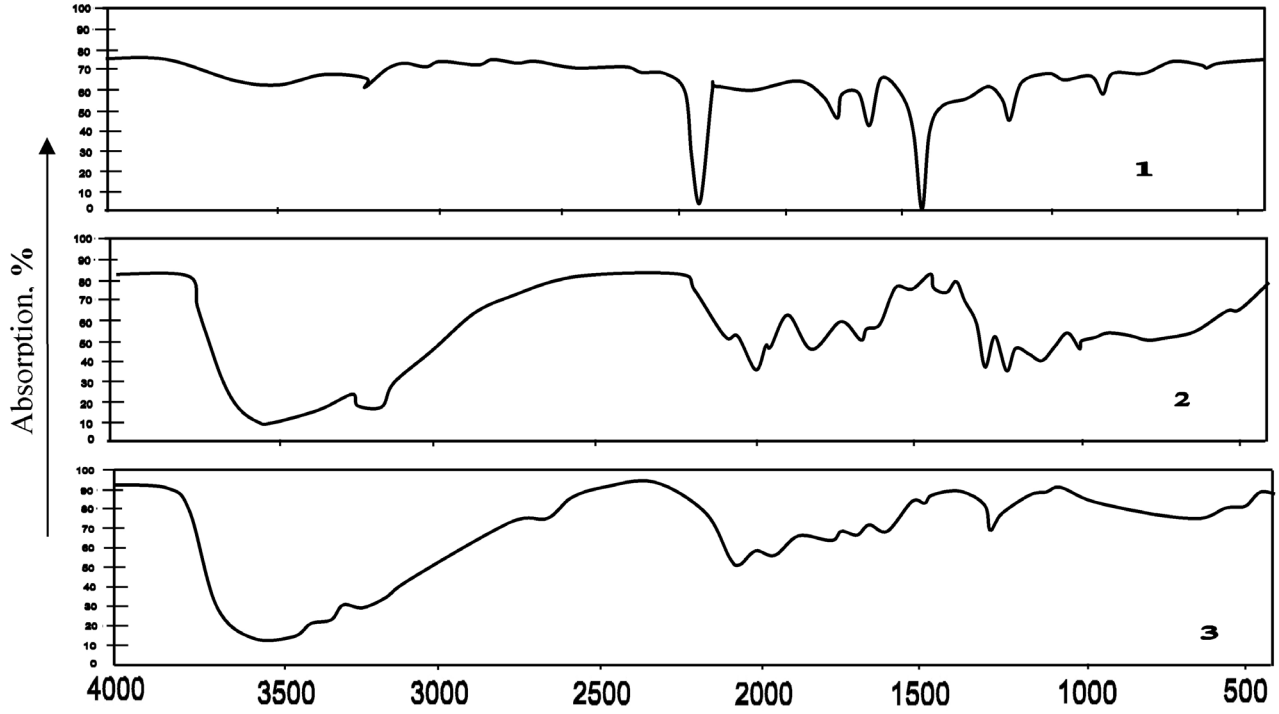

Figure 2. IR spectra of the components of the methyl acetate-monoethanolamine-water system and N-acetyl-ethanolamine compounds. 1 – methyl acetate: 2 – monoethanolamine: 3 – N – acetyl ethanolamine

The indices of H^1 and C^{13} NMR spectroscopy of N-acetyl ethanolamine were studied by means of nuclear magnetic resonance spectroscopy (NMR). The NMR spectrum of the resulting compound in dimethyl sulfoxide (DMSO-d) was obtained a spectrum (1.76 ppm) as a singlet, which is due to the presence of the group (C = O); and these allocated signals are inherent in the nature of the action of the methyl-proton group. On the spectrum of 3.05 and 3.35 ppm two methylene groups (CH_2) are linked together and their protons similarly formed a quartet (J = 6.0 Hz) and a triplet (J = 6.0 Hz), which form resonance of signals. On the part of the weak field in the center at 7.94 ppm the limit of the signals of the NH group was formed (Fig. 3).

To determine and establish the sequence of groups, we used the method of secondary resonance. In it, as in the primary substance-methyl acetate, the C = O group is linked to the CH_3 – group with the formation of the corresponding signal (1.76 ppm), when interacting with the secondary frequency resonance on the monoethanolamine NH_2 group bound to the CH_2 group a resonance of the signals is also formed (Fig. 4).

Based on the analysis it was established that the connection between the groups on the NMR spectrum of the synthesized compound on a part of the strong field is 22.66; 41.77 and 60.03 ppm, there are signals of 3 (three) carbon nuclei. Whereas on the spectrum of the weak field region, 169.92 ppm the formation of a carbonyl group corresponding to carbon was established (Fig. 4).

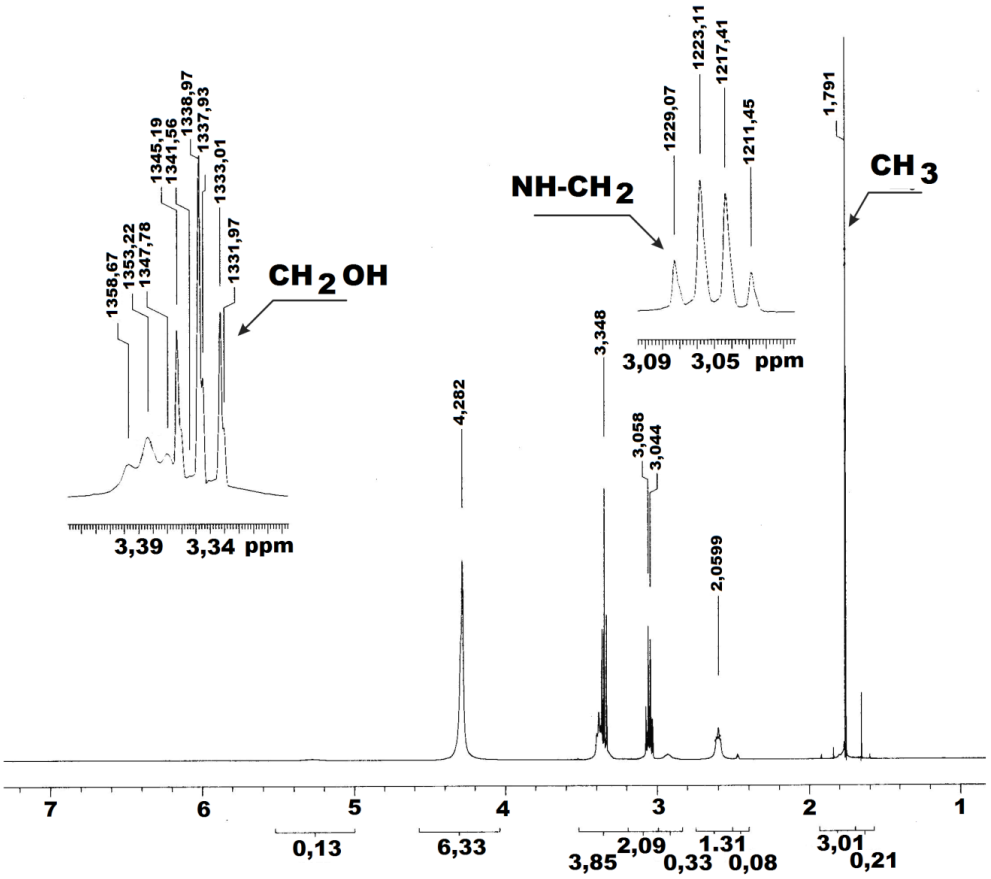

Figure 3. [1]H NMR spectra of N – acetyl ethanolamine

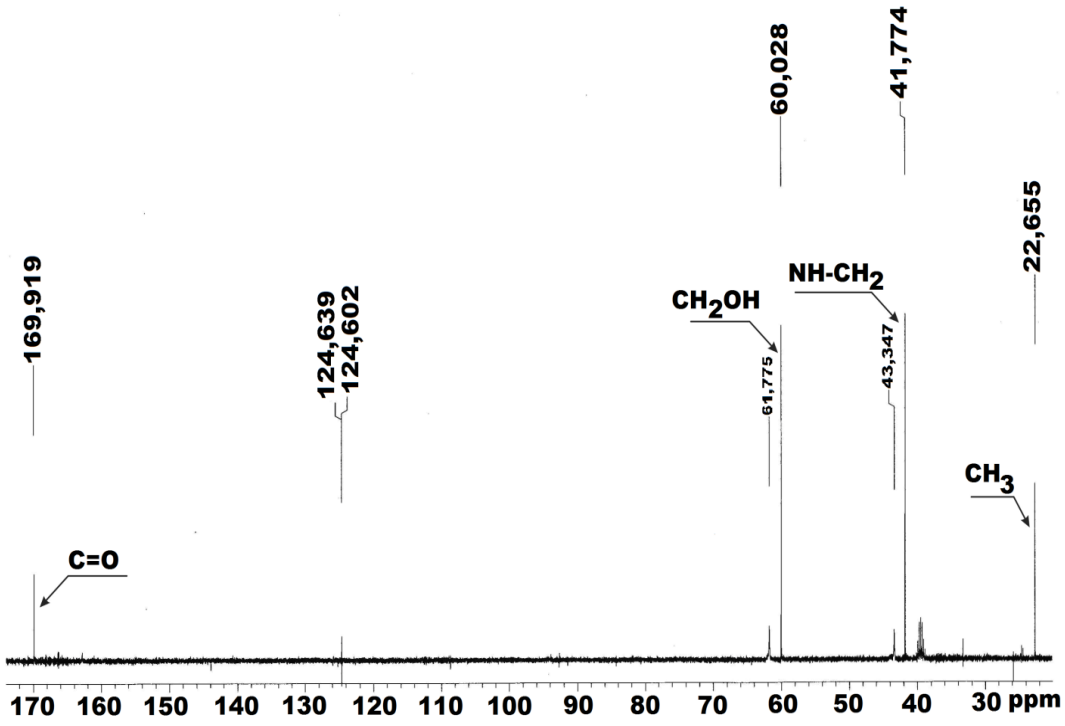

Figure 4. [13]C NMR spectra of N – acetyl ethanolamine

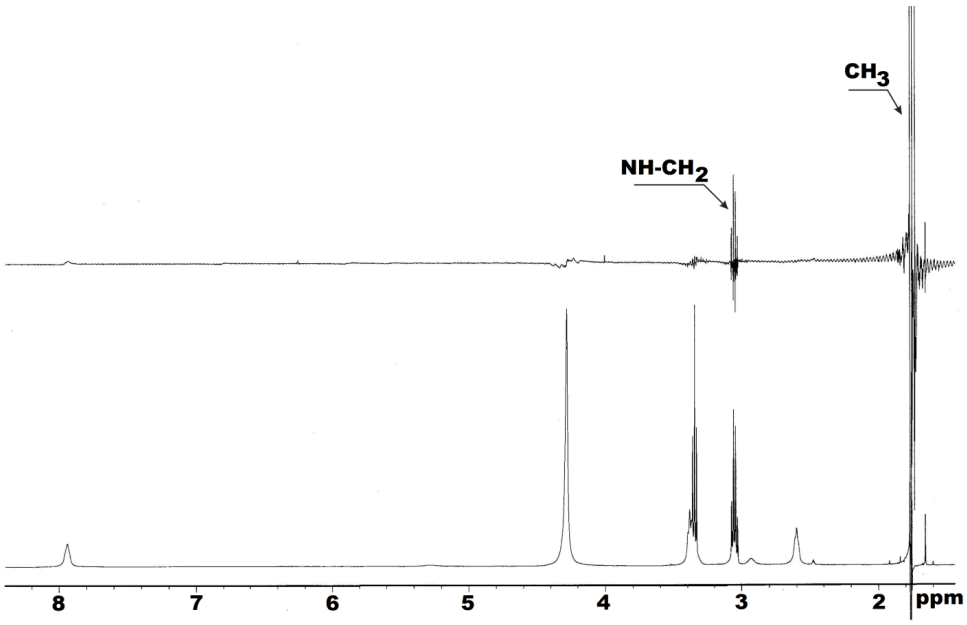

Figure 5. N – acetylethanolamine spectra of secondary resonance

When comparing the obtained results on the NMR spectrum, the resulting compound has four carbon (Fig. 5). On the basis of the "Disstortionless Enhancement by Polarization Transfer" experiment, it has been found that one carbon includes a CH_3 group, a two – CH_2– group, and the balance is a quaternary carbon of N– acetyl-ethanolamine. On the basis of the conducted studies it was established that the substance has the chemical formula CH_3-CO-NH-CH_2-CH_2-OH and is called N– acetylethanolamine.

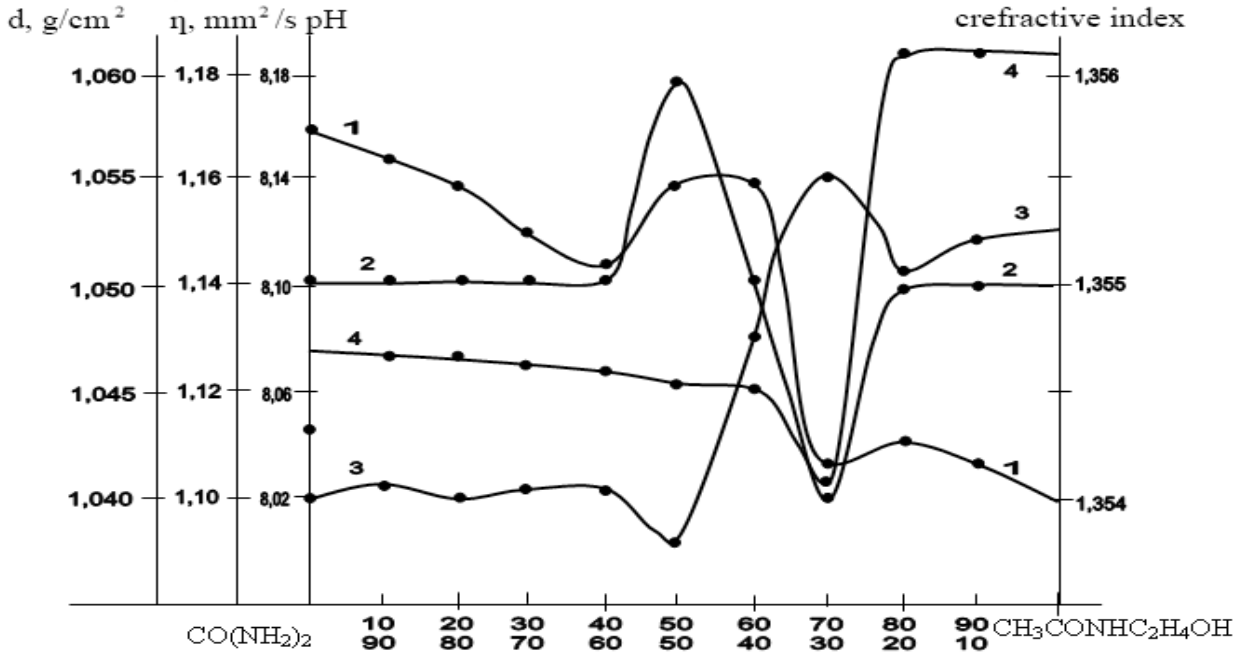

Figure 6. The carbamide-N-acetyl-ethanolamine-water system; (1) – pH of the medium; (2) – is the refractive index; (3) – is the viscosity; (4) – is the density

When studying the character of the interaction in the "carbamide-N– acetylethanolamine-water" system, the isotherms of the refractive index, density, viscosity and pH of the medium were characterized by inflection points corresponding to a content of 50.0 mol.% of carbamide (Fig. 6), that is molar ratio of carbamide: N– acetyl ethanolamine, equal to 1: 1. Thus, the formed inflection points in the system studied confirm the appearance of one new compound – carbamide N– acetylethanolamine, with a molar ratio of the original components of 1: 1.

The following physicochemical properties the crystallization temperature –60.0 °C, the refractive index is n_{20} = 1.5440; d_{20} = 1.3023 g/cm^3; η_{20} = = 32.34 mm^2/s; the pH of the medium-11.0 are typical for the $CO(NH_2)_2 \cdot CH_3CONHC_2H_4OH$ compound.

To determine the individuality and phase structure of the compound $CO(NH_2)_2 \cdot CH_3CONHC_2H_4OH$, we studied its IR spectra.

Comparative analysis of the IR spectrum of the compound $CO(NH_2)_2CH_3CONHC_2H_4OH$ and urea precursors, N– acetylethanolamine shows that when forming the compound $CO(NH_2)_2 \cdot CH_3CONHC_2H_4OH$, changes the above compound are took placed in the IR spectrum. For example, the amide band at 1681cm^{-1} is shifted to the low-frequency region by 20 cm^{-1} (1661cm^{-1}). The absorption band of $CH_3CONHC_2H_4OH$-H_2O at 1639 cm^{-1} is shifted to the high-frequency region, only by ~ 3 cm^{-1}. Hence, the above mentioned, we can assume that there is an intermolecular and hydrogen bond between > C = O carbamide and OH– group of monoethanolamine. The IR spectra of the –OH group are in the region of intense stretching vibrations of the amine groups of the carbamide.

The polytherm of solubility of the ammonium nitrate-N– acetylethanolamine-water system was studied by means of eight internal sections using a visual-polythermal method. Sections I–IV are drawn from the side of N– acetylethanolamine – water to the top of ammonium nitrate, V–VIII – from the side of ammonium nitrate – water to the top of N– acetylethanolamine.

The binary system N– acetylethanolamine-water was studied for the first time and has a eutectic point of 38.0 °C with a content of 17.4% water and 82.6% N– acetylethanolamine.

On the basis of polythermal sections and data of binary systems of polythermal sides, a diagram of the solubility of the system of ammonium nitrate-N– acetylethanolamine-water from the temperature of complete freezing –47.8 °C to 60 °C was constructed (Fig. 7).

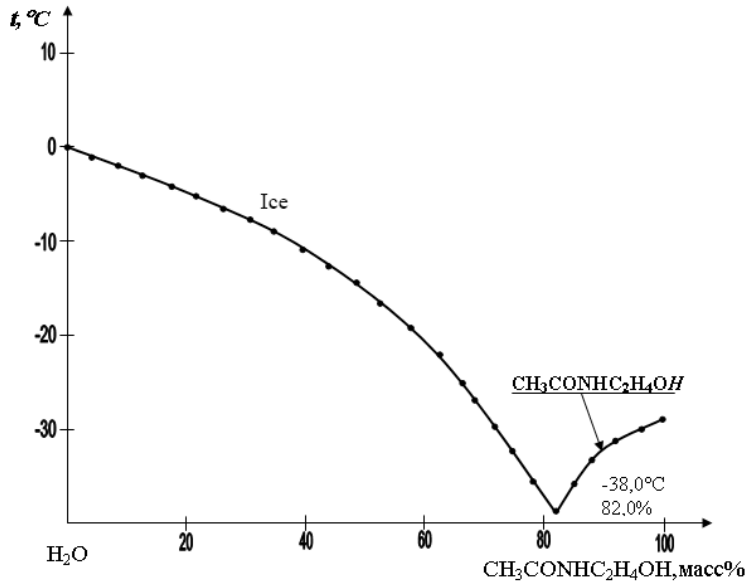

Figure 7. The binary system N – acetylethanolamine-water

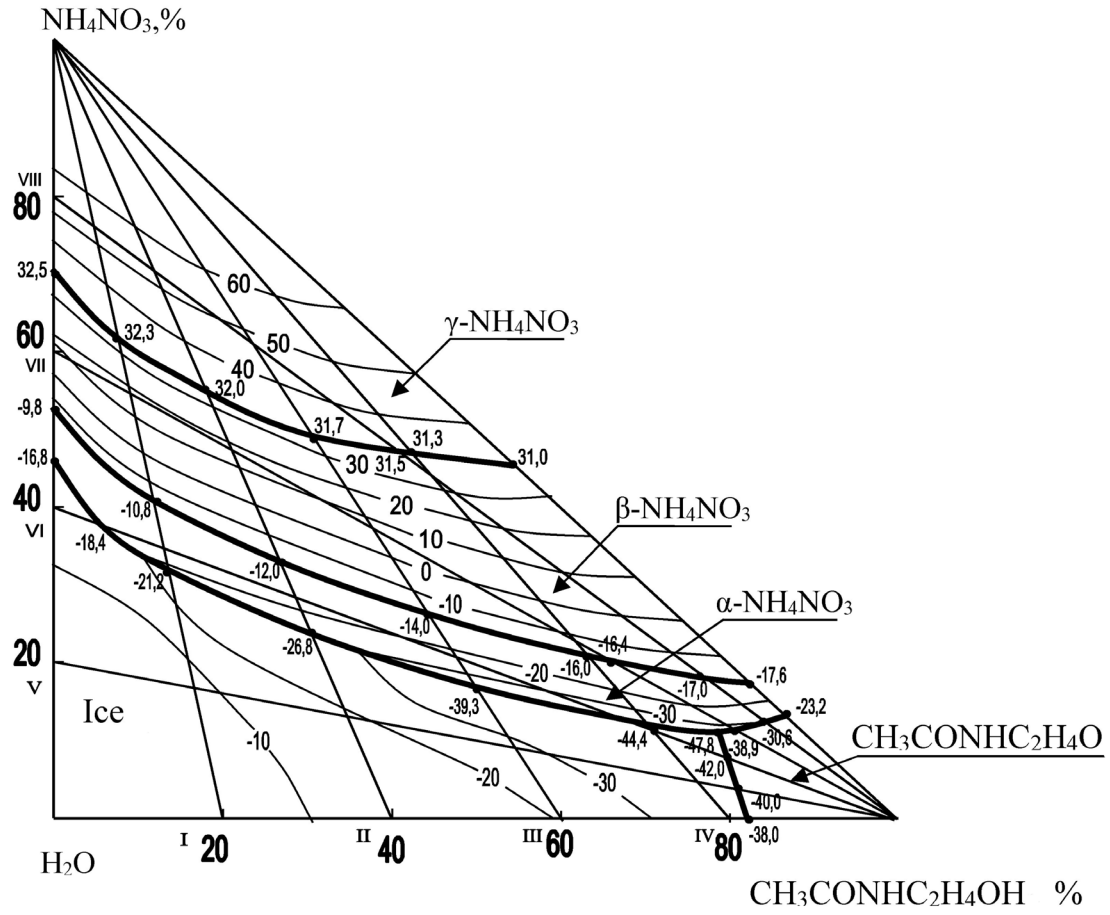

Figure 8. The solubility polytherm of the NH_4NO_3-$CH_3CONHC_2H_4OH$-H_2O system

In the studied range of temperatures and concentrations, crystallization fields of ice, N– acetylethanolamine and *α*, *β*, – modifications of ammonium nitrate have been identified. The system is characterized by one triple nodal point corresponding to 11.6% ammonium nitrate and 77.8% N– acetylethanolamine at a temperature of –47.8 °C.

According to the polythermic diagram of solubility, the formation of new chemical compounds has not been established. This system studied belongs to a simple eutonic type (Fig. 8).

Earlier we studied systems: $CO(NH_2)_2$-$CH_3CONHC_2H_4OH$-H_2O and NH_4NO_3-$CH_3CONHC_2H_4OH$-H_2O. To substantiate the process of obtaining a new liquid fertilizer on the basis of carbamide ammonium nitrate (CAN) containing physiologically active substance (PAS)-N– acetylethanolamine, we studied the mutual influence of the components in the N– acetylethanolamine – [45% $CO(NH_2)_2$ + 55% NH_4NO_3] – water system by the isomolar method. The isotherms of the refractive index, density, and pH of the medium of the system studied show that the inflection points correspond to 50.0 and 72.0 mole% of the sum of salts [45% $CO(NH_2)_2$ + 55% NH_4NO_3] (Fig. 9) i.e. molar ratio of carbamide: N– acetylethanolamine, equal to 1: 1.

Thus, the formed inflection points confirm the appearance of one new compound – N– acetylethanolamine with carbamide at a molar ratio of 1: 1. On the isotherms of the pH medium, the refractive index of the medium and the viscosity, these characteristic bending points appear less clearly.

A complex salt-carbamido N– acetylethanolamine with a molar ratio of 1: 1 was also isolated from the liquid phase.

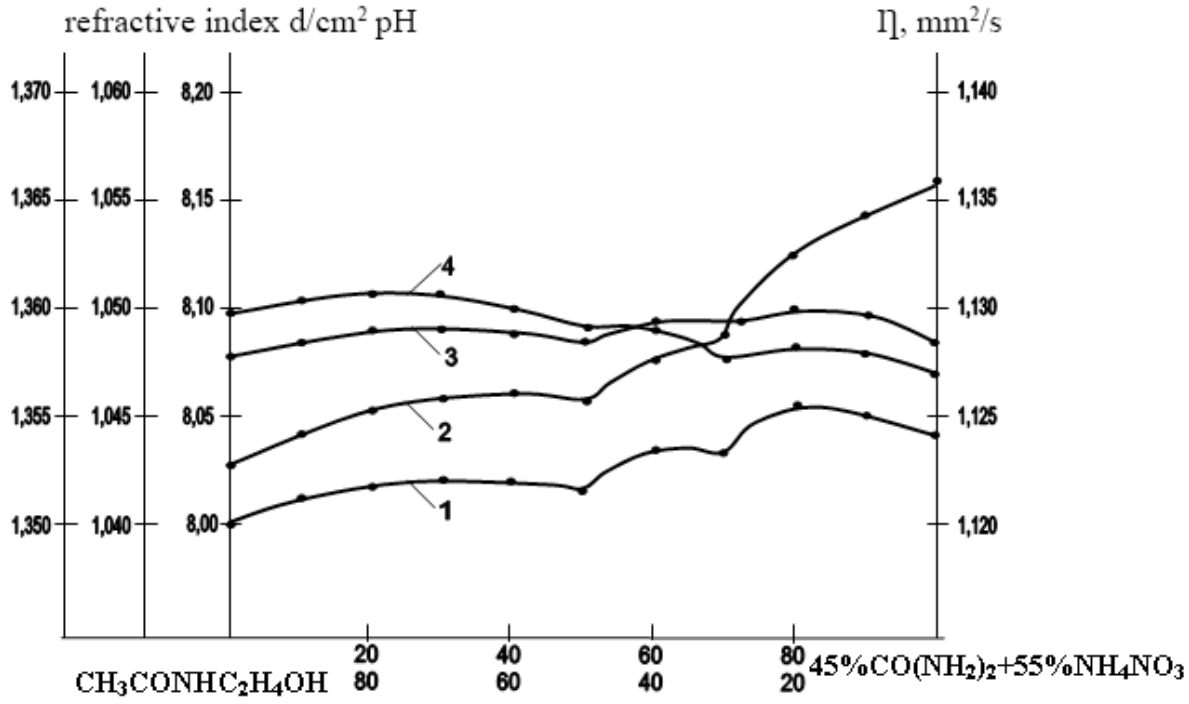

Figure 9. System N – acetylethanolamine – [45% carbamide + 55% ammonium nitrate] – water. (1) – pH of the medium; (2) – is the refractive index; (3) – is the viscosity; (4) – is the density

Conclusion

To concluded, by studying the above system, it has been established that the results obtained for rheological properties and solubility, based on the selection of the synthesis conditions of the process, sufficiently justify the possibility of obtaining a new liquid fertilizer using carbamide ammonium nitrate and N– acetyl ethanolamine.

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GYPSUM BINDERS BASED ON KARAKALPAKSTAN FIELD

Abstract: The gypsum materials of some Karakalpakstan fields was studied and such gypsum binding materials as the construction-grade, high-strength and estrich gypsums as well as the anhydrite cement were produced.

Keywords: gypsum, anhydrite cement, Karakalpakstan, gypsum minerals, binding material, thermal analysis.

Introduction. The gypsum binder manufacture is the most efficient one regarding the technical and economic feasibility, in particular, in terms of the unit costs of the raw material, fuel, electric power and labor per the product unit. The reserves of the initial natural raw material are unlimited as well as the gypsum-containing by-products for the gypsum and anhydrite binder manufacture. They include the natural calcium sulfate dehydrate, anhydride, clay-gypsum as well as the industrial wastes consisting mainly of the anhydrous calcium sulfate or calcium sulfate dihydrate, or their mixture [1, 464].

The natural calcium sulfate dihydrate (gypsum stone) is a rock of sedimentary origin formed mainly from the large or small crystals of calcium sulfate dihydrate $CaSO4{\cdot}2H_2O$. The transparent crystalline gypsum, gypsum spar, satin spar with satiny luster (selenite) and granular gypsum are distinguished in the rock appearance and fabric. The most pure kind of the granular gypsum resembling the marble in appearance is called sometimes alabaster. The average density of the gypsum stone depends on the impurity amount and type and is 2.2–2.4 g/cm^3.

Study Subjects and Methods. The study subject in this work is the gypsum mineral – selenite of Karakalpakstan field, which is unrivaled throughout Uzbekistan. In terms of the composition, it is close to the high-grade one; that is why it can be used to

produce the binding materials with high physical and mechanical properties.

The gypsum stone belongs to the rock of sedimentary origin; the content of the calcium sulfate dehydrate in it varies from 68.4 to 93.8%. Three specimens were sampled from three different Karakalpakstan fields respectively, and their complete silicate analyses was carried out. The study of the physical-chemical and mechanical properties was carried out in accordance with the requirements of GOSTs (State Standards) 23789–04 and 4013–82.

Discussion and Study Results. For study of the chemical and mineral composition of the specimens researched, the comprehensive analysis methods were used including the X-ray and differential thermal analyses (Table 1; Fig. 1).

It is known [2–3, 472] that the gypsum stone of 1st grade is used to manufacture the gypsum binders used in the whiteware, ceramic and medical industries as well as the white, architectural and expanding gypsum – alumina cement.

Table 1.– Chemical Analysis Results for the RK Gypsum Minerals

No. in order of field	**Field name**	**Content in% on air-dry basis**								
		SiO_2	**TiO_2**	**Al_2O_3**	**Fe_2O_3 total**	**Including**		**MgO**	**MnO**	**CaO**
						Fe_2O_3	**FeO**			
1.	Kuskhanatau	2.88	0.015	0.45	0.25		< 0.25	0.40	0.01	30.51
2.	Beltau	7.31	0.019	0.79	0.27		< 0.25	0.50	0.01	29.16
3.	Khodzhakul	20.16	0.15	2.44	1.08		< 0.25	0.50	0.02	23.97
No.	Field name	Content in% on air-dry basis								
		Na_2O	K_2O	P_2O_5	SO_3 total	SO_3 sulfate	S sulfide	Percentage of other impurities	H_2O 320°	CO_2
1.	Kuskhanatau	0.10	0.11	0.048	44.67	44.61		20.49	19.63	0.55
2.	Beltau	0.21	0.22	0.042	41.70	41.50		19.90	18.75	1.10
3.	Khodzhakul	0.39	0.37	0.068	34.27	32.90		17.91	14.32	2.97

The results of the chemical and mineral analyses performed have demonstrated that the specimen (No. 1) sampled from Kuskhanatau field differs with the insignificant content of the harmful impurities. In terms of the basic oxide content (CaO, SO_3, H_2O) in the amount of 93.8%, it meets the composition of the high-grade gypsum mineral, and the manufacture of the gypsum binding material with increased physical and mechanical properties is possible based on it for the whiteware, ceramic and medical industries. [4, 117–122]

The specimens from Beltau (No. 2) and Khodzhakul (No. 3) fields contain a large amount of the clay impurities; it differ with the small amount of CaO and SO_3. The total content of sulfate dihydrate $CaSO_4 \cdot 2H_2O$ is 89.5 and 68.4%, respectively for 2nd and 3rd specimens. These minerals belong to the gypsum rock of the second rate, and the production of the materials with the increased physical and mechanical properties is possible based on them for the construction industry.

The X-ray phase analysis of the gypsum specimens was carried out using diffractometer DRON-3,0 with the filtered copper radiation under 22 kW voltage, 14 mA strength of current, 2 degree/min meter disk speed.

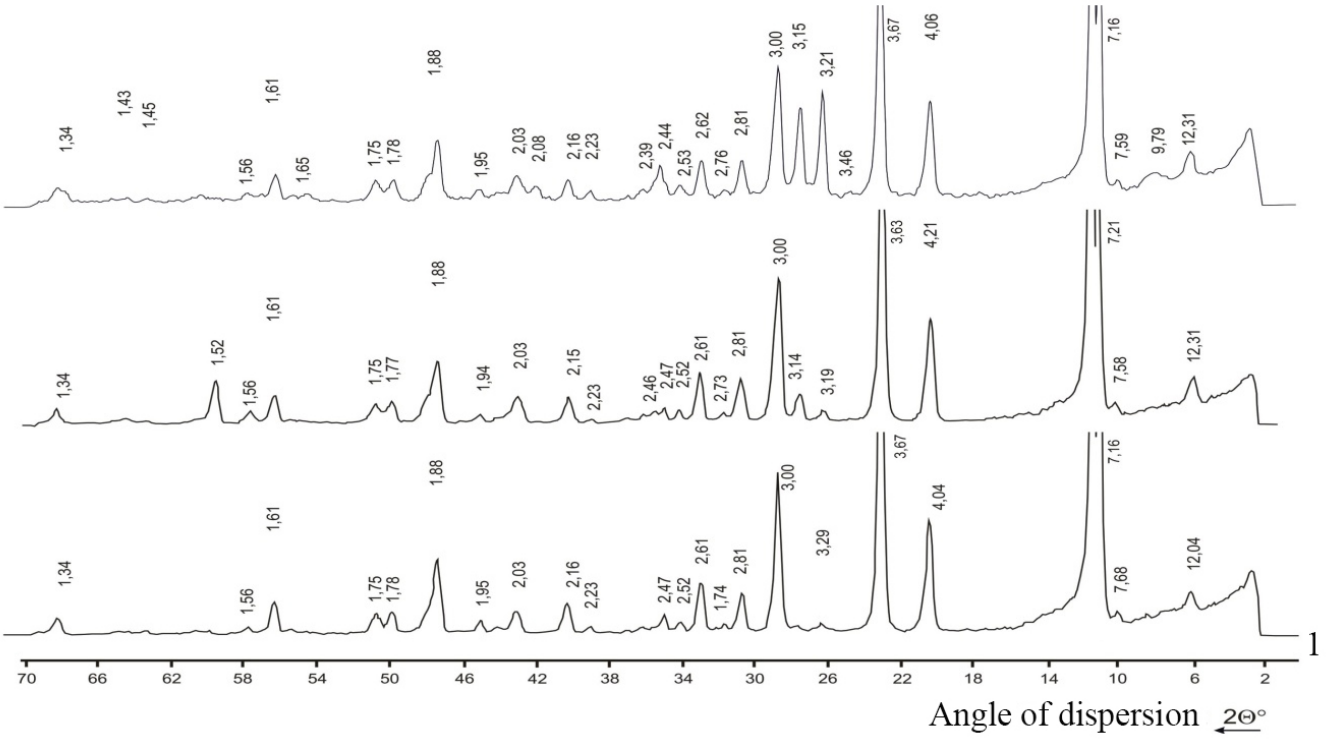

Figure 1. Gypsum stone X-ray diagrams for Karakalpak field:
1 – Kuskhanatau, 2 – Beltau, 3 – Khudzhakul

The X-ray phase analysis of specimen No. 1 (Fig. 4) has demonstrated the sufficient purity of this selenite; reflexes: 7.16; 4.04; 3.67; 3.00; 2.81; 2.61; 2.16; 2.03; 1.88; 1.75; 1.61; 1.34. A meet those of the calcium sulfate dihydrate. In specimens No. 2 and No. 3 (Fig. 5–6), reflexes: 7.16; 4.21; 3.67; 3.00; 2.81; 2.61; 2.16; 2.03; 1.88; 1.75; 1.61; 1.34. A meet those of the calcium sulfate dihydrate, reflexes: 12.04; 3.21; 2.47; 2.23 – those of the quartz, 3.46; 2.53; those of the kaolin and 3.15; 2.76; 1.86 meet the calcite lines [5, C. 19–24].

The differential thermal analysis of the gypsum specimens was carried out using the derivatograph of "Paylik-Paylik-Erday" system with 9–10 degree/min speed and 0.132–0.155 g weighed amount, with galvanometer sensitivity as T – 900, TG (Russian: ТГ) – 200, DTA (Russian: ДТА) 1/10, DTG (Russian: ДТГ) – 1/10. The recording was carried out under atmospheric conditions. The holder was 7 mm diameter platinum crucible without cover. Al2O3 was used as the reference.

The gypsum calcination was performed as per gypsum process design using the rotary kilns. The rotary kilns are the continuously operating units assuring the compact flow chart. The crushed gypsum stone with 10–20 mm and 20–35 mm fraction sizes is calcined in the rotary kilns [6, 56–62].

The gas inlet temperature at the drying drum with direct flow reaches about 900 °C, and with counter flow – 600–700 °C. Prior to entering the kiln, the gases are diluted with the air up to required 170–200 °C temperature. At the drum outlet, the gas temperature is 160–180 °C with direct flow, and about 100 °C in case of the counter flow.

The calcined grit is milled up to the residue on screen No. 02 not more than 10–12%. The milling often takes place using the single chamber or double-chamber ball mills.

The gypsum manufacturing processes with its calcination within the rotary kilns are continuous; that is why their automatic control is performed

with ease. This method of the gypsum manufacture is very cost effective.

The fuel consumption varies within 45–50 kg, that of the electric power is 15–20 kW·h per 1 t.

The testing of the physical and chemical properties of the produced gypsum binders carried out according to GOST U23789–04 (Table 2) demonstrates the possibility of their use for the manufacture of the construction, high-strength and estrich gypsums as well as the anhydrite cement.

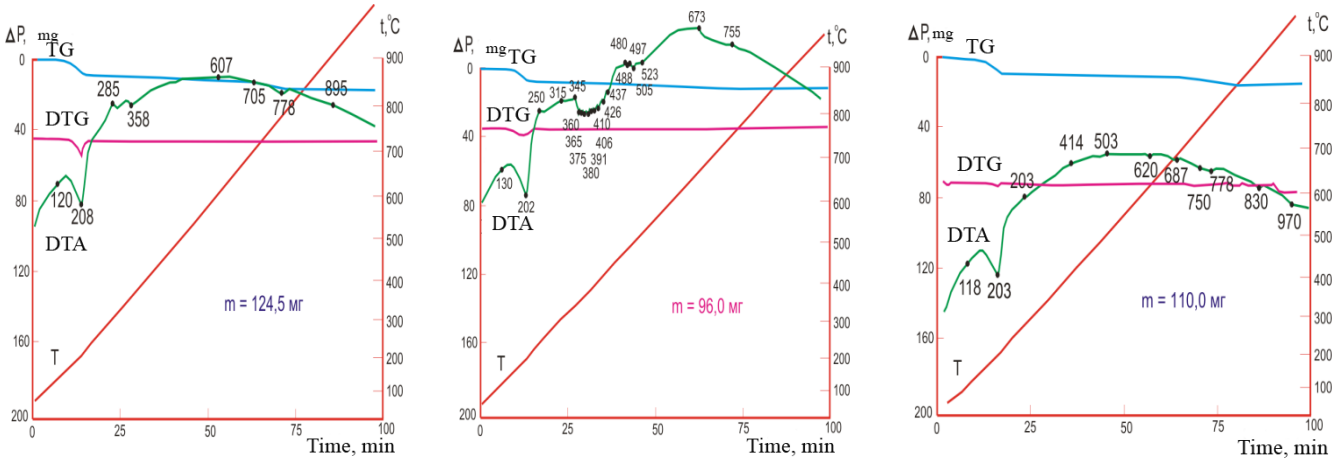

Figure 2. The differential thermal analysis of the gypsum specimens of the Karakalpak field: a – Kuskhanatau, b – Beltau, c – Khudzhakul

Table 2.– Physical and mechanical parameters of the gypsum binders

No.	Name of parameter	GB (gypsum binder) based on specimen No. 1	GB based on specimen No. 2	GB based on specimen No. 3
1.	Milling fineness, screening residue 0.2%	2	6	6.2
2.	B/G normal consistency,%	57	51	46
3.	Setting time: beginning, min. end, min.	 6 12	 7 19	 9 16
4.	Ultimate compression strength in 2 hours, kgf/cm^2	73	51	35
5.	Ultimate tensile strength under bending, kgf/cm^2	34	24	16
6.	Binder grade	G-7	G-5	G-3
7.	Metal impurities content, mg	3	4	8
8.	Volume dilatation,	0.4	0.3	0.4
9.	Impurities, which are insoluble in the hydrochloric acid,%	0.8	0.9	2.8

The study results for the binder materials have shown that specimen No. 1 meets grade G-7BIII, which is characterized by the normally setting properties and fine milling, and specimen No. 2 of grade G-5BII is characterized by the normally setting properties and medium milling.

The gypsum binders of grade G-3BII, which are characterized by the normally setting properties and medium milling, were produced from specimen No. 3.

Conclusion. The study of the physical and chemical properties of the gypsum binding materials produced based on the Karakalpakstan gypsum minerals demonstrates the possibility to use these minerals for manufacture of such binders as the construction, high-strength and estrich gypsums as well as the anhydrite cement.

The introduction of the minerals studied into the construction material manufacture is cost effective as the binding materials are produced using the low temperature calcination and fine milling of the raw material with no waste and consequently, the prime cost of the materials will be relatively low.

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CASTING ON COMBUSTIBLE AND LOST WAX CASTING 3D MODELS IN SHELL SHAPES WITH THE USE OF AUTO CAD PROGRAMS

Abstract: The article deals with the application of traditional and additive technologies in the production of machine parts. And also possibilities of introduction and use of AutoCAD programs inproduction of foundry business. Presents the article: the traditional technology of manufacturing parts by casting; of additive technology for manufacturing parts of machines using a 3D printer; Classification of technological processes using a 3D printer. The description of the presented of traditional and additive technologies in the manufacture of machine parts using a 3D printer is given. The advantages of applying additive technologies in the production of machine parts are shown.

Keywords: high technology, additive technologies, extrusion, laser technologies, gasification models, investment casting.

In modern conditions, in the era of the Internet and electronicthe widely introduction of modern information and communication technologies has the great priority determined very high (high tech) levels of additive technology and attention to this technology in all countries of the world. It gives unlimited opportunities to obtain the most complex products, in all industries and even at home.

Earlier it was supposed to carry out practical experiments for production of the cast preparation for any concrete detail of mashines and mechanisms.

Special-to-date information. To find information

– on 3D scanning and printing devices,

– on systems of automatic design and control of 3D printers.

– accessto materials for products.

– Personally to make a complex product with the help of additive technology.

The application of traditional and additive technologies in the production of machine parts is considered below [1]. Presented: the scheme of traditional technologies of manufacturing parts by casting; of formation for the traditional technology of manufacturing parts by casting; scheme additive technology of manufacturing parts of machines using 3D-printer; classification of technological processes using 3D-printer. The description of the presented schemes of traditional and additive technologies in the production of machine parts using a 3D printer. Advantages of application of additive technologies in production of details of cars are shown.

Traditional texnologi: Development Details-Designer, Logistics Operations-Technologist,

Development of Technology of foundry and pattern Tooling- Designer Technologist, Manufacturer of pattern equipment (the master model, pattern, core box) workers of different specialties plots wood – and metal – processing: turners, millers, mechanics, etc.– all the workers of high qualification, obtaining cast billets, elements snap –smelting and casting of metal melt, moulding-de-coring, cleaning-sweep, etc.– all high-skill workers, testing and control.

Additive Technology: development details- designer, development of 3d drawings of casting or moulding tooling or form – Designer, development of 3d drawings of casting or moulding tooling or form – Designer, 3d printing, casting, synthesis of model or form –Designer, testing and control.

For fast production-production of finished parts from materials supported by 3D-printers. This is an effective solution for small-scale production in the manufacture of models and molds for foundry production.

The use of two technologies: production of castings "by melted models" and "by burnt models" is due to the fact that the synthesis model on a 3D printer is completely identical. on the 3D printer is completely identical and differs only by the model material and extruder setting.

Earlier it was supposed to carry out practical experiments for production of the cast preparation for any concrete detail of cars and mechanisms.

In the future, it was decided to apply the process of obtaining a shell shape with the introduction of a thin glass fiber into the gypsum. That is, get the shell out of plaster with inserted into it a small amount, approximately less than 0.1%, glass fiber in the form of fragments with a length of 3–6 mm. It is in our opinion was to play the role of reinforcing rebar to prevent cracking of the plaster shell.

In the future, it was decided to apply the process of obtaining a shell shape with the introduction of a thin glass fiber into the gypsum. That is, get the shell out of plaster with inserted into it a small amount, approximately less than 0.1% by weight, fiberglass in the form of fragments with a length of 5–10 mm. It is in our opinion was to play the role of reinforcing rebar to prevent cracking of the plaster shell.

For the experiment was made 200 ml creamy aqueous solution of gypsum, to which was added chopped short NAPof fiber glass wool. The length of the cut fibers was approximately 5–10 mm Fiber was cut with scissors from a few irregular lump of glass so part of the cut pile may differ from the specified size higher or lower, i.e., more than 10 and less than 5 mm. This experiment had the character of production and the number of fibers and length of the detailed experiments were not carried out. To do this, it is necessary to conduct a wider experiment with the study of the influence of the length and percentage ratio of fibers to the amount of gypsum solution, the influence of the consistency of gypsum and other process parameters. It is expected that this will be the next stage of scientific work on the doctoral dissertation.

Gypsum-fiber composition was made with the introduction of dry powder gypsum (150 g) of cut glass (100 ml free poured), water (50–70 ml) to the formation of creamy consistency, constantly stirred with metal spatula. Within, approximately, 1 min.

The model was lowered into a liquid plaster composition, enveloping the model with a layer of solution 3–5 sec. Then removed the model from the solution, turned in space, allowing to form a uniform layer and the draining of excess solution for about 60 seconds. During this time, the plaster composition on the model hardened somewhat. Gypsum composition was intensively mixed at this time to reduce the rate of hardening. At this stage limited to the shell in two layers.

After 30 minutes of holding the shell with the model was placed in to a muffle furnace with a heating temperature of 400 degrees for 2 hours. After extraction of the shell form it was stated that the model completely burned down. Then the shell was placed in a flask and filled with dry sand. A small vibration compacted sand, from which left the caster shell system and immediately poured the form of with lead.

In half an hour flooded the form is removed and the shell was destroyed. It is seen that the thickness of the double layer was equal to 4–6 mm. The fibers in plaster compositions has prevented the cracking of the shape during annealing.

Thus, the time for AUTOCAD design 3D synthesis model was 2–4 hours of printing models on a 3D printer to 2 hours, were completely eliminated many traditional operations.

The conducted experiment has shown that the production of complex castings on the combustion (gasified) model prepared on a 3D printer with a form of fiber-gypsum composition is a very effective highly technological process of obtaining castings. The process can be recommended for more fundamental research and practical production usage.

Such industries as metallurgy and machine building continue to develop actively, so the implementation and use of the AutoCad program in these industries is necessary.

Carries out a complete cycle from design to production of molds and components of various complexity, both in sketches, drawings, 3D models of the customer and on the finished product, as well as provides a full range of services for servicing these products. We are ready to develop: photos, ideas, drawings in the formats SolidWorks and AutoCad, samples, 3D models. The design of molds provides for all the customer's wishes up to the small details of the work of the future product. Sophisticated complexsolutions from product design, simulation of molds, matrices, dies, their manufacture, to testing and commissioning are taken into account [2].

Manufacturing of molds is a complex, high-tech process that requires great responsibility and professionalism from the manufacturer. The basis for the mold is high-quality steel, which passes through various processing stages. During operation, the mold will be exposed to pressure and temperature, therefore the steel from which the mold is made must be of high quality and resistant to different kinds of influences. Thedesignofthemoldshouldbeimmaculatelyaccurate.

At this time, the task is extremely urgent in the rapid and error-free design of the tooling. The specialists of our company have the necessary knowledge and extensive experience in the design of metal products to order, and the development of design documentation is done using modern computer-aided design tools. These aspects reduce the number of errors at the design stage of the product and reduce the time the tool is put into production.

The price for the manufacture of molds, matrix, stamps, is set depending on the complexity of the product, the materials from which it is produced, the required size, volume, production time. Individual approach to each new task, allows you to optimize the costs and time for product manufacturing, thereby reducing costs

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ANALYSIS OF THE JOINT OPERATION OF THE SYNCHRONOUS AND INDUCTION MOTORS USED IN THE ORE-GRINDING PROCESSES

Abstract: The requirement and the available resources of energy saving possibilities in the ore-grinding technological process are substantiated. The known trends in energy saving in production enterprises are studied. The goal of the work is formulated to show the necessity of having distinct information about the reactive power produced by the synchronous motors and consumed by the induction motors operating in the given process. The reactive power consumption and its distribution at different overloads of the synchronous and induction motors are estimated. An algorithm is proposed, allowing to consider the changes in the reactive powers at changing the parameters of the synchronous and induction motors used in the process and the supply net so that the reactive powers required by induction motors are compensated by the synchronous motor.A diagram of the automated control system of the optimal distribution of the reactive power generated by the synchronous motors is proposed.

Keywords: Reactive power, technological process, electric motors, electromechanical systems, control system.

Introduction. The appropriate organization of the power-consuming technological process requires efficient usage of its power opportunities [1–3]. To ensure the operation of the ore-grinding technological process, electromechanical systems with both synchronous and induction electric drives are used.

In the ore-grinding process, the power consumed by synchronous motors constitutes 60–65% of the total consumed power. The most widely used synchronous electric drives in the ore-grinding process are applied in the autogenous, ball and core mills, while the induction motors – in the systems of classifiers and pulp pumping dries.

The economy of the consumed electric power is largely conditioned by the process peculiarities [4–6]. Below are introduced the known trends of energy saving in production enterprises.

1. Organizational – technical measures according to which it is possible to ensure the economy in the consumed power by implementing the following complex of measures:

– improvement of the operation modes of the devices by the results of thorough

investigation of the operation modes of the equipment used in the technological process;

– iappropriate organization of the technological process operation in the limited

mode of electric power;

– ioptimization od consumptions of electric powerused in the technological process;

– iavoiding the short –term operation modes of technological devices.

The implementation of measures for saving the electric power consumptions in the ore grinding process is conditioned by the topology of the technological scheme, the type and number of the devices used in the scheme, the unstable nature of the process implementation and the quality requirements set to the processed concentrate.

2. Using energy-saving devices and technologies. The application of this method is justified only under the conditions of reducing the consumption of the power used to process the material of the required quality and quantity and the mutual profitability of expenses for introducing new equipment and technologies.

3. Reduction of power losses in the functioning power supply systems. Power losses are conditioned by the following components: losses in the power supply system elements; losses in consumers.

4.Regulation of interdepartmental issues. This issue is based on the introduction of the electric power rates, stimulating the reduction of power consumption in the peak hours.

The goal of the work. Considering the centralized electric powers in the ore grinding production, the topologies of various and multiphase technological schemes used, the developed technological; situation, the structure of electric load used in the process, a necessity arises to use the compensation possibilities of synchronous motors for the purpose of saving the energy in the grinding process. In the production process, to use the compensation possibilities of the synchronous motor, it is necessary to have a clear idea about the reactive powers produced by the synchronous motors and consumed by induction motors operating simultaneously at their different technical characteristics. Taking into account the aforesaid, the goal of the work is formulated.

The goal of the work is to develop an algorithm which will give an opportunity to estimate the joint operation of synchronous and induction motors used in the ore-grinding process by the reactive powers.

Statement of the problem. To implement the goal set, the consumption of the reactive power at the joint operation of synchronous and induction motors connected to one common bus of high-voltage substation, its distribution, and the power coefficient in the bus in different operation modes of the motors have been considered.

Investigation results.

1. Estimation of the reactive power consumption and its distribution in case of nominal overload of the synchronous motors and different overloads of induction motors

In the grinding process, the single-phase grinding schemes with various topologies are widely used. As an example, the scheme with 1 synchronous and 2 induction motors has been considered. In (Fig. 1), the block diagram of connection of synchronous and induction motors supplied from one common bus (point A).

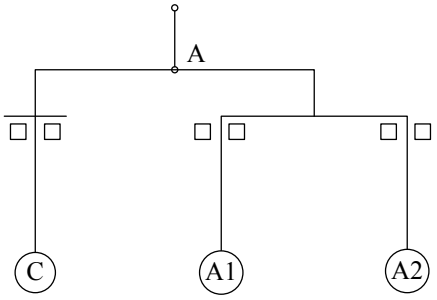

Figure 1. The block diagram of connection of synchronous and induction motors supplied

The reactive power of the synchronous motor is determined:

$$Q_{HC} = P_H tg\varphi_H,$$

where P_H is the active power of the synchronous motor in the nominal mode.

The reactive powers of the induction motors will be:

$$Q_{A1} = P_{A1} tg\varphi_H,\ Q_{A2} = P_{A2} tg\varphi_H,$$

where P_{A1}, P_{A2} are the active powers of the induction motorsin the nominal mode:

$$P_{A1} = P_{A1H},\ P_{A2} = P_{A2H},$$

while at the underloading or overloading of the motor:

$$P_{A1} = mP_{A1H},\ P_{A2} = mP_{A2H},$$

where m is the loading coefficient.

At the simultaneous operation of the motors, the total powers will be:

$$P_\Sigma = P_{HC} + P_{A1} + P_{A2},\ Q_\Sigma = Q_{HC} + Q_{A1} + Q_{A2}.$$

The power coefficient in the supply point A of the motors (Fig. 1) will be:

$$tg\varphi_A = Q_\Sigma / P_\Sigma.$$

The calculation data obtained for the DC213/24–32type of synchronous and A02–62–2У3, A02–71–2У3 induction motors are introduced in (Table 1).

Table 1.– Calculation results

Loading / Reactive power	**m = 1**	**m = 1.2**	**m = 0.8**
Q_c	140.4	140.4	140.4
Q_{A1}	7.95	9.55	6.36
Q_{A2}	10.3	12.35	8.23
$Q_A = Q_{A_1+}Q_{A2}$	18.25	21.9	14.59
$Q_\Sigma = Q_{c+}Q_A$	158.65	162.3	159.0
$\cos\varphi_A$	0.906	0.907	0.905

As it is seen, the increase in the loading coefficient leads to an increase in the reactive power consumption.

The possibility of ensuring 0,99 or 0,996 power coefficient in the supply point A of the synchronous motor in case of induction motors with different power coefficients has been considered (Table 2).

Table 2.– Calculation results

Power coeff. of synchronous. motor $\cos\varphi_c$	Q_c, **kW**	**Power coefficient of induction motor** $\cos\varphi_{A1,2}$	Q_{A1}, **kW**	Q_{A2}, **kW**	Q_A, **kW**	Q_Σ, **kW**	$\cos\varphi_A$
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
0.99	42	0.9	7.95	10.3	18.25	60.25	0.984
		0.85	10.54	13.64	24.18	66.18	0.982

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
0.99	42	0.8	12.75	16.5	29.25	71.25	0.978
		0.75	14.96	19.36	34.32	76.32	0.975
		0.7	17.0	22.0	39.0	81.0	0.973
0.996	26.31	0.9	7.95	10.3	18.25	44.56	0.991
		0.85	10.54	13.64	24.18	50.49	0.989
		0.8	12.75	16.5	29.25	55.56	0.987
		0.75	14.96	19.36	34.32	60.63	0.985
		0.7	17.0	22.0	39.0	65.31	0.982

Figure 2 introduces the dependences of the reactive powers produced by synchronous and consumed induction motors on the power coefficients of induction motors. From (Figure 2), it follows that parallel with the increase in the induction motor power coefficient, the reactive power required for its consumption decreases:

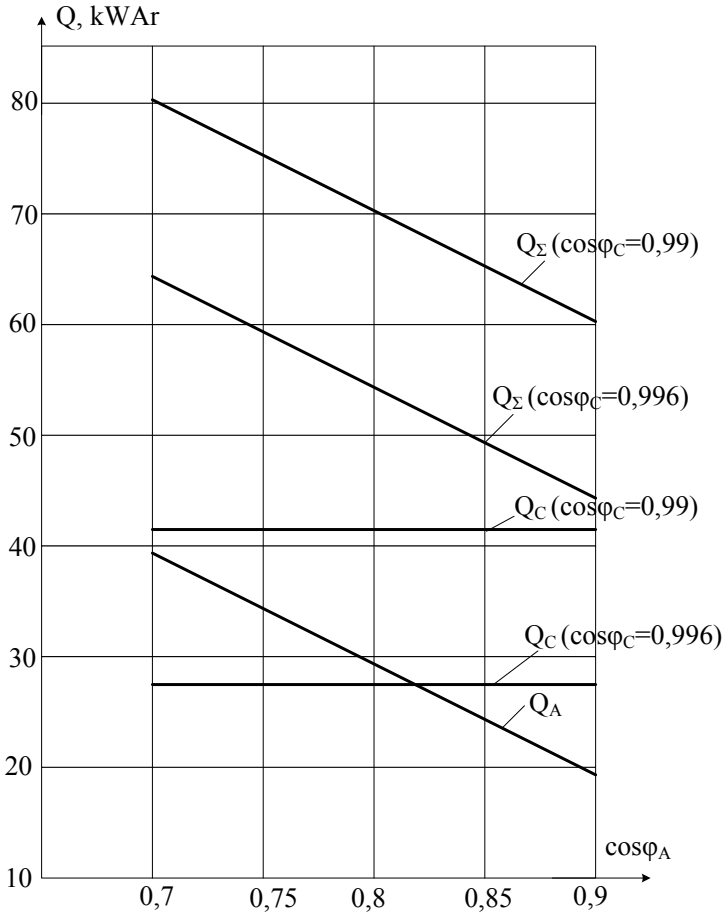

Figure 2. The required reactive powers of synchronous and induction motors, depending on the power coefficients of induction motors

2. Dependence of the synchronous motor reactive power on the angle θ of the load

The synchronous motor electromagnetic power, depending on the supply voltage, the excitation EMF, inductances of the motor's stator winding (X_d and X_q) and the angle θ of the load is expressed by the following formula [7]:

$$P_{EM} = m_1\left(\frac{U_c E_f}{x_d}\sin\theta + \frac{U_c^2}{2}\left(\frac{1}{x_q} - \frac{1}{x_d}\right)\sin 2\theta\right),$$

where x_d is the inductance of the stator phase by the longitudinal axis; x_q – the inductance of the stator phase by the transverse axis; U_c – the used phase voltage of the stator winding; E_f – the excitation electromotive force; θ – the angle of the phase shift between the main electromotive force and the network voltage vectors.

The reactive power of the motor expressed by relative values will be:

$$K_{Q_c} = \left(\frac{K_E K_u}{K_d}\sin\theta + \frac{K_u^2}{2}\left(\frac{1}{x_q} - \frac{1}{x_d}\right)\sin 2\theta\right) tg\varphi_c .$$

Figure 3 introduces the dependence K_{Q_c} of the synchronous motor reactive power coefficient on the θ angle of the motor at different values of the power coefficient.

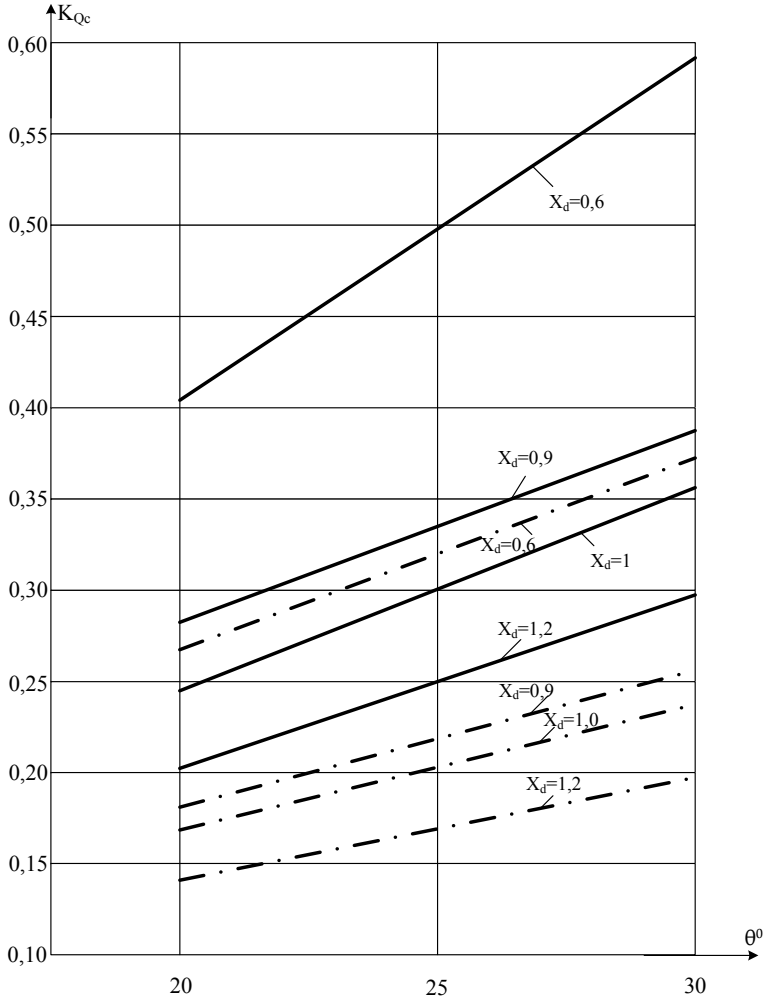

Figure 3. The dependence of the synchronous motor reactive power coefficient on the θ angle of the motor ($\cos\varphi_c = 0{,}9$; $\cos\varphi_c = 0{,}95$)

3. The calculation algorithm of the generated and consumed reactive powers of the joint operation of synchronous and induction motors and their distribution in the supply system. The possibilities of determining the reactive powers of synchronous and induction motors at changing the parameters of the motors and the supplying network so that the reactive powers required by induction motors should be compensated by the synchronous motor, ensuring the required value of the power coefficient in the point A of the supply.

Below is introduced the algorithm for calculation:

3.1. For the *m* synchronous motors used in the grinding process, we determine:

– the relative values $K_{Q_{c1}}, K_{Q_{c2}}, ..., K_{Qm}$ of thereactive power according to formula (8);

– the real values of the reactive powers:

$Q_{C1} = Q_{CH} K_{Q_{C1}}$, $Q_{C2} = Q_{CH} K_{Q_{C2}}$, $Q_{Cn} = Q_{CH} K_{Qm}$

3.2. For the *n* induction motors used in the grinding process, we determine:

– the relative values $K_{Q_{A1}}, K_{Q_{A2}}, ..., K_{Q_{An}}$ of thereactive power according to expression [8]:

– the real values of the reactive powers:

$Q_{A1} = Q_{AH} K_{Q_{A1}}$, $Q_{A2} = Q_{AH} K_{Q_{A2}}$, $Q_{An} = Q_{AH} K_{Q_{An}}$.

3.3. Determination of total powers

$Q_{\Sigma 1} = Q_{C1} + Q_{A1}$, $Q_{\Sigma 2} = Q_{C2} + Q_{A2}$, $Q_{\Sigma m} = Q_{Cm} + Q_{An}$,

where $Q_{\Sigma 1}, Q_{\Sigma 2}, ..., Q_{\Sigma m}$ are the total reactive powers generated by the synchronous motor, $Q_{C1}, Q_{C2}, ..., Q_{Cm}$ – the reactive powers required for the operation of the synchronous motor; $Q_{A1}, Q_{A2}, ..., Q_{An}$ – the reactive powers required for the consumption of the induction motor.

In case of the known values of powers $Q_{\Sigma 1}, Q_{\Sigma 2}, ..., Q_{\Sigma m}$, it becomes possible both to ensure the efficient operation of the synchronous motor and to compensate the demand for the reactive powers of induction motors by corresponding regulation of the synchronous motor excitation current.

By the calculation results carried out on the basis of the presented algorithm, dependences have been plotted (fig. 4), allowing to estimate the changes in the reactive powers of synchronous and induction motors used in the system at changing their characterizing parameters.

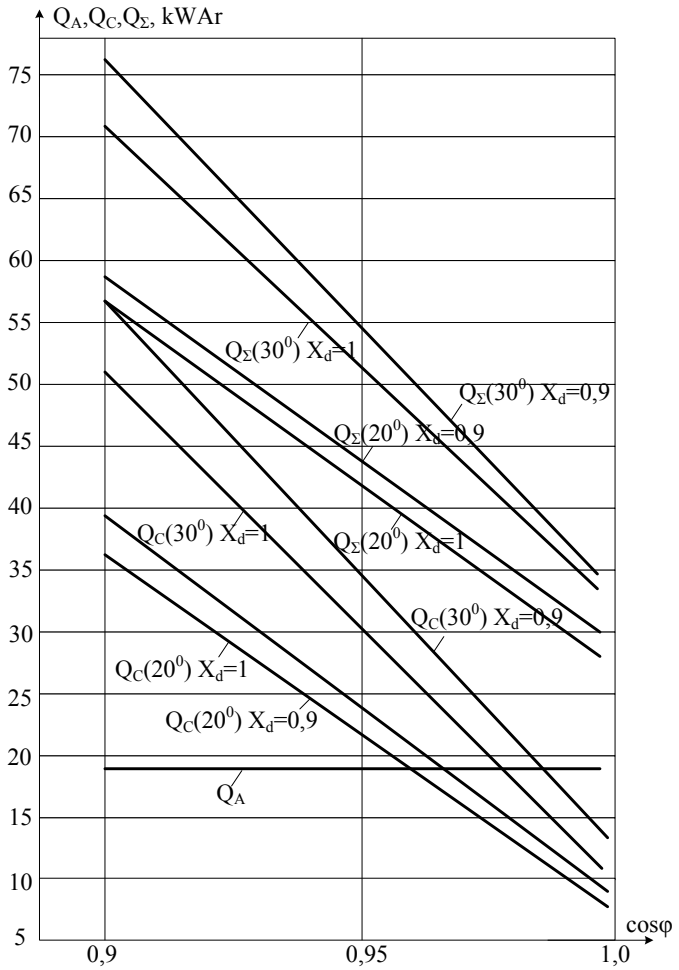

Figure 4.The changes of the reactive powers of the synchronous and induction motors under the conditions of changing their characteristic parameters

The block diagram of the automatic control system of the optimal distribution of the reactive power generated by synchronous motors is introduced in (Fig. 5).

The scheme operates by the algorithm presented below:

I. The active consumption powers of the synchronous and induction motors are respectively measured by the transducers PC1, PC2,…, PCm, and PA1, PA2…, PAn while the reactive powers – by the transducers QC1, QC2,…, QCm, and QA1, QA2,…, QAn. The measurement results are transferred to the computing block.

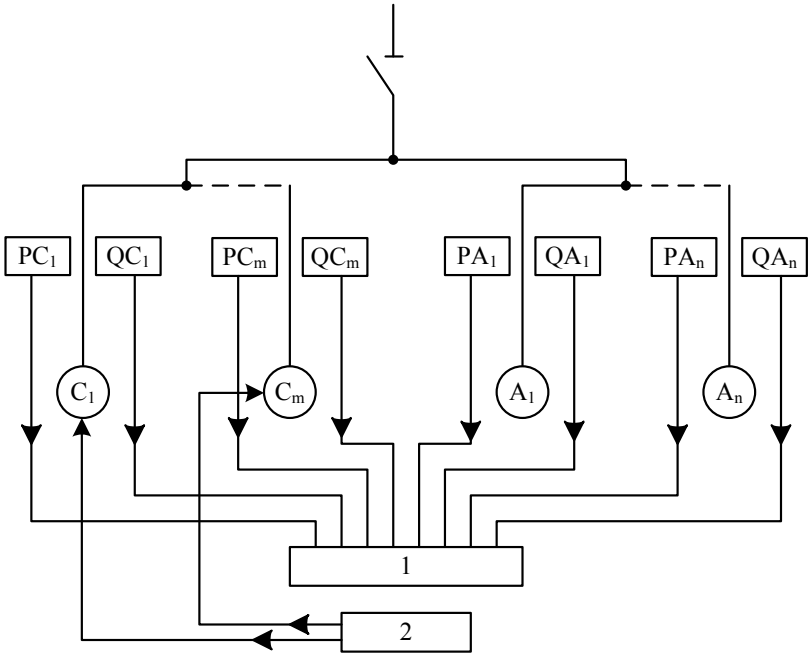

Figure 5. A block diagram of the automatic control system for the optimal distribution of the reactive power generated by synchronous motors

II. In the computing block, the analog signal changes into a digital one and according to the assigned power coefficient, we determine:

– the total reactive power required for the consumption of induction motors;

– the total reactive power required for the operation of synchronous motors;

– the value of the additional reactive power for induction motors to ensure the power coefficient set;

III. The optimal values of the reactive power produced by each synchronous motor [9].

IV. The value of the excitation current for each synchronous motor is determined, taking into account the optimal values of their reactive power.

V. The values obtained for the excitation current are transferred to the control block 2 which ensures the adequate values of the excitation currents of synchronous motors through regulation.

Conclusion. The analyses carried out allow to estimate the changes in the reactive powers of simultaneously operating induction and synchronous motors in the technological process, depending on their operation modes. The algorithm proposed allows to ensure the reactive powers required for the operation of induction motors by regulating the excitation currents of synchronous motors, ensuring at the same time the value of the power coefficient required in the supply point of the subsystem bus.

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CHOICE OF METHOD OF CALCULATION OF NATURAL ILLUMINATION UNDER NATURAL CLOUDY CONDITIONS

Abstract: In this article has showed elaboration a method for calculating natural light under natural cloudy conditions, the analysis of current methods for calculating natural light.

Keywords: cloudy, natural light, firmament, overcast days.

Introduction

Develop a method for calculating natural light under natural cloudy conditions, the analysis of existing methods for calculating natural light, one of the purposes. Choose from a variety of methods for calculating such, the scope of which, with the introduction of certain parameters and minor changes in it, in addition to cloudy and clear sky conditions, was also extend to natural cloudy conditions.

When choosing a method of calculation takes into account such characteristics as accuracy, reliability, convenience and ease of practical application in solving everyday problems of designing natural light.

In the result of the analysis method, satisfies all the requirements, was recognized as the method of Professor Kh. N. Nuretdinov [1], enabling the design of natural lighting carried out using specially designed monograms.

When developing this method prof. Nuretdinov Kh. N. considers the process of creating a complete picture of natural light indoors, as the union of elementary mathematical descriptions of individual factors. Such as: illumination of premises scattered light of the sky; illumination from the underlying surfaces and shading opposing elements; especially the passage of light through the glazed surface of the light aperture; redistribution of light indoors due to multiple reflections.

The disadvantage of the proposed formulas for determining the illumination of vertical surfaces is that their output does not take into account the influence of the underlying surface and reflected light inside the room.

As in the case of illumination on a horizontal surface, for vertical surfaces the angle α calculated from the horizontal working plane, which is taken at the level of the lower edge of the light aperture.

When determining the illumination of the vertical planes of the room, the surface integral of the second type is calculated, and the surface of the light aperture projected onto the plane XOZ.

$$E_M^V = \int_{npxzS} f\left(x.\varphi\left(x.z\right)z\right)dSxy. \qquad (1)$$

Where $f\left(x.\varphi\left(x.z\right)\right) = L_z\left(a+bz\right)$

Just as in the case of a horizontal surface, the calculation of the natural illumination of the vertical surfaces of the integral after the transition to the polar coordinate system by rather complex transformations solved, resulting in equations for determining the KEO on vertical surfaces[2, 3].

Dependence of KEO on parameters of a light aperture for the vertical surfaces parallel to planes of a light aperture has the form:

$$e_V = \frac{300}{\pi(a+2)}\left(\frac{a}{2}sin\beta_1 arctg\left(sin\beta_1 tg\varphi_1\right) - \frac{btg\beta_1 cos\varphi_1}{3\sqrt{tg^2\beta_1 + cos^2\varphi_1}} + \frac{b}{3}sin\beta_1 + \right.$$

$$+\frac{a}{2}sin^2\alpha\left(arctg\left(\frac{tg\varphi_2}{sin\alpha}\right) - arctg\left(\frac{tg\varphi_1}{sin\alpha}\right)\right) - \frac{b}{3}sin^3\alpha\left(\frac{cos\varphi_2}{\sqrt{1-cos^2\varphi_2 cos^2\alpha}} - \frac{cos\varphi_1}{\sqrt{1-cos^2\varphi_1 cos^2\alpha}}\right) + \quad (2)$$

$$\left. +\frac{a}{2}sin\frac{\beta}{2}arctg\left(sin\frac{\beta}{2}tg\varphi_2\right) + \frac{btg\beta_2 cos\varphi_1}{3\sqrt{tg^2\beta_2 + cos^2\varphi_2}} - \frac{b}{3}sin\beta_2\right)$$

Where α is the angle between the horizontal plane and the plane of drawn through the point in question and the upper line of the light aperture

β_1 and β_2 – angles between the plane of the characteristic section and the planes, passed through the point and lateral borders of the light aperture

$$\varphi_1 = arctg\left(\frac{tg\alpha}{tgb_1}\right); \quad \varphi_2 = arctg\left(\frac{tg\alpha}{tg\beta_2}\right)$$

Under, $\beta_1 = \beta_2 = \frac{\beta}{2}$, that is, the expression (2) is simplified for the points on the characteristic section of the room and takes the form of:

$$e_V = \frac{300}{\pi(a+2)}\left(\frac{a}{2}sin\frac{\beta}{2}arctg\left(sin\frac{b}{2}tg\varphi_1\right) - \frac{2}{3}b\frac{tg\frac{\beta}{2}cos\varphi_1}{\sqrt{tg^2\frac{\beta}{2} + cos^2\varphi_1}} + \frac{2}{3}bsin\frac{\beta}{2} + \right.$$

$$\left. +\frac{a}{2}sin^2\alpha\left(arctg\left(\frac{tg\varphi_2}{sin\alpha} - arctg\left(\frac{tg\varphi_1}{sin\alpha}\right) - \frac{b}{3}sin^3\alpha\left(\frac{cos\varphi_2}{\sqrt{1-cos^2\varphi_2 cos^2\alpha}} - \frac{cos\varphi_1}{\sqrt{1-cos^2\varphi_1 cos^2\alpha}}\right)\right)\right) \quad (3)$$

was constructed to calculate KEO on a vertical surface parallel to the plane of the light aperture.

Where $\varphi_1 = arctg\left(\frac{tg\alpha}{tg\frac{\beta}{2}}\right); \varphi_2 = \pi - \varphi_1$

When solving the equation (3) using computers for clear sky conditions at a = 2.74, a monograms

For vertical surfaces perpendicular to the plane of the light aperture, the expression for the definition of KEO obtained in the following form:

$$e_w = \frac{300}{\pi(a+2)}\frac{a}{2}\cdot$$

$$\cdot\left(cos\beta_1 arctg\left(cos\beta_1 tg\alpha\right) - cos\beta_1 arctg\left(cos\beta_2 tg\alpha\right) + \frac{\beta}{3}\left(cos\beta_1 - \frac{ctg\beta_1 cos\alpha}{\sqrt{cos^2\alpha + ctg^2 1}} + \frac{ctg\beta_2 cos\alpha}{\sqrt{cos^2\alpha + ctg^2\beta_2}} - cos\beta_2\right)\right) \quad (4)$$

If the room has a continuous strip of light across the width of the plant:

$$e_W = \frac{300}{\pi(a+2)}\left(\frac{a}{2}\left(\alpha - cos\beta arctg\left(cos\beta tg\alpha\right)\right) + \frac{\beta}{3}\left(1 - cos\alpha + \frac{ctg\beta cos\alpha}{\sqrt{cos^2\alpha + ctg^2\beta}} - cos\beta\right)\right. \quad (5)$$

Where $\beta_1 = 0; \beta_2 = \beta$.

When solving the equation (5) on the computer, the following monograms was obtained as in the case of nomograms for calculating KEO on a horizontal surface, using nomograms it is possible to solve the inverse problem-finding the parameters of the light aperture at known values of KEO on vertical surfaces.

Developing his own method of calculation of natural illumination with the help of monogram has obtained solution on a computer the exact analytical dependences. Professor Nuretdinov not limited only

to the calculation of luminance on horizontal and vertical surfaces in the room and expanded his research, and in [1] it provided exact analytical expressions for the determination of the coefficients of cylindrical and spherical natural illumination for rooms with side ribbon glazing taking into account the uneven distribution of brightness of the firmament:

$$e_{ц} = \frac{100\beta}{2\pi\left(a\left(\frac{\pi}{2}-\frac{1}{3}\right)+\frac{1}{3}\right)}\left(a\left(\frac{\alpha}{2}-\frac{1}{4}sin2\alpha\right)+\frac{b}{3}\left(1-cos^{3}\alpha\right)\right) \quad (6)$$

$$e_{c} = \frac{100}{\pi\left(a+1\right)}\left(\beta asin\alpha + b\left(\frac{\beta}{2}cos\alpha arctg\left(\frac{\beta}{2}-cos\alpha\right)\right)\right) \quad (7)$$

Solving the equations (6) and (7) with the help of computers it is possible to construct monogram's for calculation of coefficient of natural cylindrical and spherical illumination (KETSO and KESO), which can also be used in determining the size of light openings at known values of coefficients of natural illumination.

So, the method of calculation of natural light prof. Nuretdinov was chosen by the authors of this work as corresponding to the original task, namely the development of a method for calculating the natural light in natural cloudy conditions for the food industry on the basis of the existing method of calculation by introducing additional parameters, its correcting. The method set out in the work involves the calculation of natural light for rooms with side, mainly tape, glazing; namely, this lighting system is typical for shops in the food industry.

Analytical dependences for the calculation of natural light in the method make it possible to design the light in the room taking into account the uneven brightness for different cloudy conditions. Thus, having studied the conditions of natural illumination under natural cloudy conditions and determined the values of the relative brightness of the sky under these conditions, it is possible to calculate the values of parameters, the introduction of which into analytical dependencies will determine the values of KEO under natural cloudy conditions.

Conclusions

One of the factors that determined the choice of Prof. Nuretdinov's method, fundamental for the research carried out in this work, is also the fact that it makes it possible to calculate the natural illumination not only on horizontal, but also on vertical, variously oriented in relation to the light transmission surfaces. As well as, moving to the spatial characteristics of the light field, to determine the average spherical cylindrical illumination.

It is also very important to note that despite the complexity of analytical dependencies in the method due to the accuracy of the calculation, the method is very simple to use in solving practical problems.

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PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE ZINC CONTENTS RAW MATERIAL OF THE KHANDIZA DEPOSIT

Abstact: The results of the analysis of zinc contents ore and concentrate of the Khandiza deposit, physical and chemical investigations of ore and concentrate, are given by chemical and physical and chemical analysis. It is shown that the main elements of the ore are silicon, zinc, aluminum, iron and copper. When enriching the ore, the content of silicates, aluminum, iron decreases and the contents of zinc and copper increase.

Keywords: zinc containing ore, concentrate, insoluble residue, acid decomposition, silicate minerals.

Introduction: Sphalerite (Greek Σφαλερός "sphaleros" – blende), zinc blende – mineral of the class of sulphides.

Contents (formula): Zn S. (Zn, Fe)S – formula of solid solution, more accurately reflecting the typical composition of the mineral; As an impurity, Fe, Cd, In, Ga, Co, Mn, Ag, Au, Hg, As, and other elements are encountered. Zn – 67.1%, S – 32.9%. Most impurities are Fe (up to 20%). Sometimes chalcopyrite ($CuFeS_2$) and occasionally stannite (Cu_2FeSnS_4) are present in the form of the same inclusions, which explains the impurity in sphalerite of copper and tin. Often in the form of an isomorphous impurity, Cd (usually up to tenths of percent), In (up to one-hundredths of percent), Co, Mn, Hg and etc. are present [1, 2].

The sphalerite stone is zinc sulphide, fairly common mineral, which is one of the main sources of zinc metal. For its properties sphalerite is called zinc blende – the stone also contains associated iron impurities, which, depending on the quantity, strongly affect the appearance of the mineral. Therefore, it is often confused with other breeds, especially with galena. The color palette of sphalerite is very wide, as a result of which it can also be called pseudo-galena, copper blende, ruby blende, marmarite, clayophane and others. And it is not so much synonyms, as the designations of different varieties of this mineral, differing in color and content of accompanying metals.

Sphalerite is one of the main sources of zinc production from ore raw materials, which is usually in sulphide state. From sphalerite, metal zinc is smelted, along with the extraction of impurities: Cd, In, Ga, and other valuable components. Sphalerite used in paint and varnish production for the manufacture of zinc white, used to produce brass. Great importance is the production from natural sphalerite of chemically pure luminophore ZnS, activated Ag, Cu, which is used for the production of luminophores, various light compositions and luminous paints. In addition, natural sphalerite can be used as a photocatalyst for the decomposition of dyes in water [3].

Objects and methods: The investigations were carried out with zinc-containing ore of Khandiza

deposit containing 4.95–5.15% Zn and zinc concentrate containing 39.45–40.50% Zn.

Chemical analysis of initial, intermediate and final products was carried out by known methods [4–8].

For investigation of chemical and mineralogical contents of zinc concentrates and ore, we used X-ray fluorescence spectrometer (Zetium), an atomic absorption spectrometer (Perkin-Elmer, AAS-30-UCA-690 Elan), X-ray phase analyzes (Shimadzu, XRD6100), IR spectroscopy (Shimadzu, IRAffinity-1), electron microscopy (Leica DM500, Germany).

With the purpose of improving the technology of processing of polymetallic raw materials and developing strategy for complete, comprehensive processing, data from detailed mineralogical and chemical analysis of both the Khandiza ore and the sphalerite concentrates containing number of valuable components are needed.

Analysis of the chemical composition showed that the Khandiza deposit has complex composition (Tables 1, 2).

Most of the elements are in the form of an isomorphous mixture in sulphides.

Pyrites prevail in all varieties of pyrite ores (with variations in content from 60 to 90%), sphalerite, galena and chalcopyrite – 5–7%. Nonmetallic minerals are represented by sericite (up to 55%), quartz (up to 30%), chloride (up to 8%) and carbonates. Pb content in ores of this type rarely exceeds 1–3%, Zn – 3.0–5%, Cu – 0.25%.

Complex mineralogical composition has massive and veined-disseminated pyrite-polymetallic and polymetallic ores. Ore is mainly represented by sphalerite, galena, pyrite, chalco pyrite, faded ore (95% of the mass of ore). In small quantities, there are arsenopyrite, marcasite, pyrrhotite, hematite, magnetite, bornite. Nonmetallic compounds are represented by quartz (80–90% non-metallic component), sericite 2–10%, chloride and carbonate (less than 1%).

Table 1 presents data of the spectral analysis of the Khandiza ore. The main elements of the ore are silicon, zinc, aluminum, iron, copper. The content of sodium, potassium and magnesium is in the range from 1% to 3%. The remaining elements make up the tenth and hundredths of percent.

Table 1. – The results of spectral elementary analysis of the zinc contents ore of the Khandiza deposit

№ samples	Si, %	Zn, %	Al, %	Ca, %	Na, %	K, %	Fe, %	Mg, %	P, %	Ba, %	Mn, %	V, %	Ti, %	Cu, %	Pb, %	Bi, %	Ni, %	Sb, %	Zr, %
1.	30	4	4	0.4	1	0.8	5	1	0.04	0.01	0.05	0.01	0.03	2	0.5	0.003	0.003	0.01	0.003
2.	30	3	8	0.5	1	0.8	5	3	0.05	0.02	0.05	0.01	0.03	2	0.5	0.002	0.001	0.006	0.005
3.	30	3	10	0.5	1	0.8	5	2	0.04	0.03	0.05	0.01	0.03	2	0.4	0.001	0.001	0.006	0.005
4.	30	3	10	0.5	1	1	5	3	0.04	0.02	0.05	0.01	0.02	1	0.5	0.003	0.001	0.005	0.005

Table 2. – Results of X-ray fluorescence analysis of zinc ore from the Khandiza deposit

№ samples	Si,%	K,%	Ca,%	Ti,%	Mn,%	Fe,%	Co,%	Cu,%	Zn,%	Mo,%	Cd,%	Pb,%
1.	25.0	3.40	1.10	0.082	0.035	3.39	0.012	0.70	5.03	<0.003	0.081	2.27
2.	25.5	3.10	0.90	0.075	0.040	3.40	0.010	0.80	5.00	<0.003	0.090	2.01
3.	25.3	3.25	0.95	0.065	0.030	3.35	0.014	1.01	5.15	<0.003	0.085	2.10
4.	25.8	3.30	1.15	0.070	0.035	3.41	0.012	0.90	4.95	<0.003	0.083	1.99

The data of X-ray fluorescence analysis of zinc ore confirmed the data of spectral analysis for the content of silicon, zinc, iron, copper. The data on the content of potassium, calcium is slightly higher and make up more than 3% for potassium and about 1% for calcium.

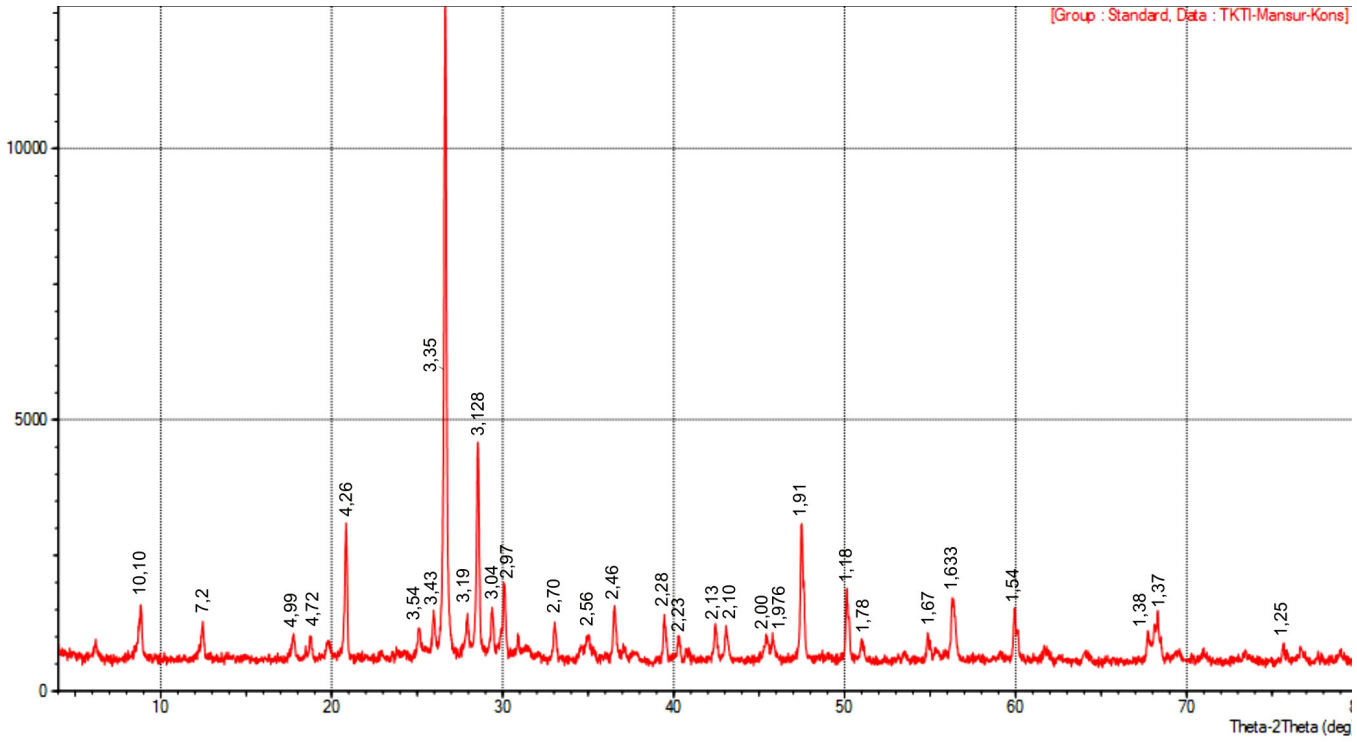

Figure 1. Roentgenogram of the zinc contents ore of the Khandiza deposit

On the roentgenogram of zinc ore, there are differential peaks related to zinc and iron sulfides and sulfates, to silicon oxides, carbonate and lead cyanide, and zinc astatine (Fig. 2). Peaks 3.43; 3.35; 3.04 Å belong to silicon oxide, 10.10; 7.2 Å belong to magnesium zinc, 2.97; 2.70 Å belong to iron sulphide, 2.56; 2.46; 2.28 Å belong to the zinc astatine of different forms, 2.23 Å belongs to zinc iron, 2.13; 2.10; 2.00; 1.91 Å belong to zinc sulphate of various shapes and the peak of 1.633 Å is zinc sulphide of β form.

Identification of the samples was carried out on the basis of diffractograms, which was recorded on computer-controlled XRD-6100 (Shimadzu, Japan). CuKα radiation was used (β filter, Ni, 1.54178 current and voltage mode of 30 mA tube, 30 kV) and constant detector rotation speed of 4 deg/min in steps of 0.02 deg. (ω/2θ – coupling), and the scanning angle varied from 4 to 80o.

Table 3 shows the spectral analysis of the zinc concentrate of the Khandiza deposit. The obtained results indicate decrease in the content of silicates, aluminum, iron, and an increase in the concentration of zinc, copper. With slight increase in the copper content, the zinc content rises to 25–40%.

X-ray fluorescence analysis of the concentrate confirms the spectral analysis in the reduction of silicates, and also indicates decrease in copper compounds in contrast to spectral analysis.

Table 3.– The results of spectral elemental analysis of the zinc concentrate of the Khandiza deposit

№ samp.	Si, %	Zn, %	Al, %	Ca, %	Na, %	K, %	Fe, %	Mg, %	Mn, %	V, %	Ti, %	Cu, %	Pb, %	Bi, %	Sb, %	Zr, %
1.	15	25	0.1	0.01	0.3	1	1	0.2	0.04	0.002	0.004	3	0.5	0.005	0.006	–
2.	15	30	1.0	0.02	0.2	3	3	0.3	0.04	0.004	0.01	3	1.0	0.006	0.03	0.002
3.	15	30	0.1	0.02	0.3	2	2	0.2	0.04	0.003	0.003	4	1.0	0.006	0.04	–
4.	15	40	0.2	0.02	0.3	3	3	0.2	0.04	0.004	0.004	6	3.0	0.006	0.04	–

Table 4. – Results of X-ray fluorescence analysis of the zinc concentrate of the Khandiza deposit

№ samp.	Si, %	K, %	Ca, %	Ti, %	Mn, %	Fe, %	Co, %	Cu, %	Zn, %	Mo, %	Cd, %	Pb, %
1.	13.10	0.95	0.56	< 0.01	< 0.01	1.65	< 0.01	0.82	40.40	0.033	0.41	3.01
2.	13.00	0.95	0.59	< 0.01	< 0.01	1.62	< 0.01	0.80	40.10	0.032	0.42	3.05
3.	13.00	0.96	0.58	< 0.01	< 0.01	1.60	< 0.01	0.78	39.45	0.034	0.40	3.00
4.	13.50	0.96	0.57	< 0.01	< 0.01	1.60	< 0.01	0.80	40.50	0.033	0.41	3.06

To confirm the salt contents, the roentgenogram and IR spectra of the zinc concentrate were taken (Fig. 2, 3).

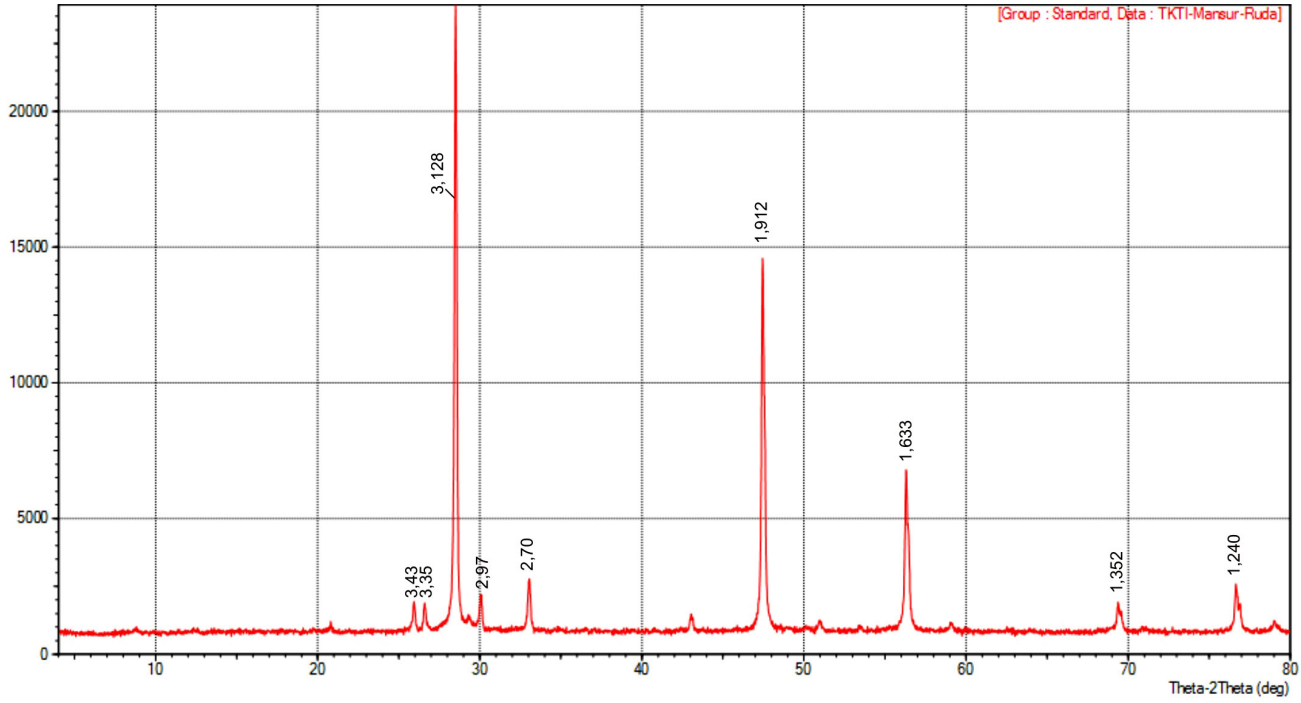

Figure 2. Roentgenogram of the zinc concentrate of the Khandiza deposit

The X-ray diffraction pattern of zinc concentrate contains differential peaks related to zinc and iron sulfides, zinc silicofluoride and silicon oxides. The peaks 3.43 and 3.35 Å belong to silicon oxides, 3.128 Å belong to the zinc sulphide form, 2.97; 2.70 Å belong to zinc sulphide, 1.912; 1.633; 1.240 Å belong to the zinc sulphide β form and the peak 1.352 Å is zinc silicofluoride.

IR spectra have absorption bands of 2092.209 cm^{-1}, which are related to cyanide groups. The absorption bands of 1648.590 cm^{-1} refer to thiosulfates, absorption bands 1390.289; 1340.544; 1195.810 cm^{-1} – refer to nitrogen and nitrate groups. The absorption bands of 1030.926 cm^{-1} refer to silicate groups, and the absorption bands of 878.510; 803,727; 675.485 cm^{-1} refer to sulfate and carbonate groups. The bands have a broadened structure, due to intermolecular interactions in the crystal structure of the mineral object. This also confirms the obtained data of chemical and X-ray phase analyzes.

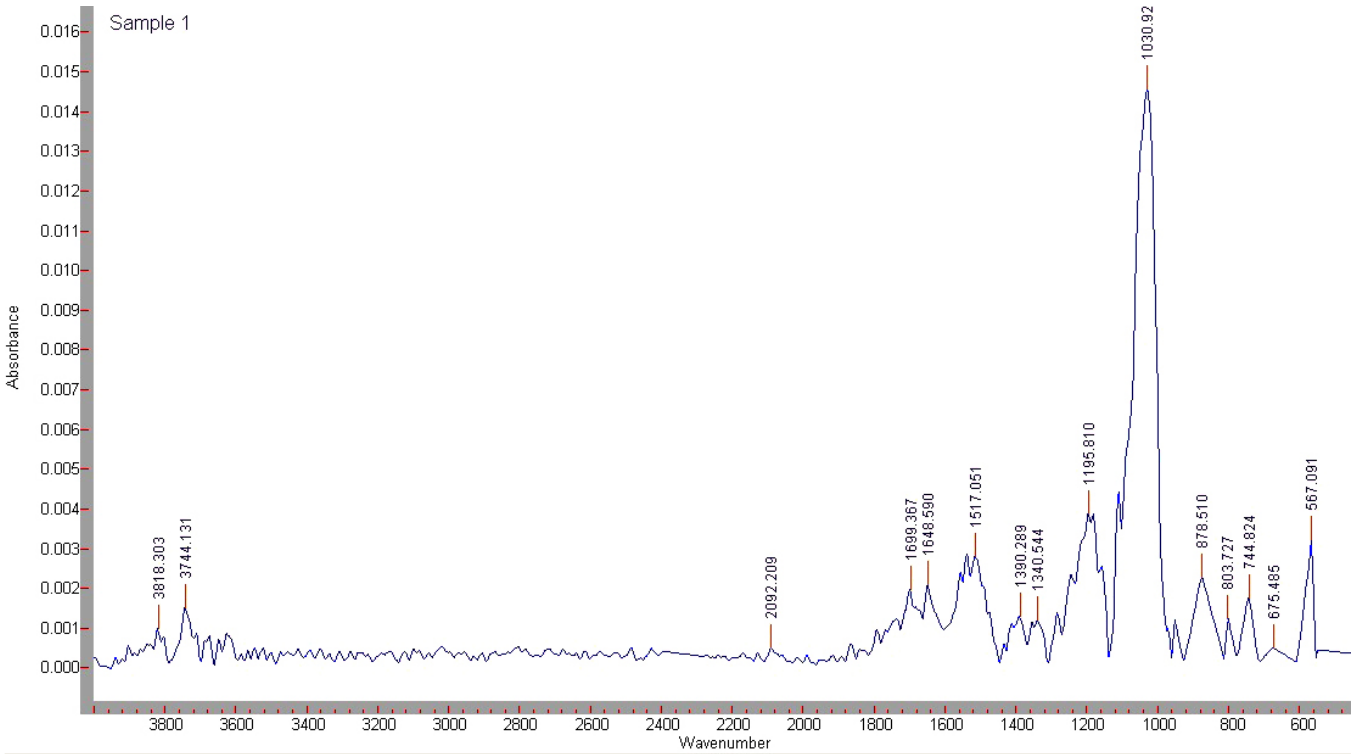

Figure 3. IR spectrum of the zinc concentrate of the Khandiza deposit

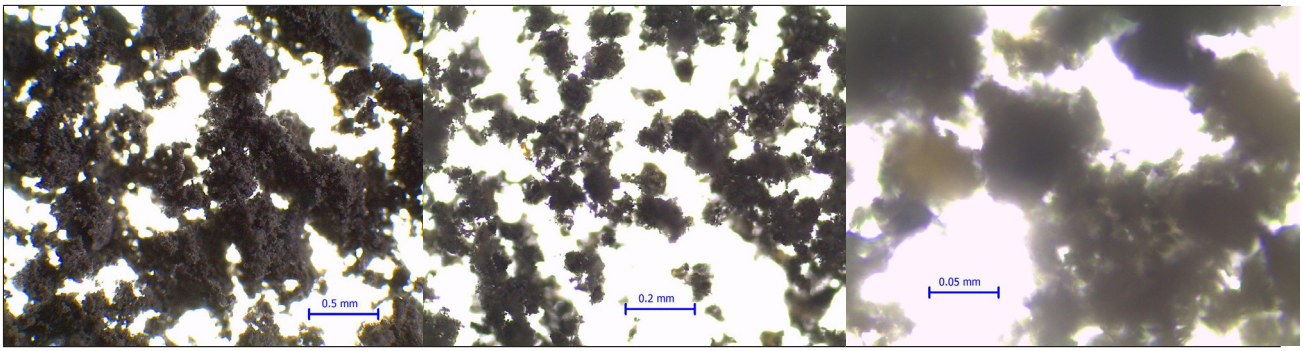

Figure 4. Microphotograph of the zinc concentrate of the Khandiza deposit

Figure 4 presents micrographs of zinc concentrate. They have more dark spots, which are due to zinc sulfides, partly iron sulphides. This is yet another confirmation of the composition of the zinc concentrate of the Khandiza deposit.

Conclusion: Thus, carried out investigations of mineralogical and chemical composition of the zinc concentrate show that the zinc concentrate of the Khandiza deposit is of interest for processing in order to effectively produce zinc chloride on an industrial scale.

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ELABORATION OF NEW TYPES OF FOOD STUFF WITH ANTI ANEMIC EFFECT BASED ON ANIMAL RAW MATERIALS

Abstract: The article describes the methods of separating heme from formedelements of blood content of slaughter animal as long as blood content holds gland.

The article introduces the technology with wasteless process, the development of new antianemic action food by thermoplastic extrusion. The article presented the technology development of these products and the results of their clinical trials. Moreover, it includes new suggestions related to sausage production based on animal raw materials.

Keywords: Component, separation of plasma, globins, oxidation, hemoglobin, protein.

Today a large part of adults and children are exposed to diseases caused by iron deficiency anemia in the Republic. In this regard, an important issue is the development of new food products with therapeutic and prophylactic action, enriched with iron.

The main factor determining the therapeutic efficacy of the product is included in its composition of iron-containing component. Today, the food industry has a sufficient amount of raw material containing a component that is highly digestible by the human body. The protein product is a nutritional blood of slaughtered animals, in which averages of 0.040% iron in the form of heme in hemoglobin protein composition. As the hemoglobin is the main protein formed elements, stabilized nutritional blood is separation for division into plasma and corpuscles. The last one dry residue contains 0.15% of iron, which is concentrated in the prosthetic group of this complex protein – heme.

The presence of hemoglobin in the blood determines the red color, which makes its use as a valuable raw material for the production of protein meat products. In this regard, for developers of new technologies is a difficult task to discolor the blood or its formal elements, which eventually can be achieved by separating the heme from the globin, or its oxidation. The separated heme can be used as a source of heme iron in the production of therapeutic and prophylactic antianemic action [1]. There are a number of methods that allow to solve this problem. The traditional method is the chemical separation of hemoglobin heme and globin by the method of Tibor. Its accomplishment involves hemolysis formed elements of water, chloroform treatment, the addition of ascorbic acid to weakening of the connection between heme and globin, as well as treatment acidified acetone extraction of the heme group.

However the given method involves not only the significant amounts of acetone but the obtained globin acquires an unpleasant taste. The use of other solvent – butane does not have such a strong effect on the globin. Nevertheless it is impossible to com-

pletely remove the solvent, which has a negative impact on human health, food which have been developed with the protein globin. This method cannot be considered safe based on not only the toxicity but also the fire risk[2].

Another known method involves enzymatic hydrolysis of hemoglobin in the acid medium for 10–24 h, subsequent neutralization with calcium hydroxide, separating the unhydrolyzed part by filtration or centrifugation. Hydrolysis of globin protein in place of its cleavage products are obtained in the form of amino acids and peptides, separated from the gem and having low bitter taste and functional properties. Their water binding and emulsifying capacity by an average of 30% lower than the original hemoglobin.

The methods based on the oxidation of heme strong oxidants, envisage further using of obtained insoluble protein product as components of raw materials for the elaboration of certain types of meat products as a substitute for 10% of meat protein. It should be noted that the remaining product in a strong oxidizing agent (e.g. hydrogen peroxide) negatively affects other feedstock components, changing, in particular, their colors and oxidizing the contained fat. Thus, the storage of sausages with blood discolored strong oxidants, its color changes on the cut and becomes yellow.

These technologies show their complexity, multistage, duration, there are significant weaknesses in the quality of products. All this explains why they are not accepted for service industry.

It is also necessary to taking into account the potential volume of sales of manufactured products, as well as the using of technology, providing lasting chemical processing of raw materials which can be an obstacle to their deployment into the production.

This requires a fairly simple and not labor methods of processing raw materials, affordable and equipment operating costs, high yield and quality of manufactured products, which ensures the effectiveness of their application.

Such requirements are satisfied in the production of stabilized blood and blood formed elements of black edible albumin as a source of heme iron. Improvement of this process is based on a new principle feedstock drying, provide the using of low-pressure steam, the possibility of placing dryers in a one-story house, in the absence of the final product tendency to caking during storage and a high content of soluble proteins from bacterial safety. These requirements are implemented in dryers with a vibrated fluid bed of inert material such as A1-FMU, A1 and A1 FMYA-FMB. In installations of this type use a vapor pressure of 0.5 MPa, their height does not exceed 4.5 m, the content of soluble protein substances in the finished product is not less than 90% (for the highest grade), the presence of scales and prevents caking films.

By using black edible albumin was established food antianemic action. The most well known is child gemotogen. It consists of 4% black edible albumin as a source of heme iron, as well as sweetened condensed milk, glucose syrup, vanilla.At the Research Institute of sanitation, hygiene and nutrition of the country has been developed the technology for producing of anti anemic action products. Which it is composed of black food albumin, milk sugar, wheat flour, starch.The technology provides a one-step and short-term (1–2min) handling raw mixture by extrusion cooking. The extrudate thus obtained the following chemical composition in%: moisture –5–12 protein, fat –2.5–80 carbohydrates, mineral salts –1,–5 iron. High solubility indicates the deep degradation of starch, which determines a good digestibility of the final product.

Studies have shown that this technology provides the death of microorganisms contained in the raw material mixture, and allows to get it safely in sanitary terms product. Clinical studies of the product on women aged 25–35, suffering from iron deficiency showed that after 20 days of regular reception providing additions to orgasm 5 mg of iron per day,

the concentration of hemoglobin in blood have increased to 14.0 g / dm3, serum ferritin blood – 4.5 ng / cm3 serum iron at 1.49 mol / dm3, transferrin saturation ratio increased to 0.9.

These data indicates that the inclusion of anti anemic product in the diet of persons suffering iron deficiency, improves biological indicators characterizing iron metabolism.

It should be emphasized that this technology is characterized by simple, and allows you to implement a comprehensive waste-free processing of the raw material mixture in a single unit, guarantees a safe in sanitary terms and high biological value of the product.

The same technology is used for production of therapeutic and prophylactic product supply multipurpose, as part of the raw material which is also present black eatable albumin. This product is positively established in the treatment of hypertension, diabetes and gastric diseases.

Great opportunities for the production of food antianemic action opens the using of formed elements and stabilized blood to produce sausages and minced semi-finished products (Table 1). A large range of blood boiled, smoked sausages and brawn. For their production does not require special equipment. These products, as well as semi-finished minced using blood carried out on conventional equipment sausage shops of any power [3]. It should be noted that the production of sausages, frankfurters and sausages with haemo- protein and fat emulsions that can replace part of the raw meat in the recipe of sausage products, enriches them with iron and reduces the cost price.

To obtain protein and blood-fat emulsions can be used raw fat. This significantly reduces heat costs compared with the elaboration of it melted fat, and also makes it possible using the protein portion of raw fat as edible raw product [4]. The Research Institute of sanitation, hygiene and nutrition developed normative documentation for the production of cooked sausages, frankfurters and sausages with the introduction of protein-carbohydrate-fat emulsions, where the carbohydrate moiety was used to enrich wheat flour locally produced.

For deployment it into production, the development of new food anti anemic action on the basis of raw materials of animal origin must be clearly and professionally show its harmlessness, high digestibility and efficiency of using in the daily diet for the prevention and treatment of anemic disorders.

Table 1.– The results of the experiments on the use of beef in a stable blood

Indicators	**A 5% stabilized blood**		**10% stabilized blood**	
	delayed	**without exposure**	**delayed**	**without exposure**
Raw beef				
Moisture contents,%	76	76	76	76
Viscosity, 10^{-5} *pz*	0.85	0,87	0.77	0.78
The shear modulus, 10^{-3} *dyne/cm*^{2}	1.37	1.40	1.27	1.29
Stickiness, *g / cm*^{2}	48	48	51	50
finished product				
The compression ratio,%	32	32	30	30
Elasticity,%	38	39	40	41
Ductility,%	49	48	46	45
Cutting force, *g/cm*	460	460	530	550
moisture loss during the heat treatment, to the initial content%	16.0	16.3	15.4	15.1

This will undoubtedly contribute to the organization of production of special category called anti anemic food anti anemic destination.

The developed technology of treatment and prevention, anti anemic food is distinguished by its usefulness to the human body, and can be introduced into production in the food industry of different capacities, using the raw materials of animal origin.

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UTILIZATION OF ROCKET FUEL OXIDIZERS BASED ON NITRIC ACIDS

Abstract: Continuous emission sources of ecological condition of the planet together with industrial wastes are both non-standard rocket fuels and their oxidizers. In this connection the task of utilizing non-liquid components of missile fuels is vitally important, relevant and requires rapid solution. The paper offers processing method of oxidizer into the technical and industrial goods.

Keywords: missile fuel oxidizer, utilization, nitric acid, nitrogen tetraoxide.

In the world the situation has developed in such a way that scientists began paying much special attention to the processes which negatively influence on the environment. It is obvious that industrial wastes are a constant source of pollution of an ecological condition of the planet.

These wastes, for example chemical wastes, can be valuable raw materials for producing various chemicals to recycle them in industry.

For the last decades in Germany essential changes have occurred in the management of wastes: country passed a way from simple burial to processing and reasonable use of secondary resources. Recycling process is any way of utilization in which materials of wastes are subjected to the processing that makes products, materials or chemicals suitable for their utilization. Germany is a pioneer in the field of a recycling of wastes both in Europe, and beyond its boundaries. There is hardly any other country where so many raw materials are produced from wastes, as it is done in Germany. German recycling technologies are leaders all over the the world.

Therefore the first stage of development of a recycling system in Germany is related to the creation of the Federal Union of German industry on waste management in the beginning of 1960s.

One of the examples of negative impact on ecology is the storage of sub-standard missile fuels.

In the territory of the Commonwealth of Independent States including Azerbaijan a large number of various components of missile fuel which are not used since the former Soviet Union are concentrated. After the breakup of the Soviet Union many military bases were faced the fact of various toxic components of missile fuel which after many years and the expiration of storage time represent a serious threat to the environment and the population in settlements. In this regard the problem of elimination and utilization of accumulated components of missile fuel is vital and very relevant, requiring the solution at the international level.

As it is known two-component fuels (TG-02, TM-185, etc.) were used in liquid rocket engines (LME) with nitrate oxidizers under the technical name "Melange". These oxidizers were developed in the middle of the last century.

Now the storage of all these components results in the risk of violation of an ecological condition in certain regions. Therefore the high-priority problem is to start the elimination dangerous unsuitable components of rocket fuel for the environment and mankind as soon as possible without waiting for an ecological disaster.

Nitrate oxidizers is the category of components of liquid rocket fuel applied in military missiles, space carrier – vehicles, etc. where the use of liquid oxygen is impossible or inexpedient due to its evaporation.

These oxidizers contain concentrated nitric acid, and corrosion inhibitors added to decrease corrosion effect of an oxidizer on communications and the equipment of the rocket engine as well as tanks in which oxidizers are stored.

Physical properties of these oxidizers are defined by content of nitrogen oxides and water in them. Main properties: from light yellow to brown; density at 15.6 °C 1.511–1.575 г/см^3; temperature of boiling 66–86 °C.

The mixture of HNO_3:$N_2O_4H_2O$ is a strong oxidizer and therefore the interaction with the vast majority of combustible substances leads to spontaneous ignition.

Notwithstanding that nitric acid and oxidizers on its basis are corrosion active agents, some metals interact with it very poorly. Among these are aluminum and its alloys nickel-chromium alloyed steels, cast iron and ferro-salicyl alloys. Due to the corrosion of metal of tanks and technical means under long-term contact with an oxidizer the composition of an oxidizer changes, it is polluted with salts and technical means are destroyed.

Effective means of reducing corrosion dissolution rate of metals is the use of corrosion inhibitors,

the most effective of which is iodine – and fluorinated inhibitors in an amount of 0.4 – 0.5%.

The estimated composition of some oxidizers of rocket fuels is given below:

AK-20I: 80% HNO_3, 20% N_2O_4, iodine-containing inhibitor

AK-27I: 73% HNO_3, 27% N_2O_4, iodine-containing inhibitor

AK-27P: 73% HNO_3, 27% N_2O_4, fluorine-containing inhibitor

Table 1.– Oxidizers on the basis of nitric acid

Parameters	**Oxidizer**		
	AK – 20I	AK – 27I	AK – 27P
Weight percent of nitrogen oxides (N_2O_4),%	17.5 – 22.5	24.0 – 28.0	26.7 – 28.0
Weight percent of water,%	3.3 – 4.3	1.3 – 2.0	1.3 – 1.6
Weight percent of iodine,%	up to 0.04	0.12 – 0.16	–
Weight percent of hydrogen fluoride (HF),%	–	–	0.3 – 0.55
Weight percent of ortho-phosphoric acid (H_3PO_4),%	–	–	0.05 – 0.13
Weight percent of dissolved aluminum salts (Al_2O_3),%	0.04	–	–
Weight percent of nitric acid,%, not less than	72.9	69.8–70.2	69.5
Weight percent of mechanical mixtures,%, not more than	0.01	0.01	0.01
Weight percent of phosphate ion, %, not more than	–	–	0.002
Density at 20 °C, g/sm^3	1.587 – 1.604	1.603 – 1.616	1.606 – 1.611

Two directions of utilization of melange are generally used.

– Destruction (burning). For economic and ecological reasons this method cannot be realized commercially.

– Processing of oxidizer to technical and industrial goods. This method of utilization opens the possibilities for production directed to the agricultural application.

Considering high toxicity of nitrogen-containing oxidizers of a rocket fuel Azerbaijan finished the destruction of reserves of rocket fuel oxidizers which remained in the territory of the state since the Soviet Union by the program of NATO "Science for the world and safety".

About 1,3 thousand tons of "Melange" were processed using the chemical process which did not do any harm to the environment in Azerbaijan.

If consider that "Melange" generally consists of concentrated nitric acid and nitrogen tetroxide the neutralization process of oxidizers proceeds according to the scheme:

$$N_2O_4 + H_2O \; HNO_2 + HNO_3$$

The assigned task is solved by processing it to diluted nitric acid. Melange is dosed in water at 0–5^{0}C. The process proceeds smoothly in dosage of an oxidizer in water. This is due to the fact that water in this case is not only a reagent, but also a solvent, i.e. interaction process of nitrogen tetroxide with water, absorption by water and formed nitric and nitric acids proceeds in the diluted solutions.

Nitric acid externally represents the colourless transparent liquid without mechanical impurities which does not smoke in an open air. Changing molar ratio of mélange: water (1–10) and temperature (0–15 °C) we defined:

– running of the process at higher temperatures (above 5 ^{0}) decreases the yield of a target product to 92% against 96%.

– running of the process at a mass ratio of N_2O_4:H_2O exceeding 1:5 is undesirable since it leads to the production of diluted acid.

Further solution of calcium nitrate "Norwegian saltpeter" which can be used as mineral feed is produced by the reaction of extracted nitric acid with calcium carbonate (there is enough calcium carbonate in the territory of the country) to perform the assigned task aqueous:

$$2HNO_3 + CaCO_3Ca(NO_3)_2 + CO_2 + H_2O$$
$$2HNO_2 + CaCO_3Ca(NO_2)_2 + CO_2 + 2H_2$$
$$2HF + CaCO_3CaF_2 + CO_2 + H_2O$$

The mobile processing plant which was constructed within the joint project of the government of Azerbaijan with NATO was used for implementation of these works.

The project was developed and was performed by the Ministry of Defence of the Republic of Azerbaijan and Azerbaijan National Academy of Sciences. The Azerbaijani in turn provided necessary infrastructures and materials for implementation of the project.

The similar utilization technology of rocket fuel oxidizers was further used in other country which faced a similar problem. Specifically in Uzbekistan where about 1,1 thousand tons of "Melange" were destroyed.

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A NEW KIND OF FERTILIZER CARBONITROPHOS OF CENTRAL KYZYLKUM PHOSPHATES AND UREA

Abstract: This article presents the results of a study on the production of carbonitrophos slurry based on the decomposition products of phosphorites from Central Kyzylkum with incomplete norm of nitric acid and urea. The chemical composition and rheological properties of the pulp depending on the amount of water, the mass ratio of calcium nitrate: urea and temperature. It is shown that with the increase in the amount of urea and temperature, the density and viscosity of the urea pulp is significantly reduced. Rheological characteristics meet the requirements for the current technology of nitrocalciumphosphate production fertilizer at the JSC "Samarkandkimyo".

Keywords: phosphorite powder, nitric acid, decomposition, urea, carbonitrophos, nitrophos, density, viscosity.

Over the past 10–20 years, the global fertilizer market has seen a high demand for various types of complex NP, PK and NPK fertilizers. This situation is caused, first of all, by their high agrochemical value, as fertilizers can be used under the soil at the same time two or three of the most valuable nutrients – nitrogen, phosphorus and potassium. In addition, the continuous growth of the population on the Earth leads to high demand for agricultural products. In this case, triple fertilizers make it possible to solve the problem of food security of each country on the planet.

In the literature it is known that products having two nutrient components – nitrogen and phosphorus is adopted, called nitroammophos, carboammophos and nitrophos, and when the three nitroammophospotassium, carboammophospotassium and nitrophospotassium. All of them are products of sulfuric acid and nitric acid processing of natural phosphates. The latter method has become widespread, nitric acid has a two – way advantage – is the activity of the hydrogen ion of the acid, revealing the phosphate mineral and nitrogen remains in the composition of the product as a nutrient component. It should be noted that acid decomposition requires high-quality phosphate raw materials.

Currently, phosphorites of Central Kyzylkum are the main raw material for Uzbekistan plants producing phosphoric fertilizers. Phosphorites of the Central Kyzylkum are characterized by low content of phosphorus (16.2% P_2O_5), high content of carbonates (17.7% CO_2) and high value

of calcium module (CaO: P_2O_5 = 2.85). This raw material is practically unsuitable for sulfuric acid extraction or for nitric acid decomposition. But the phosphorites of the Central Kyzylkum quite reactive even at low amounts of acidic reagent, which show the work [1]. The decomposition products of low-grade phosphorites of the Central Kyzylkum at low rates of acid reagent are also detailed in [2–4]. The authors showed the principal possibility of obtaining nitrocalciumphosphate fertilizer by decomposition of Kyzylkum phosphorite in incomplete norm of nitric acid. This fertilizer is produced at JSC "Samarkandkimyo". The main disadvantages of the technology are the energy intensity of the process and the hygroscopicity of the resulting product due to the content of a sufficient amount of calcium nitrate (more than 2%). In case, it is necessary to find solutions to reduce energy consumption and improve the properties of the target product. One of such solution to the problem can be dealt with urea additives. The reason for this was the work [5], where the effect of urea on calcium nitrate is studied in detail. The author studies the resulting compound $Ca(NO_3)_2 \cdot CO(NH_2)_2 \cdot 3H_2O$, $Ca(NO_3)_2 \cdot 4CO(NH_2)$. Methods of thermal, IR – spectroscopic and X – ray phase analysis carried out identification of the obtained compounds.

The results of the research have led to the carrying out of this work to improve the quality nitrocalciumphosphate pulp, the intermediate product produced at JSC "Samarkandkimyo".

To do this, the objective of the study was to study the rheological properties of nitrocalciumphosphate pulp with addition of urea.

As object of research was used phosphorite flour of the Central Kyzylkum (wt.%): P_2O_5–16.38, CaO – 45.93, CO_2 – 18, 15, 57% nitric acid and urea with a content of 46% N. the Stoichiometric rate of nitric acid was calculated on the decomposition of phosphate and carbonate minerals in the phosphorite with the formation of monocalcium phosphate and calcium nitrate. Normal nitric acid was taking 40% from stoichiometry considerations the industrial condition of JSC "Samarkandkimyo".

Decomposition of phosphate rock with nitric acid was carried out at a temperature of 30–40 °C and continuous stirring in a glass reactor for 25–30 min. Calculated amount of nitric acid was applied to phosphate rock for 5–10 min. in the reactor, there was intense interaction of the acid with the components of the highly-phosphate. After decomposition, the calculated amount of urea (calcium nitrate: urea= 1: 1.0 – 4.5) and water (15–25% of the total pulp mass) were added to the resulting nitrogen – phosphoric pulp to obtain the flowing carbonitrophos mass.

The content of all forms of P_2O_5 – total, digestible (in 2% citric acid), water soluble) in the feedstock and the resulting products was determined by the photocolorimetric method in the form of a yellow phosphoramidite molybdenum complex on the photocolorimeter KFK-3 (λ = 440 nm) [5]. The determination of the content of all forms of calcium was carried out by the volumetric complexonometric method of trilon B titration in the presence of fluorexone indicator [6]. The total CO_2 content was determined by dissolution of samples in hydrochloric acid (HCl = 10%). The amount of CO_2 is calculated from the volume difference between the total carbon dioxide mixture and the air volume remaining after adsorption of carbon dioxide by 40% potassium hydroxide solution [7]. The pulp density was determined by a universal pycnometer with capillary tube in the socket. The values were taken as the arithmetic mean of three measurements. The relative error was 0,02%. Viscosity was determined on a capillary viscometer VTL – 2 (error not higher than 2% relative) [8]. Measure the pH of solutions and suspensions was performed on pH meter METTLER TOLEDO. The density and viscosity of the pulp with the addition of urea are determined in the temperature range 30–80 °C.

The results of the research (table. 1) indicate that nitrocalciumphosphate pulp without the addition of urea has a low value of the digestible form

P_2O_5 in the range from 45.36 to 44.36%; total form P_2O_5 9.01 – 7.84% varies depending on the amount of water 15 – 25%. While urea additives at the ratio of calcium nitrate: urea = 1:1–1: 4.5 leads to a significant increase in the digestible forms of P_2O_5 and CaO 2% citric acid on average from 1.05 to 1.32 times, but a decrease in the overall shape of P_2O_5 from 1.05 to 1.30 times. Under the same conditions, there is an increase in total nitrogen on average from 1.20 to 2.18 times. Although the addition of water has little effect on the composition of intermediates, but significantly reduces the content of all components of the nutrient components in the composition of carbonitrophos pulp. For example, with the addition of water 15% by weight and a weight ratio of calcium nitrate: urea = 1: 1 carbonitrophos pulp has a composition (wt.%): 7.95 N_{total}; 8.24 P_2O_{5total}, 3.92 $P_2O_{5assimilable}$; 23.12 CaO_{tot}, 11.20 $CaO_{assimilable}$, 8.14 $CaO_{watersoluble}$. However, when water is added 20 and 25% by weight of pulp and at the same ratio of calcium nitrate: urea pulp contains (mass.%): 7.44 – 6.99 N_{total}; 7.72 – 7.25 P_2O_{5total}, 3.63 – 3.37 $P_2O_{5assimilable}$; 21.64 – 20.33 CaO_{total}, 10.37 – 9.64 $CaO_{assimilable}$. It should also be mentioned water forms P_2O_5 and Cao, which are contained in small quantities in the range from 0.18 – 0.16 and 8.14 – 7.03%, depending on the amount of added water from 15 to 25%, respectively. In addition, the content of both water-soluble nitrate and slow-acting forms of nitrogen in the pulp contribute to the uniform growth and development of plants during the growing season.

In any case, the composition of the pulp is characterized by the presence of 8.24–11.98% P_2O_5, 16.31–20.48% CaO, 7.04–15.42%, as well as the content of total nitrogen 3.52–2.80% in nitrate and 3.52–12.62% in amide form.

Table 1.– Changes in the chemical composition carbonitrophos pulp depending on the amount of water and the ratio of $Ca(NO_3)_2$: $CO(NH_2)_2$, (%)

$Ca(NO_3)_2$: $CO(NH_2)_2$ in pulp	N			P_2O_5			CaO			H_2O	CO_2	pH
	total	nitrate	amide	total	assimilable	water-soluble	total	assimilable	water-soluble			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
25% H_2O												
1: 0	3.78	3.78	–	7.84	3.48	0.16	21.98	9.95	7.56	40.05	5.21	4.66
1: 1	6.99	3.49	3.49	7.25	3.37	0.16	20.33	9.64	7.03	37.05	4.82	4.77
1: 1.5	8.42	3.37	5.05	6.99	3.40	0.16	19.60	9.71	6.99	35.71	4.65	4.82
1: 2	9.75	3.25	6.50	6.75	3.43	0.17	18.92	9.78	6.96	34.47	4.48	4.88
1: 2.5	11.00	3.14	7.86	6.52	3.45	0.17	18.28	9.85	6.93	33.31	4.33	4.93
1: 3	12.16	3.04	9.12	6.31	3.48	0.18	17.68	9.91	6.90	32.22	4.19	4.98
1: 3.5	13.25	2.94	10.30	6.11	3.50	0.18	17.13	9.97	6.87	31.20	4.06	5.03
1: 4	14.27	2.85	11.42	5.92	3.52	0.19	16.60	10.02	6.85	30.25	3.94	5.09
1: 4.5	15.23	2.77	12.46	5.75	3.54	0.19	16.11	10.07	6.83	29.35	3.82	5.14
20% H_2O												
1: 0	4.04	4.04	–	8.38	3.76	0.17	23.51	10.76	8.08	35.87	5.57	4.36
1: 1	7.44	3.72	3.72	7.72	3.63	0.17	21.64	10.37	7.55	33.01	5.13	4.47
1: 1.5	8.94	3.58	5.36	7.42	3.65	0.18	20.81	10.42	7.49	31.74	4.93	4.52
1: 2	10.33	3.44	6.89	7.15	3.67	0.18	20.04	10.47	7.44	30.57	4.75	4.58
1: 2.5	11.63	3.32	8.31	6.89	3.69	0.19	19.33	10.52	7.39	29.48	4.58	4.63
1: 3	12.83	3.21	9.62	6.66	3.71	0.19	18.66	10.56	7.35	28.47	4.42	4.67
1: 3.5	13.96	3.10	10.85	6.43	3.72	0.20	18.04	10.60	7.31	27.53	4.28	4.72

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1: 4	15.01	3.00	12.01	6.23	3.74	0.20	17.46	10.64	7.27	26.64	4.14	4.78
1: 4.5	15.99	2.91	13.09	6.03	3.75	0.21	16.92	10.67	7.23	25.81	4.01	4.83
15% H_2O												
1: 0	4.34	4.34	–	9.01	4.09	0.18	25.27	11.69	8.68	31.06	5.99	4.06
1: 1	7.95	3.97	3.97	8.24	3.92	0.18	23.12	11.20	8.14	28.42	5.48	4.17
1: 1.5	9.53	3.81	5.72	7.91	3.93	0.19	22.17	11.22	8.06	27.26	5.26	4.21
1: 2	10.99	3.66	7.32	7.60	3.94	0.20	21.30	11.25	7.98	26.19	5.05	4.27
1: 2.5	12.33	3.52	8.81	7.31	3.95	0.20	20.50	11.27	7.92	25.20	4.86	4.32
1: 3	13.58	3.40	10.19	7.04	3.96	0.21	19.75	11.29	7.85	24.28	4.68	4.37
1: 3.5	14.74	3.28	11.47	6.80	3.97	0.21	19.06	11.31	7.79	23.43	4.52	4.42
1: 4	15.83	3.17	12.66	6.57	3.98	0.22	18.41	11.33	7.74	22.64	4.37	4.47
1: 4.5	16.84	3.06	13.78	6.35	3.99	0.22	17.81	11.34	7.69	21.89	4.22	4.52

Also, the obtained results show that the addition of water in the amount of 25%, 20% and 15% does not significantly affect the pH of the pulp, but with an increase in the additive of urea, this value increases in the range of 4.66 – 5.14, 4.36 – 4.83 and 4.06 – 4.52 respectively.

Further, to assess the process ability of pulp rheological properties – density and viscosity were determined (table. 2). Indicators of rheological properties show that with a decrease in the water additive from 25 to 15% leads to an increase in both the density and viscosity of the carbonitrophos pulp at the same mass ratio $Ca(NO_3)_2$: $CO(NH_2)_2$ and temperature. For example, at a ratio of $Ca(NO_3)_2$: $CO(NH_2)_2$ = 1: 1 and a temperature of 40 °C, the density and viscosity increase from 1.5117 to 1.6203 g/cm^2 and from 13.77 to 27.48 mm^2/s. Whereas, with the addition of water in an amount of 25%, but with an increase in $Ca(NO_3)_2$: $CO(NH_2)_2$ from 1 : 1 to 1 : 4.5 these figures are significantly reduced from 1.5117 to 1.4116 g/cm^2 and from 13.77 to 10.55 mm^2/s at 40 °C.

This phenomenon is explained by the chemical substitution of calcium nitrate tetrahydrate water for urea according to the equation:

$$Ca(NO_3)_2 \cdot 4H_2O + nCO(NH_2)_2 = Ca(NO_3)_2 \cdot \cdot 4 - n\ CO(NH_2)_2 + n\ H_2O$$

The increase of temperature from 30 to 80 °C to give the density reduction in the range from 1.5938–1.4937 g/cm^2 to 0.8527 – 0.7218 g/cm^2, and viscosity of 15.26 – 11.85 mm^2/s to 11.96 – 4 22 mm^2/s, respectively. Whereas, with the addition of 20% water and an increase in the mass fraction of urea in the mass ratio $Ca(NO_3)_2$: $CO(NH_2)_2$ and temperatures from 30 to 80 °C, the density and viscosity decreases from 1.6611 to 0.7780 g/cm^2 and the viscosity from 22.80 to 8.83 mm^2/s, i.e. decreases 2.14 times, and the viscosity of 2.58 times.

Table 2. – The rheological properties carbonitrophos pulp depending on the requirement of water, the ratio of $Ca(NO_3)_2$: $CO(NH_2)_2$ and temperature

$Ca(NO_3)_2$: $CO(NH_2)_2$ in pulp	**25% H_2O**		**20% H_2O**		**15% H_2O**	
	μ, mm^2/s	**ρ, g/cm^2**	**μ, mm^2/s**	**ρ, g/cm^2**	**μ, mm^2/s**	**ρ, g/cm^2**
1	***2***	***3***	***4***	***5***	***6***	***7***
Temperature, 30 °C						
1: 0	15.26	1.5938	22.80	1.6611	30.34	1.7284
1: 1	14.44	1.5628	22.01	1.6173	29.58	1.6718
1: 1.5	14.07	1.5454	21.64	1.5980	29.20	1.6506

1	*2*	*3*	*4*	*5*	*6*	*7*
1: 2	13.70	1.5333	21.26	1.5880	28.82	1.6427
1: 2.5	13.33	1.5304	20.89	1.5760	28.44	1.6216
1: 3	12.96	1.5293	20.51	1.5712	28.06	1.6130
1: 3.5	12.59	1.5143	20.14	1.5529	27.68	1.5914
1: 4	12.22	1.5019	19.76	1.5418	27.30	1.5816
1: 4.5	11.85	1.4937	19.39	1.5282	26.92	1.5627
Temperature. 40 °C						
1: 0	14.69	1.5443	21.55	1.5974	28.40	1.6504
1: 1	13.77	1.5117	20.63	1.5660	27.48	1.6203
1: 1.5	13.31	1.4930	20.17	1.5626	27.02	1.6321
1: 2	12.85	1.4846	19.71	1.5381	26.56	1.5916
1: 2.5	12.39	1.4653	19.25	1.5179	26.10	1.5704
1: 3	11.93	1.4523	18.79	1.5081	25.64	1.5639
1: 3.5	11.47	1.4329	18.33	1.4879	25.18	1.5428
1: 4	11.01	1.4240	17.87	1.4780	24.72	1.5320
1: 4.5	10.55	1.4116	17.41	1.4612	24.26	1.5107
Temperature. 50 °C						
1: 0	14.20	1.4147	20.43	1.4677	26.66	1.5206
1: 1	13.06	1.3821	19.29	1.4374	25.52	1.4927
1: 1.5	12.49	1.3632	18.72	1.4185	24.95	1.4738
1: 2	11.92	1.3502	18.15	1.4060	24.38	1.4617
1: 2.5	11.27	1.3343	17.54	1.3874	23.81	1.4405
1: 3	10.75	1.3212	17.00	1.3760	23.24	1.4307
1: 3.5	10.23	1.3106	16.45	1.3628	22.67	1.4150
1: 4	9.71	1.2943	15.91	1.3495	22.10	1.4047
1: 4.5	9.19	1.2822	15.36	1.3325	21.53	1.3828
Temperature. 60 °C						
1: 0	13.76	1.2826	19.31	1.3366	24.86	1.3905
1: 1	12.42	1.2518	17.97	1.3073	23.52	1.3628
1: 1.5	11.75	1.2327	17.30	1.2878	22.85	1.3428
1: 2	11.08	1.2245	16.63	1.2775	22.18	1.3305
1: 2.5	10.40	1.2134	15.96	1.2636	21.51	1.3138
1: 3	9.74	1.1943	15.29	1.2574	20.84	1.3204
1: 3.5	9.07	1.1728	14.62	1.2267	20.17	1.2805
1: 4	8.40	1.1616	13.95	1.2172	19.50	1.2728
1: 4.5	7.73	1.1442	13.28	1.1985	18.83	1.2527
Temperature. 70 °C						
1: 0	12.98	1.0754	18.02	1.1291	23.06	1.1828
1: 1	11.44	1.0415	16.48	1.0970	21.52	1.1525
1: 1.5	10.67	1.0237	15.71	1.0771	20.75	1.1304
1: 2	9.90	1.0123	14.94	1.0662	19.98	1.1201
1: 2.5	8.98	0.9921	14.10	1.0463	19.21	1.1004

1	*2*	*3*	*4*	*5*	*6*	*7*
1: 3	8.26	0.9831	13.35	1.0369	18.44	1.0907
1: 3.5	7.54	0.9616	12.61	1.0159	17.67	1.0702
1: 4	6.82	0.9536	11.86	1.0074	16.90	1.0611
1: 4.5	6.10	0.9345	11.12	0.9889	16.13	1.0432
Temperature. 80 °C						
1: 0	11.96	0.8527	16.57	0.9066	21.18	0.9605
1: 1	10.24	0.8318	14.85	0.8878	19.46	0.9437
1: 1.5	9.38	0.8125	13.99	0.8670	18.60	0.9214
1: 2	8.52	0.8009	13.13	0.8569	17.74	0.9128
1: 2.5	7.66	0.7805	12.27	0.8369	16.88	0.8932
1: 3	6.80	0.7707	11.41	0.8262	16.02	0.8817
1: 3.5	5.94	0.7528	10.55	0.8067	15.16	0.8605
1: 4	5.08	0.7447	9.69	0.7978	14.30	0.8508
1: 4,5	4,22	0,7218	8,83	0,7780	13,44	0,8342

In the production of nitrophos at JSC "Samarkandkimyo" pulp has a density of 1.4 – 1.5 g/cm^3 and viscosity of 15 – 16 mm^2/s. In this regard, these indicators were the basis for selection of the rheological properties of the slurries carbonitrophos. From these tables it follows that the optimal ratio is calcium nitrate: urea is 1 : 4 and the amount of water 15% of the total pulp mass.

At the same time, the urea-containing pulp at low amounts of water (15%) is movable in comparison with the nirocalciumphosphate pulp. If you keep in mind the fact that in the production of nitrocalciumphosphate to the slurry is added 25% water of the total weight, in this case, the optimal can be considered the addition of water 15%.

Based on this mass ratio $Ca(NO_3)_2$: $CO(NH_2)_2$ is equal to 1 : 4 water additive 15% of pulp weight can be considered a rational choice. In this case, the density of the pulp with an increase in temperature from 30 to 80 °C varies in the range 1,5816–0,8508 g/cm3 and 27.30 – 14.30 mm^2/s. While carbonnitrogen pulp has a composition (wt.%): 12,66 N_{total}; 6.57 P_2O_{5total}; 3.98 $P_2O_{5assimilable}$, 0.22 $P_2O_{5watersoluble}$; 18.41 CaO_{total}, 11.33 $CaO_{assimilable}$; 7.74 $CaO_{watersoluble}$ and 22.64 H_2O.

Thus, with the addition of the urea the system is diluted, and the slurry becomes fluid, which contributes readily available for transfer from one model to another, that is, provide transportability carbonitrophos slurries. Reduction of water additive and enrichment of the product with even more amide nitrogen leads to improvement of technical and economic indicators of the product per unit of specific consumption of both raw and heat- and – power resources.

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