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Section 1. Biology

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A SIMPLE NON-INVASIVE METHOD FOR COLLECTING VENOM AND THEIR ANALYSIS FROM SOCIAL BEES (HYMENOPTERA: APIDAE)

Abstract. The objects of study were the venoms of stinging Hymenoptera insects. Conducting species identification of representatives of the *Bombus* genus studying the composition of proteins and peptides of their toxic secrets using electrophoresis and mass spectrometry.

Keywords: *Bombus*, MSI-Q-TOF, insects, fauna of Belarus.

The Hymenoptera order comprises many families, which include both highly toxic and relatively low-toxic species. The most famous and well-studied venoms representatives of this order are stinging Hymenopterans, such as bees, wasps and bumblebees.

Of particular practical interest in terms of obtaining biologically active proteins and peptides are some species of Hymenoptera insects. They have various protective devices with which they can cause damage to a person, cause allergic reactions or severe skin irritation. Hymenoptera venoms (bees, wasps) – usually weakly mobile, colorless or slightly colored liquids soluble in water, when dried, they form brownish plates, in the solid state they remain active for several years [4, 108–121]. Although the amount of venom released when stinging is small, even single bites can be fatal if a rapidly developing allergic reaction occurs.

About 300 species of bumblebees are known in the world, which are widespread throughout the globe. Especially many representatives of the genus

live in Northern Eurasia, North America, as well as in some other regions [3, 78, 97]. Representatives of the genus *Bombus* are large Hymenoptera. Their body is covered with thick long hairs, forming a band of various colors: red, black, white, etc. In Belarus they are mostly active in the warm season, from May to October. Build their nests (bombidaria) in soil or litter, sometimes in hollows, abandoned nests of rodents or birds [1, 64].

Bumblebees (genus *Bombus*) belong to the family Real bees (*Apidae*), so it can be argued that the venom produced by bumblebees is, in principle, similar in composition to those venoms that are produced by other representatives of this family, for example, the bees.

So, bumblebee venom is characterized by the presence of such compounds as phospholipases A and B, as well as histamine, serotonin and acetylcholine. The presence of these substances provides the manifestation of the same effects that are observed when struck by venoms of other species of

Hymenoptera [4, 122]. Their chemical composition is not well studied.

The urgent task of the practical use of toxic invertebrate invertebrates is the search for new sources of proteins and peptides. Development of biotechnology for producing venom, its processing and isolation of proteins and peptides with biological activity. Several methods have been tested to collect the venom of the sting insects studied.

According to the literature, native venom should not contain protein impurities from the walls of the reservoir of the poisonous apparatus and intestinal tract. Almost all methods for producing insect venoms lead to their pollution by extraneous organic compounds. Hydrolysates from various body tissues are often found in the extract obtained. In this regard, a search was made for the most optimal method for collecting poisons of various representatives of the pitiful Hymenopteran – Aculeata [2, 209–210]. Venom was collected from 5 species of representatives of various families of Hymenopteran insects, among them: *Bombus sylvarum*, *B. ruderarius*, *B. humilis*, *B. pascuorum* and *B. lapidarius*. At identification the species was used a key including the family *Apidae* of Belarus [5, 320]. The amount of venom collected from one individual in various species of bumblebees ranges from 4.7 to 17.1 µg. The greatest amount of venom is obtained from *B. pascuorum*.

In one technique, insects were placed in a freezer at a temperature of –18 °C per day. Then, the insect was taken with tweezers on the lateral surfaces of the tergites and gently squeezed until the end segments of the abdomen opened. After that, a stinging apparatus, including a sting with a poisonous gland attached to it, containing venom was pulled carefully with tweezers. The poisonous gland consisted of two sections: a thin filiform tubular section and an expanded part of the reservoir. The expanded portion was placed on a glass slide and the venom was squeezed out onto the surface of the glass slide. By washing away the toxic secretion from the glass surface with distilled water, 15 µl of the venom sample

was obtained from all the 5 studies species. An electrophoretic analysis of the composition of proteins and peptides obtained from samples of venoms was carried out. Based on the results obtained, it is possible to judge the similarities and differences between proteins of different species of Hymenoptera.

At the same time, an analysis of the results indicates the presence of a large number of high molecular weight proteins that are not characteristic of the venoms of the studied insects. The reason for this is the extraction of proteins from some parts of the pituitary apparatus, which leads to contamination of the sample with impurities that are not related to the components of the venom. Thus, according to the results of the study, it can be stated that the technique for isolating venom from insects exposed to low temperatures is not correct.

The second technique, which was used to obtain insect venoms, was the use of electric shock. Upon receipt of the venom by this method, electrodes were brought to the insect's abdomen and a constant voltage of 9 volts was applied for 5 sec. This method is laborious and excretion of venom from small specimens was no occurred.

The most productive was the third method of obtaining venom from Aculeata insects. Upon receipt of the venom, the insects were held with tweezers by the thoracic part, while the tip of the abdomen was stroked with a thin capillary until the sting and venom was released. This method allowed the collection of venom without killing the insect, as well as increasing the efficiency of its selection. The proposed method for removing venom from Hymenopteran insects is more effective, because the toxic secretion is not contaminated, and the insect remains viable.

The resulting venoms of various Hymenoptera insects were investigated using electrophoresis under denaturing conditions to determine the molecular weights of proteins and peptides. Determination of the molecular weights of the proteins and peptides included in the venom of the studied insects allows us to determine the features of their composition in

insects. According to the results obtained, it is possible to judge the similarity and difference of proteins of various species of Hymenoptera, detected at the biochemical level.

Analysis of proteins and peptides and their molecular weights showed that the venoms contain proteins with close molecular weights: 16 and 29 kDa. A protein with a molecular weight of 16 kDa is phospholipase A2 and its content in venoms ranges from 40 to 60%. Due to the presence of a large number of hydrophobic amino acids in its composition, it is able to form dimers. Protein with a molecular weight of 29 kDa is contained in the studied venoms in significant quantities from 2 to 45%. The following poisons were found in the composition of the proteins of the studied venoms: hyaluronidase, which, according to the literature, has a molecular weight of 36 to 45 kDa, mesophospholipase with a molecular weight of 22–25 kDa, and acid phosphatase (phosphomonoesterase) of 45–52 kDa. The difference in the composition of proteins and peptides for each of the studied venoms indicates the specific features of their biosynthesis.

The amount of venom collected from individual species was insignificant, which allowed only electrophoretic studies and the molecular weights of the proteins and peptides included in these venoms to be determined. The small amount of venom obtained from certain species of bumblebees was not sufficient to immunize rabbits and obtain antisera against them. In addition, the composition of the venom includes a large number of low molecular weight peptides that do not have antigenic determinants and are not able to lead to the synthesis of immunoglobulins against these peptides.

Further identification of the proteins and peptides of the poison was carried out using ESI-Q-TOF mass spectrometry.

The use of chromatography and mass spectrometry made it possible to detect in the studied venoms more than 150 chemical compounds with molecular weights from 150 to 2165 Da. The composition

of most low molecular weight compounds was the same in the studied venoms. The greatest differences in the composition of the peptides included in the studied venoms was due to their molecular masses from 1000 to 2000 Da. Depending on the retention time on a chromatographic column, these peptides eluted for 5.0–8.5 minutes. The retention time of the peptides on the column depended on their charge, in this regard, 3 peptides with a molecular weight of 1854–1860 Da and two peptides with a molecular weight of 1740–1756 Da were found in *B. pascuorum* venom. Two peptides with a molecular weight of 1860–1880 Da and two peptides with a molecular weight of 1740–1760 Da were detected in *B. humilis* venom. In *B. ruderarius* venom three peptides with a molecular weight of 1840–1870 Da and one peptide with a molecular weight of 1720 Da. No peptides with similar molecular weights were found in the *B. sylvarum* and *B. lapidarius* venoms.

The composition of venoms: *B. pascuorum*, *B. humilis*, *B. sylvarum*, *B. lapidarius* contains a peptide with a molecular weight of 1220–1224 Da and the same retention time on the column of 6.2 min. The same retention time indicates their likely identity. Such peptides, similar in structure, having the same retention time of 7.03 min. and a molecular weight of 1860 Da, are characteristic of venoms *B. pascuorum*, *B. sylvarum*. With a retention time of 7.13 min and a molecular weight of 1740–1760 Da, characteristic of venoms *B. pascuorum* and *B. humilis*. With a retention time of 7.3 minutes and a molecular weight of 1860–1880 Da, they are characteristic of venoms of *B. pascuorum*, *B. humilis*, *B. ruderarius*. With a retention time of 7.5 min and a molecular weight of 1860 Da, they are characteristic of venoms of *B. humilis*, *B. ruderarius*. With a retention time of 8.2 min. and a molecular weight of 1720–1756 Da, they are characteristic of venoms of *B. pascuorum*, *B. humilis*, *B. ruderarius*, *B. sylvarum*.

Analysis of the composition of the peptides of poisons of five species of representatives of the genus *Bombus*, indicates that there are three taxonomic groups

that differ in their composition. The closest species, on this basis, are *B. pascuorum*, *B. humilis*, *B. sylvarum*.

In consequence, the use of electrophoresis and chromatography with mass spectrometry of the venoms of five species of bumblebees confirmed

the taxonomic differences between them. Based on the biochemical analysis, we can conclude that the studied insect species are related, but each of them is characterized by the presence of specific marker protein and peptides present in their venoms.

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Section 2. Biotechnology

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SELECTIVITY AND STABILITY OF SIGNAL OF AMMONIA SEMICONDUCTOR SENSORS WITH MEMBRANE COATINGS BASED ON $\text{SiO}_2/\text{TiO}_2 + \text{Fe}_2\text{O}_3$ STRUCTURE

Abstract. A selective semiconductor method for determining ammonia in atmospheric air and a mixture of various process gases has been developed. A sensor has been developed that provides selectivity for the determination of ammonia in multicomponent gas-air mixtures, which simultaneously contain ammonia, hydrogen, carbon monoxide and methane (natural gas). In all cases, the value of the relative standard deviation (Sr) due to unmeasured components does not exceed 0.03. The output signal of the sensors also does not depend on the location in space and the angles of inclination, which allows us to classify the developed sensors (according to GOST-13320–82) as independent.

Keywords: calibration characteristics of the sensor, selectivity, stability, signal, ammonia, sensor, semiconductor, catalyst, titanium oxide, iron(III) oxide.

Introduction

Ammonia is a colorless gas with a pungent characteristic odor, formed as a result of the decomposition of amino acids, proteins and other nitrogen-containing organic compounds. The main sources of ammonia emission are refrigeration units, livestock farms, enterprises for the

production of HNO_3 , ammonium salts and coke plants [1].

The maximum permissible concentration of ammonia in the air of settlements 0.2 mg/m^3 , in the working area of industrial premises is 20 mg/m^3 , in the water of reservoirs 2 mg/m^3 . The odor perception

threshold is 0.5 mg/m^3 [2]. At concentrations of $40\text{--}80 \text{ mg/m}^3$, there is a sharp irritation of the eyes, upper respiratory tract, headache, with 1200 mg/m^3 cough, pulmonary edema is possible. Fatal concentrations of $1500\text{--}2700 \text{ mg/m}^3$, acting for $0.5\text{--}1$ hours. Forms explosive mixtures with air within $15\text{--}28 \text{ vol.}\%$ ammonia [2]. The most available and correct solutions to the problems of express and accurate determination of the content of gases (in particular ammonia) in air and process gases is the use of simple and affordable semiconductor sensors [3]. Semiconductor ammonia sensors are becoming the main devices that can quickly monitor the environment and process gases [4]. In this regard, the development of highly efficient methods and semiconductor sensors for determining ammonia in environmental objects is becoming an actual task of safety engineering, analytical chemistry and ecology.

Research methods and results

The experimentally established dependences of the sensor signal on the content of the detected impurity are calibration characteristics of the sensor. The calibration characteristic of the ammonia sensor was determined by passing a vapor-gas mixture containing ammonia in a wide range of its concentra-

tions through a developed sensor. The experiments were carried out under ordinary conditions (temperature 20°C , ambient pressure 745 mm Hg and an relative humidity of 60%). In the experiments performed, each test point in the measuring range was characterized by six values: three for the forward and three for the inverse measurement cycle. The analytical signal of the sensors was monitored by a B7-35 digital voltmeter after establishing a constant value (at least 1 min after supplying a standard mixture to the device). During the experiments, the calibration characteristic of the ammonia sensor based on titanium oxide was studied. To increase the sensitivity to ammonia, iron oxide was deposited on the titanium oxide film, which is an active and selective catalyst for the oxidation of ammonia by atmospheric oxygen [5]. The results of determining the dependence of the resistance of the GSM on the ammonia content in the gas mixture are shown in (Table 1). As follows from the data given in (Table 1), depending on the content of the alloying component (Fe_2O_3), the properties of the GSM as a whole change. With increasing concentration of the alloying component, the resistance of the films decreases.

Table 1. – The dependence of the resistance of the GSM on the content of ammonia, and the gas mixture

| No | Ammonia content in the mixture, mg/m^3 | Composition GSM | | | |
|----------------------------------|---|-----------------------------|--|--|---|
| | | $\text{SiO}_2/\text{TiO}_2$ | $\text{SiO}_2/\text{TiO}_2 + 1\%\text{Fe}_2\text{O}_3$ | $\text{SiO}_2/\text{TiO}_2 + 5\%\text{Fe}_2\text{O}_3$ | $\text{SiO}_2/\text{TiO}_2 + 10\%\text{Fe}_2\text{O}_3$ |
| Resistance GSM, $\text{k}\Omega$ | | | | | |
| 1. | Air | 2768 | 2465 | 1980 | 1665 |
| 2. | 100 | 2590 | 2219 | 1440 | 1100 |
| 3. | 200 | 2515 | 2145 | 1233 | 917 |
| 4. | 300 | 2480 | 2095 | 1143 | 815 |
| 5. | 400 | 2450 | 2043 | 1072 | 737 |
| 6. | 500 | 2430 | 1997 | 1011 | 670 |
| 7. | 600 | 2410 | 1953 | 960 | 613 |
| 8. | 700 | 2387 | 1908 | 910 | 566 |
| 9. | 800 | 2363 | 1865 | 866 | 527 |
| 10. | 900 | 2346 | 1821 | 826,6 | 492 |
| 11. | 1000 | 2328 | 1779 | 789 | 461 |

More sensitive ammonia sensors are formed using mixed oxides of titanium and iron. The $\text{TiO}_2 + 10\% \text{Fe}_2\text{O}_3$ deposited on the surface of the film at an ammonia concentration of 1000 mg/m^3 in the mixture leads to a 5-fold decrease in the resistance of the GSM (from 2328 to 461). In the studied concentration range, the dependence of the resistance of the semiconductor sensor on the amount of ammonia in the mixture is, as a rule, nonlinear (table 1). The most noticeable decrease in the resistance of GSM is observed at initial concentrations of ammonia in

the mixture. With increasing concentration, the resistance of the GSM decreases. This makes it difficult to use the developed sensors to create gas analytical instruments. In fig. Figure 1 shows the dependence of the signal of semiconductor sensors with various GSMs on the concentration of ammonia. As follows from the above data, in a wide range of concentrations ($20\text{--}1000 \text{ mg/m}^3$), the dependence of the signal of the semiconductor sensor on the concentration of ammonia in the GSM has a straightforward character.

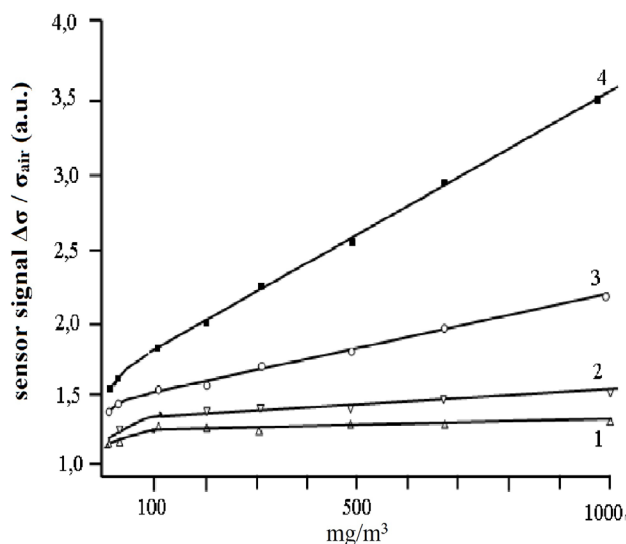


Figure 1. The dependence of the signal ($\Delta\sigma/\sigma_{air}$) of semiconductor sensors on the content of ammonia in the air. 1 – $\text{SiO}_2/\text{TiO}_2$, 2 – $\text{SiO}_2/\text{TiO}_2 + 1\% \text{Fe}_2\text{O}_3$, 3 – $\text{SiO}_2/\text{TiO}_2 + 5\% \text{Fe}_2\text{O}_3$, 4 – $\text{SiO}_2/\text{TiO}_2 + 10\% \text{Fe}_2\text{O}_3$; experience temperature – 350°C

Dependencies similar to those presented in (Fig. 1), they allow us to compare the sensitivity (signal magnitude) of various sensors in a wide range of gas impurity concentrations, extrapolate to a low concentration range and evaluate the possibility of sensors measuring threshold concentrations of individual components in air.

The analysis presented in Fig. 1. The data shows that GSM based on $\text{SiO}_2/\text{TiO}_2$ and $\text{SiO}_2/\text{TiO}_2 - 1\% \text{Fe}_2\text{O}_3$ are characterized by a low sensitivity to ammonia. The sensitivity threshold of sensors based on thin-film undoped titanium dioxide is $0.01\% \text{ NH}_3$ in air. A sharp increase in gas sensitivity is observed for a sample with an iron oxide content of 5–10%. Semiconductor sen-

sors based on $\text{SiO}_2/\text{TiO}_2 - 5\% \text{Fe}_2\text{O}_3$ and $\text{SiO}_2/\text{TiO}_2 - 10\% \text{Fe}_2\text{O}_3$ can detect NH_3 gas impurities at the permissible and lower. The minimum ammonia concentration that can be detected by a semiconductor sensor based on $\text{SiO}_2 - \text{TiO}_2 + 10\% \text{Fe}_2\text{O}_3$ is about 5.0 mg/m^3 . The dependence of the sensor signal on the concentration of ammonia in air at the test temperature of 350°C was studied. A linear section of the signal was detected that provides the determination of ammonia content in a wide range of its concentration. The curve of gas sensitivity ($\Delta\sigma/\sigma_{air}$) of this sensor versus ammonia concentration in the concentration range of the latter from 10 to 1000 mg/m^3 is straightforward (Fig. 1), and the S value varies in the range from 0.01 to 0.17.

Selectivity of a semiconductor ammonia sensor.

The selectivity of determining the individual components of the analyzed gas mixture is the most important characteristic of semiconductor sensors. In the sensors developed by us, the selectivity of determination is ensured by the selection of optimal temperatures and the composition of the catalytic coating of GSM. The study of ammonia selectivity by the developed sensors was carried out using certified gas

mixtures according to the requirements of GOST, presented to gas analytical devices for closed ecological systems and chemical industry facilities. The selectivity of a semiconductor ammonia sensor was determined in the presence of hydrogen, carbon monoxide, and methane. The ammonia selectivity of the sensors was determined at a sensor temperature of 350 °C and a pressure of 730–10 mm Hg. using standard gas mixtures, the composition of which is given in (table 2).

Table 2. – Composition and parameters of calibration gas mixtures used to determine the selectivity of the ammonia sensor

| No. | Composition of SGS | Component content, mg/m ³ . | | | |
|-----|--|--|----------------|-------------|-----------------|
| | | NH ₃ | H ₂ | CO | CH ₄ |
| 1. | NH ₃ + air | 356.0 ± 0.6 | – | – | – |
| 2. | NH ₃ +H ₂ + air | 356.0 ± 1.0 | 460.0 ± 1.8 | – | – |
| 3. | NH ₃ +CO+ air | 356.0 ± 0.8 | – | 380.0 ± 2.5 | – |
| 4. | NH ₃ +CH ₄ + air | 356.0 ± 1.0 | – | – | 450.0 ± 1.5 |

At the SCS input, mixture No 1(NH₃ + air) was fed for 5 min, the readings were recorded with a digital voltmeter, then mixture No 2(NH₃ + H₂ + air) was fed, and after 5 minutes the readings of the digital voltmeter were re-recorded. Mixture No 1(NH₃+air) was fed to the SCS input for 5 min, the readings were recorded with a digital voltmeter, then mixture No

2(NH₃+H₂+air) was fed and the digital voltmeter readings were re-recorded after 5 min. Similarly, signals were obtained for a mixture of No 3(NH₃+CO+air) and No 4(NH₃+CH₄+air). The number of repeated measurements for each standard gas mixture is 5. The average results obtained when establishing the selectivity of SCS-NH₃ are presented in (Fig. 2).

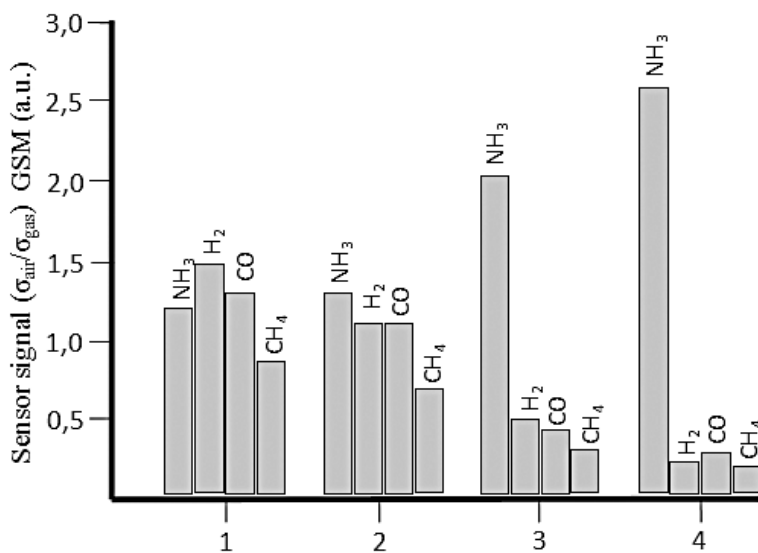


Figure 2. The results of the study of the selectivity of sensors based on titanium and iron oxides for ammonia. 1 – SiO₂/TiO₂, 2 – SiO₂/TiO₂+1%Fe₂O₃, 3 – SiO₂/TiO₂+5%Fe₂O₃, 4 – SiO₂/TiO₂+10% Fe₂O₃

As follows from the given experimental data (Fig. 2), when determining ammonia in the presence of CO , H_2 , CH_4 , the most selective of the studied GSM is a sensor based on $\text{SiO}_2/\text{TiO}_2 + 10\% \text{Fe}_2\text{O}_3$. In the presence of $\text{SiO}_2/\text{TiO}_2 + 10\% \text{Fe}_2\text{O}_3$ at a temperature of 350°C , the presence of carbon monoxide (380 mg/m^3), hydrogen (460 mg/m^3) and methane (450 mg/m^3) in the analyzed mixture does not affect the value of the output signal of the ammonia sensor. From the above data it follows that the developed sensor in the studied concentration range allows the selective determination of NH_3 .

Thus, as a result of the experiments, a selective semiconductor sensor was developed that provides the rapid determination of ammonia in atmospheric air and process gases in the presence of CO , H_2 , CH_4 in a wide range of their concentrations.

The developed semiconductor ammonia sensors are not inferior to the known foreign analogues in selectivity and reproducibility, while maintaining the following characteristics: expressness, portability, ease of operation and manufacture.

Conclusion

A selective semiconductor method has been developed for the determination of NH_3 in atmospheric air and a mixture of various gases. A sensor has been developed that provides selectivity for the determination of NH_3 in multicomponent mixtures where simultaneously with NH_3 , H_2 , CO and CH_4 are contained. Such mixtures include gaseous emissions from industrial enterprises producing mineral fertilizers, paints, sugar, asphalt, air from livestock breeding complexes, sewer pipes, etc. In all cases, the value of the relative standard deviation (S_r) due to unmeasured components does not exceed 0.03.

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Section 3. Journalism

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HISTORICAL DEVELOPMENT TRENDS OF MODERN NEWS AGENCIES (FOR EXAMPLE, XINHUA, ASSOCIATED PRESS, REUTERS)

Abstract. News agencies are an important component of modern communications and broader socio-political and cultural processes. In the developed countries of the West, news agencies are the main means of covering news in the news. It is difficult to imagine a modern information society without a constant flow of information reflecting the processes and events that occur in our daily lives. In the modern world, information is a serious strategic resource and one of the leading factors in the development of the community. The relevance of this case also lies in the role of news agencies in this information society and in the fact that the news agency is a database. News agencies – a large corporate organization for the search, collection and dissemination of information.

The growing interest in the novelty of information is associated with the efficient and targeted use of accurate operational data to solve dynamic problems of the community, which, in turn, is a prerequisite for sustainable development in the third millennium [1, P. 127].

Keywords: International Cooperation, Information Society, development trends, news agencies, Xinhua news agency, Associated Press news agency, Reuters news agency.

We suggested that the first decisive step toward the information society was the emergence of news agencies in the second half of the 19th century. This is due to the fact that the emergence of news agencies has helped shape a new culture of data collection and dissemination.

News agencies not only track the development of advanced technologies in their history, they also developed modern information technologies and introduced innovative methods of disseminating information, from mail to satellite.

The concept of objectivity of news agencies is aimed at the development of information pluralism

in society. The rapid introduction of modern technology will turn information into a very useful business product. We can also note that the emergence of new information technologies is one of the factors undermining censorship in the media, as it prevents the media business from working in the new environment.

However, in these conditions it is important to study the experience of financial and economic activities of the Reuters news agency. This is an example of how an effective organization of economic and journalistic activities can benefit a loss-making enterprise as an information agency.

For example, Fedininclaims that “the influence of the media on the intensification of scientific and technological progress depends, first of all, on the fact that their activities are aimed at solving key economic problems.” [2].

The uniqueness of Reuters is that it is the only high-income news agency.

Throughout its history, the agency has studied, first of all, in terms of making money. Thus, the activities of the agency, from the Julius Reuter office in Aachen to modern Reuters products, have always brought economic benefits. Currently, Reuters has abandoned the traditional sphere of activity of a news agency and has become a mixture of a news agency and a large dealer center, which not only provides economic information to customers, but also provides them with a wide range of financial transactions. Reuters, one of the 500 largest European companies, ranked 46th by market capitalization in 1994, United (335th), Daily Mail (339th) and Pearson (130th) [3].

Reuters, which began to earn a lot of money, has a direct impact not only on the news market, but also on the news market. An example of this is the acquisition of Wisnews video services and the participation of British commercial television ITN in the processing of an independent international broadcasting agency. The uniqueness of Reuters TV lies in the fact that most shopping centers can change the trading program, adapted to the news of Reuters TV. Reuters executives require 50% of all foreign exchange transactions in the world through the company’s operating systems [4, P. 216].

It is important to note that Reuters operating systems are a vivid example of how news agencies work directly with clients, which ensures their independence in the information field. Reuters has maintained its basic tradition of working with the news and has received the status of a leading global agency thanks to its economic benefits.

The experience of Western news agencies, in particular Reuters, can help Uzbek journalists or-

ganizationaly and creatively. When creating a new system of relations between information providers and information consumers in our country, it is important to take into account the shortcomings and shortcomings of other news agencies and take into account their positive experience.

The main thing is caution: Reuters reorganized the company at all stages of its activities, following the same principle. It is also commendable for the efforts of company executives, such as caring for the agency’s best traditions.

An analysis of the contradictions in the development of the media in the West can help make sure that journalistic problems are connected with today’s global problems and that they cannot solve these problems without a cultural approach.

Xinhua News Agency runs the State Department of Press, Broadcasting, Cinema, and Television of the People’s Republic of China. The agency was established in 1931. The headquarters is in Beijing. It offers news in 7 languages: Chinese, English, French, Russian, Spanish, Arabic and Japanese. There are correspondent offices and more than one hundred branches in Asia, the Middle East, Latin America and Africa. The agency’s site is very active: today the agency’s website is visited by more than 300 mobile users and more than 120 million visitors through computers.

Xinhua News Agency is one of the most important media networks in China. The agency is switching to 100% digital technology. His site is used by more than 100 million readers per day.

Xinhua is one of the leading international news agencies not only in China, but also in the world. Now it has headquarters in the Middle East, Asia-Pacific, Latin America and Africa, as well as offices in different countries of the world. There are reporters all over China.

To date, the agency has created a new media center to develop developments that will help the industry. One of these know-how is called the “media brain”. A dedicated device monitors an agreement

or event and prepares a message or news about its details within ten seconds.

“Today, another innovation of our media center has become a huge noise around the world. This is a virtual TV presenter who works on artificial intelligence and can read texts independently”, said Zhang Jie, a regional foreign affairs officer at Xinhua News Agency [5].

For a virtual television project created by Xinhua News Agency in collaboration with Sogou, agency employee Zhang Zhao has an external image and voice that reads texts in Chinese and English. A 24-hour virtual launch is available for instant delivery over the Internet and mobile applications.

In general, Xinhua News Agency is conducting serious research on artificial intelligence. The so-called “media brain” has the ability to quickly sort and analyze information regardless of an event or event. With its speed and responsiveness, this can ease the burden of journalists. For example, if a journalist spends 14–15 minutes sorting certain information and producing informative material, one minute is enough for the device.

The Xinhua News Agency website, launched in 2000, has been refined over time. Initially, only text and photo materials were published on the site, but today the reader can simultaneously access information in text, photo, audio, video and infographic formats.

Efforts to improve the news agency site are paying off. Today, the Agency’s website is visited by more than 300 million subscribers via mobile phones and more than 120 million visitors through computers.

What topics does the reader prefer? What form and form of information do you prefer? It is no exaggeration to say that these are problems of life and death for the world media. In the end, the media can retain their customers in the face of fierce competition, and the expansion of the audience depends on how well they answer these questions.

Xinhua News Agency also conducts regular surveys and social surveys to explore student interest. In this regard, modern technologies are effectively used.

The news agency has a laboratory equipped with special biosensors. The procedure is as follows: the biosensors will be connected to the clients participating in the study, and the head of government, for example, will present a screen. The biosensor will say which part of the public lecture is interesting to him and which is boring. It is worth noting that this is one of the most advanced ways to study customer reviews [6].

It is reported that the virtual launcher displays the hologram on its own. Experts say that anyone can become the prototype of a virtual launcher. To do this, just upload the video from the newcomer to a specific program, and the program will be able to accurately reproduce gestures, facial expressions and images of the presenter [7].

The social and political leaders of developing countries emphasize strengthening national press agencies to implement effective ideas for rationalizing the existing international information dissemination system.

In the mid-19th century, based on the demand of the American information system for “news reserves,” the Associated Press not only won, but continued to do so. Today, in the information market of the third millennium, in the middle of the 19th century, a “third generation” mobile phone is significantly different from a mobile phone with a steam engine.

As of 2003, the Associated Press had 147 US posts and 95 (total 242) posts in 78 foreign countries. The agency has its own television service and the largest subsidiary network of radio stations in the United States [8].

The main products of the agency are: text, audio, video and multimedia data, photographs, graphics, satellite and terrestrial communication services. The agency transmits 20 million words of text per day, processes and distributes about 2,000 photographs.

Over 1,700 daily and weekly newspapers in the United States receive text and graphic information from the Associated Press. The Associated Press provides audio and video information to more than 5,000 radio and television stations in the United States.

8500 subscribers abroad receive text and photo data from the Associated Press, and another 330 customers receive video information. The Associated Press serves more than 15,000 newspapers and radio and television stations around the world. The total audience of AP media subscribers is more than 1 billion people in 121 countries.

The Associated Press regularly covers events in 112 countries. The agency publishes information in five languages: English, German, Spanish, Dutch and French.

The Associated Press employs 3,500 people, including creative (1,500), technical and administrative staff worldwide. The agency's annual budget is about \$600 million. Throughout the history of the Associated Press, its employees have been awarded the prestigious American Pulitzer Prize 45 times in various categories [9].

In order to correctly assess the current state and prospects of the Associated Press, it is necessary to analyze several important aspects. The first is the state and trends of the global media market. The second is the need to assess the characteristics of large media corporations, which are constituted by the main consumers of news agency products. It is also necessary to take into account the peculiarities of the development of the US information market, which is the main market for the Associated Press and a strong customer base. Finally, it is necessary to assess the characteristics and development trends of other global news agencies playing with APs in the same "on the ground" or "related areas". These four factors reflect the forecast of the economic, political, and financial conditions under which the Associated Press should begin.

At the same time, the Agency's development strategy and key focus in its activities allow us to distinguish significant differences from the main competitors in the accountability and response of the Agency.

The Agency not only adheres to the status of a cooperative non-profit organization, which is often con-

sidered incompatible with the requirements of the era, but also significantly benefits from new conditions.

The key stages in the development of the agency correspond to the development and expansion of the American economy (including the international one), the evolution of the US role in international relations and the expansion of its political and economic interests. All these processes, every step and every serious decision require high-quality and timely information, for which the Agency is responsible.

In the 19th century, the American media system already needed an organization that formed industry standards. The agency was well suited to solve this problem as a cooperative, "paid" structure, which combined the commercial and informational interests of the media in all formal and informal ways.

Since its founding, AP has also been a unique "generator of innovation" in the American media market. This explains the almost constant leadership of AP in the field of technological innovation and the design and implementation of services in the process of obtaining, processing and transmitting information. In addition, the agency will always make full use of all available innovations to maximize financial returns, but only because it is limited to building relationships with customers and providing them with distinctive advantages. As a rule, AP creates a new model of some equipment or develops new technologies ("electronic development", digital camera, etc.) and delivers them to its customers and subscribers. The next generation of this technique or technology is produced by serially specialized companies. Excludes AP affiliate AP Broadcast Technologies, AP News Center Products, and E-News Production Systems.

In 1990, American newspapers accounted for 45 percent of revenue, while television and radio stations accounted for about 20 percent, and by 2001 this number had dropped to 32 and 15 percent, respectively. Thus, the agency now receives 53% of its annual income from new "services" and "non-traditional" services or foreign trade. In developing its external network, AP switched from a

hierarchical method of structural design to a “matrix” method in the early 1980 s, instead of bureau in the most developed media markets of foreign countries with the status of an independent legal entity. In fact, these are mini-agencies operating in the Netherlands, Germany, France, Sweden, Great Britain and some other countries. They are financially self-sufficient and their data network is optimized for a particular national market and is usually issued in two languages – English and the host country. Relations with these companies are usually based on the principle of “information exchange”, and the management of these branches is appointed by the “senior” AP board of directors.

Despite the emerging opportunities and even a change in the legal form of its activities, becoming a joint-stock company, AP remains firmly cooperative and non-profit. This to some extent restricts the freedom of management, but also forces them

to study all attempts to ensure success and control operating costs.

Time has shown that the joint form of the news agency is probably the most viable, and that news agencies have long been the industry standard, despite the fact that it is a very expensive and time-consuming business.

The main trends that have appeared in news agencies over the past 20 years have predetermined the current configuration of the information market, which has undergone further concentration. In fact, the AP, together with Reuters, manages all major global flows, including the Internet. Only the previous five “global” agencies were able to fully respond to the emergence of new types of information demand, effectively mastering new segments of the information market. They also successfully rejected the thesis that the development of the Internet raises doubts about the existence of news agencies in general.

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Section 4. Study of art

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BALL IN HISTORICAL AND CULTURAL DIALOGUE: THE BASIS AND SPECIFICITY OF THE PHENOMENON

Abstract. The article is dedicated to the ball – one of the milestones of the cultural tradition of the past, the interest to which is once again rises in present. The author focuses on such aspects of ball practice as multifunctionality and synthesis of arts. The category of harmony is analyzed as one of the characteristic features of this phenomenon.

Keywords: ball; interpersonal communication; multifunctionality; synthesis of arts; category of harmony.

We live in an amazing time – a time of innovation and the reign of information technologies. The latter provide us with vast opportunities in many areas, including the communication area. Today, thanks to cellular communications and the Internet, we can freely communicate with each other online, while being in different places and countries, as well as being in touch with each other on social networks, etc. It is really convenient. Often, online relationships are started on the Internet, beginning from a simple acquaintance and ending with serious feelings, such as friendship and love. Often, without leaving the zone of personal comfort (for example, the premises of office at work or house), a person communicates with one or more persons online.

It would seem that great expansion of communication technologies means that people should not suffer any issues with lack of communication. However, facts speak of the opposite. According to

statistics, more than 30% of people suffer from loneliness and emotional isolation in the world today [1]. One of the reasons that deepen this serious issue is associated by psychologists with the technological development. More specifically it is associated with the advent of communication through gadgets and the Internet. As a result of such communication, “... more and more people are moving further apart from each other and all the more they feel a spiritual need for sincere, beautiful communication. <...> modern youth, despite all their “progressivism” and the desire to be in tune with time, is already experiencing emotional emptiness and the need for live communication” [2, P. 157]. According to scientists, the current situation negatively affects human health, leading to mental dependence on the gadgets (iPhones and smartphones, tablets, computers, etc.), sleep disturbance, depression (According to the World Health Organization, more than 350 million people

in the world suffer from depression today [1]) and, in general, significantly reducing life expectancy. In addition, as a result of online communication "... live communication is transformed, turning into its illusion" [3, P. 9].

A completely different situation is observed in case of the direct "face to face" communication of people. Full with real emotions and feelings that create a certain energy aura around a person, it is distinguished by authenticity, and not by illusory nature. Also, in personal communication, along with verbal means, an important role is played by the moment of physical (tactile) contact between the communicating persons, which is absent during communication through various gadgets. As a result of scientific experiments, it was proved that tactile contact "favorably affects not only physical and emotional development, but also brain biochemistry and even resistance to leukemia" [4].

Consequently, online communication cannot replace healthy, proper live communication. Hence the conclusion about its importance, as well as the importance of those forms of sociocultural activity, the foundation of which is direct interpersonal communication. In this regard, let us take a look at the past centuries when the dominance of the latter was total, and indirect communication between people was minimized – epistolary correspondence. Accordingly, we shall exclude the 20th century from the list of past centuries, in which a telephone, tape recorder, and other technical "modern products" appeared. The emphasis will be placed on the 18th and 19th centuries, when one of the most striking, interesting and indicative forms of cultural tradition, as considered by us, reached its peak – ball.

When viewing this phenomenon as a milestone for the designated historical eras, it is necessary to identify its two essential aspects – multifunctionality and the synthesis of arts. The components of the first aspect include socio-adaptive, integrative, epistemological, incultural (human-creation), game, communicative-informational, axiological, educational (didactic), educational, regulatory (norma-

tive), sign (semiotic), presentation, matrimonial ("marriage fair"), Self-identifying ("vanity and status fair"), recreational, aesthetic-hedonistic, ethical and humanistic functions. Each of them solved a specific problem. In the complex, the implementation of all of the above functions at ball events served the main goal – the goal of harmonious development of the individual.

The second aspect, which focuses on the ball as a phenomenon based on a complex of arts, serving the same noble purpose of harmonization as a ball society as a whole, and each of its representatives in particular. According to F. M. Dostoevsky, "Art is as much a need for man as eating and drinking. The need for beauty and the creativity that embodies it is inseparable from man, and without it, perhaps, man would not wish to live in this world" [5]. Music, painting, choreography, sculpture, architecture, arts and crafts, theater, organically fusing with each other as the ball, create an absolutely amazing atmosphere for aesthetic, ethical, intellectual and emotional improvement of a person. This special atmosphere of the ball can be defined by the words HARMONY and BEAUTY.

The very concept of harmony, as a philosophical and aesthetic category, comes from the Greek word "harmonia" – communication, proportionality, harmony. It means "a high degree of orderliness of the components in something whole, one, and the compliance of this whole with the aesthetic criteria of perfection and beauty. Harmony is coherence, coherence, mutual conditioning of parts as a whole, their consistent combination" [6]. It is known that in the theory of harmony there is a system of categories that define this concept. In addition to the above-mentioned sign of coherence, connectedness and unity of all elements, it includes: unity and struggle of opposite principles, contrasts; knowing of limits; proportionality and proportionality; balance and symmetry; clarity and ease of perception; relevance, relevance, environmental conformity; beautiful; sublime; perfection. As you can see, BEAUTY is one of the categories of HARMONY, is its characteristic feature.

Therefore, at the balls, the achievement of the global goal of improving the human personality occurred through the prism of comprehension of the beautiful in its diverse manifestations through the synthesis of arts. Moreover, it should be noted that the ball, as one of the iconic forms of the cultural tradition of the past, solved the problem of HARMONY at different levels. The role of the ball as a large-scale artistic phenomenon, foundation of which is formed on the basis of a complex of various types of art, which means it has a large degree of aesthetic impact on a person, can hardly be overestimated. Music, choreography, painting, sculpture, architecture, arts and crafts, theater, etc. within the framework of the ballroom action form its special, artistic, chronotope. It should be emphasized that each component of the artistic chronotope of the ball was presented in the framework of this solemn event in an exemplary, perfect form.

Ball is one of the social practices that fuse purely sociological matter with artistic matter. The ballroom was one of the important places for the interaction of many different cultural vectors, aimed, on the one hand, to realize the socialization of the

participants in the balls, and on the other, to create a culture of their behavior and communication within the framework of ball etiquette. In this regard, the importance of ball practice as an indicative sociocultural form, a special social mechanism is difficult to overestimate.

The functional and artistic levels considered in the article, connecting in the ballroom with the social level (the problem of social harmony), lead us to the “problem of harmony between man and the world, culture and life” [7].

In conclusion, it should be noted that in modernity the revival of the ball tradition is not just a manifestation of a genuine interest in the culture of their ancestors. In the context of a growing year by year tendency for people to feel loneliness and lack of live communication, balls can become a kind of “Noah’s ark” for everyone who wants to expand the circle of acquaintance and the sphere of interpersonal communication; a place where everyone will find for themselves one form or another of creative realization and, of course, will be able to fully compensate for the lack of communication and destroy the “vicious circle” of loneliness.

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Section 5. History

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BASHKIRS IN THE RESEARCH OF S.I. RUDENKO: ON THE INTERPRETATION OF SOME ISSUES

Abstract. Based on the materials collected during trips to the Bashkir region, the famous Russian scientist S. I. Rudenko wrote the scientific work “Bashkirs: The experience of an ethnological monograph”, in which he considered many important questions of the history and culture of bashkirs. Staying on the family and domestic aspects of the life of the people, he showed the position of women in traditional society. What was the interpretation of this issue by scientists, we consider in the article.

Keywords: the bashkirs, the traditional society, study, the scientist, woman, standing.

In Russian history, the position of women in the family and society, the distribution of duties and roles of men and women in the family and household sphere, were regularly subjected to changes and became generally recognized traditions. In this regard, the status of a bashkir woman in traditional society, which underwent dramatic changes in the XX century, is of undoubted interest. This topic has always attracted the attention of researchers. Among them, one should mention the famous Russian scientist Sergei Ivanovich Rudenko, who devoted many years of his scientific activity to the study of the history and culture of the bashkirs, as well as the other peoples of the country as a whole.

In his studies, the scientist drew attention to many issues of social, economic, family and household life of the bashkirs. The result of this was a fundamental work in two parts “Bashkirs: The experience of an ethnological monograph”, published in 1916 and

1925. When studying the life and family life of the people, scientists were given their own interpretation of the issue of the status of women among the bashkirs. Showing their rather high status in a traditional society, he noted that he was diminished as society developed, from one stage to another in the history of the people, and the situation became unequal. His conclusions coincided with the opinions of many domestic researchers.

This interest of the scientist in the bashkirs is explained by the fact that his father was busy working in the commission on the delimitation of bashkir lands, and therefore the family lived in Bashkiria. Sergey often visited bashkir villages with his father and observed the daily life and economic activities of people, their traditions and customs. Entering St. Petersburg University, he is interested in research and begins it by studying the history and life of the bashkirs. In 1906, 1907, a student

of Rudenko made trips to the Bashkir region with the aim of examining and collecting clothing for the ethnographic department of the Russian museum. Fulfilling the task assigned to him, he simultaneously studies the structure of the tribal organization of the bashkirs, the territory of their settlement, land relations, writes down folk customs and rituals, traditions and tales. Subsequently, more than once, the scientist will visit the region to collect materials on the history and culture of the people, which he needed to write a monograph. Its first part was devoted to the examination of the physical type of bashkirs and in 1915 a test presentation was completed. She saw the light next year [1].

By this time, he had prepared the second part of the monograph, which he called "Gen. Bashkir". But it was published only in 1925 for objective reasons [2]. It is she who is of interest in connection with the topic considered in the article. In Russian historiography, the attitude about the "unbearably difficult situation of the bashkir in the family and society" has been fixed. But the appeal to historical, ethnographic, folklore materials, cases of divorce proceedings does not give its confirmation. Opinions of researchers on this issue were many [2, 257]. Despite the differences of opinion, they were united in one thing: the bashkirs enjoyed relatively greater freedom than women of other peoples of Russia.

In the monograph S. I. Rudenko gave a detailed ethnographic description of the bashkirs of the XIXth – early XXth centuries, of all forms of economic activity of the people: everyday life, material and spiritual culture. Based on various sources, such as folklore, statistical information, scientific, local history literature and his own observations, the scientist analyzed the sphere of family and household relations among the bashkirs. Without sharing the opinions of some researchers about the "disempowerment" of bashkirs in the family and society, he gave his own interpretation of this issue. To this end, the question poses the following question: "What is the position of the bashkir woman in the

family? Are they looking at her like a slave bought for money, as some researchers think ... or is her position pretty tolerable and even better than the position of a russian woman, as others think ...?" [2, 257]. In response, he cited the following arguments: "... first of all, it should be borne in mind that the wife always brings rather significant property to the economy and his wife remains the owner. She owns, in addition to all kinds of clothes and expensive jewelry, also cattle, which she brought with her to her husband's family with all the offspring. Not only the proceeds of her property go to her benefit, but the husband without her consent does not have the right to either sell or kill any of her animals. The possibility of a divorce, in the case of beatings by her husband or even with rough treatment, after which she can leave the family with all her property, makes her position quite independent, and older women often use even greater attention in bashkir families" [2, 257]. This is also mentioned in his writings known russian scientists and researchers as B. M. Cheremshansky [3, 148], N. Kazantsev [4, 28], S. G. Rybakov [5, 20], D. P. Nikolsky [6, 51] and others, that the position of the bashkir woman in the family is "pretty tolerable".

On the nature of family life in the bashkirs S. I. Rudenko expressed himself in the monograph as follows: "... it proceeds very peacefully, the wife almost never objects to her husband, the latter treats her with great attention". He believed that it was based on the clan system of the bashkirs, and compared it with other muslim peoples. In his opinion, the bashkirs had many similarities with the kazakirghiz in the family and household system" [2, 258].

On the other hand, based on some wedding ceremonies, the customs of the traditional family life, the scientist shows the dependent position of the bashkir. This is also indicated by her heavy workload of homework, participation on an equal footing with men in household affairs (mowing, reaping, threshing, etc.) [2, 258]. Academician of the Petersburg Academy of Sciences I. I. Lepekhin wrote about this

in the XVII century in a generalizing work on the peoples of Russia [7, 154]. In the subsequent period many russian scientists and researchers wrote in support of the academician's statement about the position of the bashkirs in the family and society.

So, the position of the bashkir woman in society from the early stages of the history of the people was quite high and was characterized by a specific originality, in comparison with other peoples. Researchers attributed this to the peculiarities of the nomadic lifestyle of the bashkirs, where, along with men, women shared the hardships of a difficult nomadic life, conducted all their homework. What is the interpretation of S. I. Rudenko? In his opinion, "... in general, bashkir women enjoy relatively greater freedom than many other muslim peoples". The confirmation indicated that there was no tradition of "covering the face", the exception for them was the presence of older and unfamiliar men, which older women and girls under 12 did not adhere to at all. Moreover, he cited the preserved tradition of the participation of bashkir women on a par with men in folk festivals, general games, etc. He believed that the seclusion and the wearing of a ritual bedspread in bashkir society was almost unknown [2, 257, 258].

However, then the position of the bashkir in society began to decline. S. I. Rudenko cited the tradition of the Bashkir family life in the monograph: "... If a woman eats with all her children and household members in her family circle, then with an outsider, if he is not a close person, she fades into the background, brings to the table, but she's not takes place". In his opinion, along with the manifestations of patriarchy, the status of women in society was also affected by the spread of Islam among the bashkirs. This limited the scope of freedom and independence of women, placed barriers between men and women, both in public life and in everyday life. Of course, deep into the bashkirs, islam could not penetrate due to the specifics of the nomadic way of life of the people and a sufficiently

high level of women's participation in economic life. Nomadic culture gave birth to a respectful attitude towards a woman, due to the serious contribution she made to the economy of the family and society. However, this did not mean her equal rights with men, because a feature of traditional society was the dominance of patriarchal relations based on the dominance, dominance of men and the subordinate, dependent position of women. Therefore, the active economic activity of the bashkir in a nomadic society, on the one hand, and the institution of seclusion, which assumed the minimum role of female labor, on the other hand, could not be compatible [2, 258].

Thus, the famous russian scientist S. I. Rudenko paid serious attention to a thorough study of the bashkirs. In his scientific works, they received a comprehensive and objective consideration of many issues of public, economic, family and household life of the people. Of course, the role of women in a given society, the place it occupies, the functions that it performed, have always been different. This depended on many factors: historical, economic, geographical conditions, characteristic of a given people and this social system of customs, traditions and generally accepted moral standards, etc. And therefore, the conclusions made by the scientist about her "rather high" position coincided with the established views of many domestic researchers. However, as he pointed out, as society developed, it became more and more belittled, dependent and unequal. This was confirmed by the powerless position of the bashkirs in the family and household sphere. This was especially evident in matters of inheritance and division of property. Subsequently, in published domestic works, researchers on these issues did similar to S. I. Rudenko conclusions, which even had a more categorical character up to comparison with slave position [8, 13]. The conclusions of the scientist take place in the works of modern researchers [9].

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Section 6. Information technology

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THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN LEGAL PRACTICE

Abstract. In this paper we explore problem of creating, as well as the effective use of electronic information tools is currently particularly relevant. The task of a modern lawyer is to use them rationally in the relevant legal activities, since any information technology must be properly implemented in legal processes and procedures.

Keywords: lawyer, information technology, PC, information.

Introduction. With the onset of the 21st century, which went down in world history under the name of “information”, rapid development has become an industry of modern technologies, the products of which deeply integrated into almost all spheres of public life [3–5]. Global telecommunication networks appeared and became widespread, which led to significant changes in existing social relations. The various gadgets that are the latest achievements of this industry are so closely entrenched in our daily lives that we are almost dependent on their use – it is difficult to imagine a businessman (or contract employee) who would not use his computer for professional activities or, at least a mobile phone. It should be remembered, that the main goal of information technology is to optimize our time spent on professional activities, i.e. no case should such technologies be perceived as the only way of leisure. In modern literature, there are several approaches to the definition of the concept of “information technology”. From the point of view of analyzing the quality of the information presented, over which certain actions performed that change its characteristics, un-

der the information technology we understand “the totality of methods and methods for obtaining, processing, presenting information aimed at changing its state, properties, form, content and implemented in the interests of users” [1; 2].

To date, the information component is the main component of the professional activity of a specialist in the field of jurisprudence. All stages of the legal impact process are carried out using continuous information communication with the activities of institutions, enterprises, organizations, citizens, etc. On the basis of timely collected, sufficient, analyzed information, for example, an information model of the crime is built and the necessary decisions are made. Information support is the core of legal activity.

Despite the fact that traditional methods and forms of obtaining legal information for a lawyer remain a necessary tool for searching for subject material, and printed media of information data (texts of laws and other regulatory legal acts, codes and comments thereto, published judicial practice, etc.), legal literature of scientific and practical significance, as before, remains in the use of lawyers as a source

material for making legal decisions, their professional activity still requires knowledge of them in the field of information tools and technologies for the search and use of legal texts in electronic form, as well as practical skills and their application [1; 2; 5]. This is due to the introduction in the legal activity of computer help systems and special software.

The presence of a personal computer as a necessary tool for changing the state of information allows a lawyer to quickly find and process legal texts, transfer them over the Internet, receive an answer to his queries, select data from a certain set of information, etc. In addition, it becomes possible to solve legal tasks quickly and correctly, which means it's most effective.

In general, information processes in the legal system are processes of search, collection, production, receipt, storage, dissemination, processing, transmission and consumption of information, adoption of necessary decisions on its basis and are determined by the specifics of a particular subject area

Typical operations (actions) of information technology are:

- Collection and registration of information;
- input of information;
- Information transfer;
- data processing;
- information output;
- data storage;
- accumulation of information;
- search for information;
- analysis of information.

A similar definition can be found in many works: "Information technologies are processes, methods for searching, collecting, storing, processing, providing, disseminating information and methods for implementing such processes and methods" [5]. However, in our opinion, the most accurate definition is given in the scientific works of E. V. Nadygin, where such a technology is defined as "a combination of processes based on the achievements of modern computer technologies and means of communication influencing information, tools for obtaining

diverse information, as well as a way of interaction between members of modern society, the method of joint decision making and the birth of new knowledge, the creation of legislation, development of the legal system of the state as a whole "[5]. What is the role of information technology directly in legal activity, why do we need a computer in the work of a lawyer – did they somehow manage? In legal activities, information technologies are designed to solve a number of problems, the appearance of which is due to the specifics of the work of a lawyer – in the first place, the search, processing and analysis of current legal information. However, it should be noted that with the development of the Russian legislative base, such technologies were also used to quickly exchange information, provide the necessary data to state authorities, and even in the framework of judicial procedures. Modern technologies significantly accelerate the process of searching, preparing and analyzing legal documentation required in each case. Moreover, often information technology is not just ease of use, but also an opportunity to avoid possible "traps" that the legislator intentionally or unintentionally left to citizens. It's not a secret for anyone that most representatives of the older generation prefer to draw up documents "old", manually, that they use not very honest bureaucrats, so as not to react to certain appeals of citizens.

Further integration of information technologies in legal activities will significantly reduce the time spent on making decisions within a specific legal situation, to improve the quality and develop the right solution. To carry out its professional activities, the lawyer is often required not only legal information but also various statistical data, research material and General information in the related fields of public activities. In most cases, the lawyers get all these data from information technology: reference legal systems (hereinafter referred to as PCA), specialized databases and the Internet. A characteristic feature of a lawyer's work is the need to analyze the many options allowed by the circumstances of the case, from

which it follows choose the only – to find the most reasonable solution for each particular situation. Today almost all jobs, corporate lawyer, lawyer or legal counsel is established with a particular SPS. Leaders of the domestic market prevacidprevacid systems today are the following: “ConsultantPlus”, “Garant” and “Code”. Working with these systems provides lawyers reliable legal support, providing a huge list of opportunities, from access to the latest (actual) publications of normative legal acts and analysis selection of judicial practice in specific legal situations to the study of scientific and practical comments on the legislation and the use of various forms of legal documents. Considering specifics of work of a lawyer, drafting a huge number of procedural text documents (statements of claim to the arbitration court, failing to fulfill the conditions of the works contract for capital construction, the recovery of cash from a Bank account, debt collection, debt under the loan agreement, etc.), from the lawyer requires committing the same type of operations, associated not only with the formation and formatting of the documents themselves. For automation of routine operations you can use the text editor Microsoft Word merge documents. The essence of the fusion of documents is that is generated by the receiver (the template) and the source document (table) with specific data, that when combined generate a set of similar documents with various details. The result you can either display directly on print or in a new document with many pages. Merge can be used to create any type of documents in which fields are mapped to data [1; 2; 5]. For written statement of claim about divorce and alimony for the child (children) in the Bulletin of the Council of young scientists and specialists of the Tashkent (17) (vol. 12017 73) Microsoft Word, you must perform the following steps: 1) create the source document in a separate table that contains the following information: name of court, name of claimant, place of residence and of registration of the plaintiff, name of defendant, place of residence and registration of the defendant, the

value of dispute (in rubles), date of marriage, place of marriage, period of stay (dates), children (name, date of birth), the date from which the plaintiff and the defendant does not reside, number of records; 2) create a document template of the statement of claim; 3) select “Start mail merge” – “step by Step mail merge wizard” on the ribbon, “Lists” 4) fill out the required blanks (on the basis of claim 1 of the recommendations) using panel the Merge (Fig. 2). In the future it is necessary to make only changes to the source document (the table), creating a new record. By merging the two documents it is possible to obtain an output document. Note also that currently, there are separate software products that facilitate the work of a lawyer (or a lawyer). These include the program complex “Workstation of a lawyer (attorney)” containing a database of cases (claims (claims, court, pre-trial cases) and participants in the process), an organizer (a notebook with contact information, a scheduler of working hours), a tool for compiling an inventory of documents, an editor for creating documents based on macros [5]. With the help of this complex, it is possible to automatically prepare documents, a journal of contracts with customers, display statistics on cases from the database, and create reports.

In the course of professional activities of lawyers, regardless of specialization always have to work with a large amount of information stored on various media, and share electronic information sources is growing every year. In addition, their work involved the processes associated with creating, processing and storing text documents, their structural and graphic design, systematization and statistical analysis of legal data, searching of legal material, information exchange through networks, including electronic mail. Therefore, an important part of the model of professional competence of a lawyer is information competence, which includes competence in the field of information technology, namely, to use the provided rich tools not only for information and its processing, but also for its presentation

in a new capacity; competence in communications and networking technology, which is characterized not only prompt acquisition of information, but also the ability to organize their activities in a qualitatively new conditions, for example, to create your own legal advice on the Internet; analytical competence, the essence of which is skill based information technologies to obtain, to summarize and analyze professional information [3]. The competence of professionals (including a lawyer) in the field of information and communication technologies, many researchers [3; 5] relates to the basic along with scientific, socio-economic, civil, Polytechnic etc. In accordance with the common understanding of the phenomenon of ICT-competence, analyses the provisions of the Qualification Handbook for managers, professionals and other employees, ICT possibilities for the legal sector, we have developed the following author's definition of the phenomenon being studied: the competency of a lawyer in the field of information and communication technologies is a complex personal and professional characteristics, containing motivational and valuable, cognitive, operational and reflective design components, giving you the flexibility and the lawyer's willingness to adapt to changes in professional activity in the conditions of Informatization of society, to move

ideas from the field of Informatics and information technologies in the legal sphere when working with databases, various documents, and strive to creative expression with the use of ICT [1; 2; 4; 5]. Among the key competences that constitute information and communication competence of a lawyer, you can specify the following: information (characterized by the means of reception, storage and transmission of information); design (characterized by means for determining objectives, resources, actions to reach them, timing of implementation); evaluation (characterized by methods of comparison, classification, abstraction, prediction, systematization, specification of information); communicative (characterized by the ways of conveying information and attracting resources of other people to achieve their goals) [3].

Conclusion

Information technologies are increasingly influencing social relations, and the problems associated with their use, as well as determining the role and place of such technologies in the life of a modern person are still not resolved. Nevertheless, with the development of society, the role of technology in human life will only increase. Thus, a high level of training in the professional, humanitarian and information sphere is simply necessary for "survival" in the current conditions.

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Section 7. Medical science

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CORRELATION OF CLINICAL SIGNS WITH THE OUTCOME OF TRAUMATIC BRAIN INJURY AND THEIR PROGNOSTIC VALUE

Abstract. Clinical manifestations were correlated with traumatic brain injury (TBI) outcomes using computer software. Neuroophthalmologic signs, motor and vital disorders had maximal prognostic values. Outcome was highly correlated with consciousness disorders phase scaling and patients' state scores (PSS) as well as with coma and consciousness disorders length suggesting that these parameters are of major prognostic importance. A close correlation was found between consciousness states, PSS and TBI variants, brain lesion forms, vital and somatic disorders indicating their role as determinants of TBI outcome.

Keywords: clinical signs, TBI, correlation, prognostic, Moscow Coma Scale.

In order to solve the problem of predicting the outcomes of traumatic brain injury (TBI) unification of a large clinical material and the determination of a set of informative clinical signs has great importance. Informative value of each investigated clinical signs is determined by differences in clinical signs of its mean values and standard deviations for different outcomes, as well as its correlation with the other signs [1; 2; 3; 6; 11; 13; 14, P. 6; 15].

In this study, carried out with the use of a statistical computer processing, it has been put the following tasks: 1) to reveal a correlation of individual outcomes of TBI with neurological symptoms and state of consciousness in the affected people in a large number of observations, 2) to determine

the relationship between the outcome and severity of the patients' condition, assessed by the use of a scale point assessment of the condition and the state of consciousness according to the Moscow Coma Scale, and various forms of TBI, and 3) to explore and describe the meaning of mean and standard deviation of some clinical signs to predict the outcomes of TBI [4; 5; 7; 8; 9; 10].

The study is based on the materials of the unified survey of 320 patients with TBI who were hospitalized and treated at the Clinic of Neurosurgery of Samarkand Medical Institute, as well as 91 patients who were treated in the Neurosurgery Institute N. N. Burdenko, Moscow. 331 patients suffered from closed TBI, 42 patients suffered from an

open non-penetrating TBI and 38 patients suffered from open penetration TBI. The largest numbers

of cases (73.5%) were patients with severe brain contusion.

Table 1. – Moscow Coma Scale

| № | Consciousness phase | Neurological sign | | | | | | Code | Middle scores on a Patients' state scores (PSS) |
|----|--|-------------------------------|---------------------------|----------------------|-------------------------|---------------------------|--------------|------|---|
| | | Opening eyes to sound or pain | Execution of instructions | Answers on questions | Focus on time and place | Bilateral fixed mydriasis | Muscle atony | | |
| 1. | Clear state of consciousness | + | + | + | + | - | - | 1 | 65 |
| 2. | Moderate stunning of consciousness | + | + | + | - | - | - | 2 | 60 ± 1 |
| 3. | Deep stunning consciousness | + | + | ± | - | - | - | 3 | 54 ± 3 |
| 4. | Soporotic consciousness (*Vegetative status) | + | - | - | - | - | - | 4 | 46 ± 3 |
| 5. | Moderate coma | - | - | - | - | - | - | 5 | 32 ± 5 |
| 6. | Deep coma | - | - | - | - | - | + | 6 | 20 ± 7 |
| 7. | Terminal coma | - | - | - | - | + | + | 7 | 6 ± 6 |

* Periodic restoration of elementary verbal contact

Table 2. – Patients' state scores (PSS)

| Neurological sign | Points |
|---|--------|
| Opening eyes to sound or pain | 10 |
| Execution of instructions | 8 |
| Answers on questions | 8 |
| Focus on time and place | 5 |
| Bilateral fixed mydriasis | 5 |
| Muscle atony | 5 |
| Respiratory failure | 4 |
| Corneal reflexes | 4 |
| Knee reflexes | 4 |
| The reaction of the pupils to the light | 3 |
| Cough reflex | 3 |
| Symptom of Majandi | 3 |
| Spontaneous movements | 3 |
| Movements to pain | 3 |
| Maximum points | 65 |

State of consciousness of the affected patients has been evaluated in dynamics according to the uni-

form classification of disturbance of consciousness with the use of Moscow coma scale developed by A. R. Shakhnovich and A. M. Mamadaliev. The data craniography, echoencephalography, computer tomography have been used to verify the various forms of TBI [8; 9; 10; 11; 12].

Clinical and series instrumental data (in general 70 signs) of these 411 patients at the age from 1 to 87 years old (343 males and 68 female) were used to examine the issues of predicting outcomes and the effectiveness of treatment of TBI in acute period by statistical processing on the computer. Patients were distributed into four groups depending on the outcomes, among which it has been detected the death outcome (DO), rude neurological disorders (RND), mild neurological disorders (MND) and restoration of function to the compensated condition (CC).

The study of correlations of different features that define the state of consciousness, and two quantita-

tive scales that characterize the state of consciousness and severity of the patients' condition, as well as the correlation of these factors with the outcomes of TBI have been given us the possibility to obtain data to assess the prognostic significance of clinical signs.

Table 3.– Correlation of neurological signs with TBI outcome

| Neurological sign | Correlation coefficient (<i>r</i>) |
|---|--------------------------------------|
| Opening eyes to sound or pain | + 0.41 |
| Execution of instructions | + 0.3 |
| Answers on questions | + 0.31 |
| Focus on time and place | + 0.14 |
| Bilateral fixed mydriasis | + 0.24 |
| Muscle atony | + 0.32 |
| Respiratory failure | + 0.32 |
| Corneal reflexes | + 0.36 |
| Knee reflexes | + 0.28 |
| The reaction of the pupils to the light | + 0.45 |
| Cough reflex | + 0.32 |
| Symptom of Majandi | + 0.12 |
| Spontaneous movements | + 0.33 |
| Movements to pain | + 0.35 |
| Epileptic seizures | - 0.26 |
| Anisocoria | - 0.33 |
| Speech Disorders | - 0.24 |
| Hemiparesis | - 0.31 |

The most interesting in terms of predicting outcomes in TBI is the study of correlation dependence between neurological symptoms and sign of "outcome". The correlation coefficient (*r*) of any neurological signs with the outcome actually specifies its information and prognostic significance in determining the outcome of TBI: the higher the correlation coefficient, the higher this value.

It was established a high predictive value of neuro-ophthalmological signs (reaction of pupils to light, eye opening for sound or pain, corneal reflex safety, anisocoria, bilateral mydriasis), as evidenced by the relatively high correlation with their outcome.

The next most important thing for predicting the outcomes by the group of symptoms were disorders in the motor spheres: movement in response to pain stimulation, spontaneous movements, muscle atonia and hemiparesis ($r \approx 0.35 - 0.31$).

The Influence of the vital disorders on the outcome of TBI at victims in this table is characterized by a significant correlation with the outcome of trauma symptoms such as breathing problems and cough reflex ($r = + 0.32$). The absence of cases with low ($r < 0.1$) correlation with neurological symptoms with outcome of TBI confirms the prognostic value of all the above signs, carefully selected on the basis of the study of literature and clinical experience of leading medical and research institutions, as well as the study of being kept informed of 50 neurological signs with the use mathematical methods.

Table 4.– Correlation of phases of impaired consciousness and PSS in patients with TBI outcome within 5 days after injury

| Signs | Day after TBI | Correlation coefficient (<i>r</i>) |
|----------------------------------|-----------------|--------------------------------------|
| 1 | 2 | 3 |
| Phases of impaired consciousness | 1 st | - 0.46 |
| | 2 nd | - 0.62 |
| | 3 rd | - 0.68 |
| | 4 th | - 0.66 |
| | 5 th | - 0.63 |
| PSS | 1 st | + 0.53 |
| | 2 nd | + 0.65 |

| 1 | 2 | 3 |
|------------------------------------|-----------------|----------|
| PSS | 3 rd | + 0.67 |
| | 4 th | + 0.65 |
| | 5 th | + 0.62 |
| Coma duration | – | – 0.40 |
| Duration of impaired consciousness | – | – 0.31 |

During the analyzes the correlation of states of consciousness and PSS with the outcome of TBI (table 4) it has been revealed a significantly higher correlations ($r \approx 0.46 - 0.68$), than during study of relationships outcomes with individual neurological symptoms during the 5 days of the investigation. The maximum correlation is marked on the 3–4th day after the trauma, which indicates about the critical value of these days for fatal or favorable outcome.

The high correlation of using scales of states of consciousness and PSS with the outcome of TBI is an important fact testifying about the prevailed importance them in order to predict the outcomes of TBI among all investigated clinical signs (separate neurological signs, the type and severity of TBI, vital disorders, etc.).

There are some reports on the impact of the outcome of TBI duration of comatose condition, which is a highly informative indicator of the severity of brain damage. We have assessed in detail not only the duration of the comatose condition, but also the duration of impaired consciousness in accordance with

the classification of states of consciousness. The duration of coma – is the whole period of the patient in a comatose state, regardless of its degree (moderate, deep, prohibitive) after admission to hospital. The duration of impaired consciousness is not only the duration of comatose condition, but also the entire period of impaired consciousness, including coma, stupor, deep and moderate stunning. The duration of coma and duration impaired consciousness estimated in the dynamics with the use of a scale states of consciousness have significant correlations with the outcome ($r = - 0.40$ and $- 0.31$) and, therefore, significantly affect the TBI outcome.

These clinical factors were investigated in order to clarify their values to predict both the DO and the degree of recovery functions in patients with different categories of a favorable outcome (CC, MND and RND). As you see from (Table 5) the average duration of coma at DO and RND is the same and equal to 5 days, while in patients with restoration of functions to the CC and the MND it ranges from a few hours to 1 day.

Table 5. – Duration of coma and impaired consciousness (in days) in patients with TBI with different outcomes ($M \pm m$)

| Sign | DO | RND | MND | CC |
|---|-------------|-------------|------------|-----------|
| Coma duration | 4.7 ± 4.0 | 4.6 ± 4.3 | 1.1 ± 1.4 | 0.4 ± 0.5 |
| Duration of impaired consciousness | 15.0 ± 15.3 | 26.7 ± 26.6 | 5.4 ± 5.0 | 3.6 ± 3.7 |

The study of coma duration in acute TBI is prognostic important in determining the character of the outcomes. If the duration of coma is more than 5 days, it increases the likelihood of DO and RND.

The various outcomes of TBI significantly depend on the duration of comatose condition and impaired consciousness: the more their duration,

the worse the outcome, and, conversely, if the duration of coma is less than 1 day, and the duration of impaired consciousness is 3–5 days, it increases the likelihood of recovery from CC and MND. An exception is the duration of impaired consciousness at RND, where it is more than in the DO.

Prognosis of TBI significantly becomes worse with increasing age. In this investigation we restrict ourselves by the analysis of the average values of age during the various outcomes of TBI. As it can be seen from (Table 6), in the group of patients with DO the

average age was respectively for 10–14 years longer than in patients with MND and recovery functions to the CC. The average value of age at the DO and outcomes with RND differs less – about 6 years, but this difference is significant.

Table 6. – Mean age at different TBI outcomes (M ± m)

| Outcomes | Number of patients | Age, years |
|----------|--------------------|-------------|
| DO | 129 | 37.4 ± 19.3 |
| RND | 71 | 31.6 ± 17.5 |
| MND | 103 | 27.4 ± 17.0 |
| CC | 108 | 23.7 ± 17.6 |

As it is known, along with the state of consciousness and neurological symptoms the great importance for the outcome of has the type of TBI and form of brain damage, focal neurological and vital disorders. The analysis of their correlations with the state of consciousness and PSS in the different days of the acute period of TBI show the close relationship between the state of consciousness, and the severity of the condition and forms of brain damage ($r = 0.44 - 0.51$), intracranial hematomas ($r = 0.31 - 0.36$). In addition, it has been observed the correlations of the values for 5 days with the following features: body temperature ($r = 0.33 - 0.40$), with a frequency of breathing and self-managed or moderated breathing ($r = 0.21 - 0.34$), with convulsions of the hemispheric or stem origin ($r = 0.26 - 0.34$), with anisocoria ($r = 0.26 - 0.3$) and with an offset of M-echoes ($r = 0.26 - 0.38$).

Based on the dynamics of change in correlations with the state of consciousness and PSS in different days after the trauma can be stated as follows: the maximum correlations with the frequency of breathing spontaneously breathing or IVL and body temperature observed in the first days after the trauma, then to the 5th day they are decreased, in contrast, the occurrence of pneumonia has a maximum correlation to the 5th day, as soon as the correlation be-

tween the state of consciousness, pneumonia and PSS for all 5 days is quite high ($r = 0.21 - 0.50$).

Conclusions:

1. The analysis of the correlations of the separated neurological symptoms with the outcome of TBI demonstrates their high predictive value, moreover the neuroophthalmological symptoms have a leading role (especially the opening of the eyes for the sound or pain, reaction of pupils to light, the preservation of corneal reflexes, bilateral fixed mydriasis), then disorders in the movement sphere (movement or reaction to pain and muscle atonia) and vital disorders.

2. The high correlation the scales of states of consciousness and PSS in patients with the outcome of TBI which we used demonstrate about the high importance of them for predicting the outcome of TBI than all investigated clinical signs.

3. The duration of coma and duration of the impaired consciousness have significant correlations with the outcome of TBI and, therefore, significantly affect to the outcome of TBI: the more their duration, the worse the outcome, and vice versa.

4. It has been determined the close connection between the state of consciousness, PSS and types of brain damage, vital and somatic disorders. This shows not only the interdependence of these signs, but also its essential importance for the outcome of TBI.

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CHARACTERISTIC FEATURES OF CHANGES IN THE FIELD OF VISION IN PATIENTS WITH BRAIN TUMORS

Abstract. It is known that optic recess is located in that part of the optic chiasm where the papillomacular bundle passes with its ceased fibers. The carried out research allows to consider that changes in the central field of vision in posterior cranial fossa tumors with the development of internal hydrocephalus is caused by the direct action of the enlarged optic recess of the third ventricle on the chiasm of the optic nerves.

Keywords: brain tumors, hydrocephalus, intracranial pressure.

Due to a number of negative factors, both in nature and in our life, the number of people who suffer from tumors of the central nervous system (CNS) is growing [1; 2; 8; 9]. These circumstances require constant attention to the development of a system for providing medical care to neurosurgical patients, as well as improving the methods of neurosurgical research in the examined patients [1; 2; 6; 7; 10; 16].

Brain tumors are manifested by different signs and present severe form of neurosurgical pathology, which requires early and specific surgical treatment [1; 2; 5; 8; 10]. A clinical progression of brain tumors leads to a significant impairment of brain function [6; 7; 10; 18].

Intracranial pressure rises due to an increase of brain mass caused by brain tumor and perifocal edema or stasis of cerebrospinal liquid because of decreased outflow from the ventricular system, this difficulty in cerebrospinal fluid outflow which underlies the formation of internal obstructive hydrocephalus [3; 4; 6; 9; 11; 12; 17]. One of the

earliest signs of the brain tumors is the loss of visual fields [13; 14; 15].

Aim of the study. Identification of changes in visual fields depending on the location of brain tumors.

Material and methods of the research. We studied the state of central and peripheral visual fields in 136 patients with brain tumors between 4 to 76 years old, 72 men and 54 women, who received treatment at the Neurosurgery Department of the Samarkand State Medical Institute. From 136 patients, 89(65.4%) had supratentorial and 47(34.6%) of patients had infratentorial localization of the brain tumor. All patients with the diagnosis of a brain tumor were verified by histological examination.

During the examination were excluded patients with tumor which could directly affect the optic pathway. Study of the peripheral field of vision conducted on projection perimeter. The central field of vision was studied using the LambD-100 device.

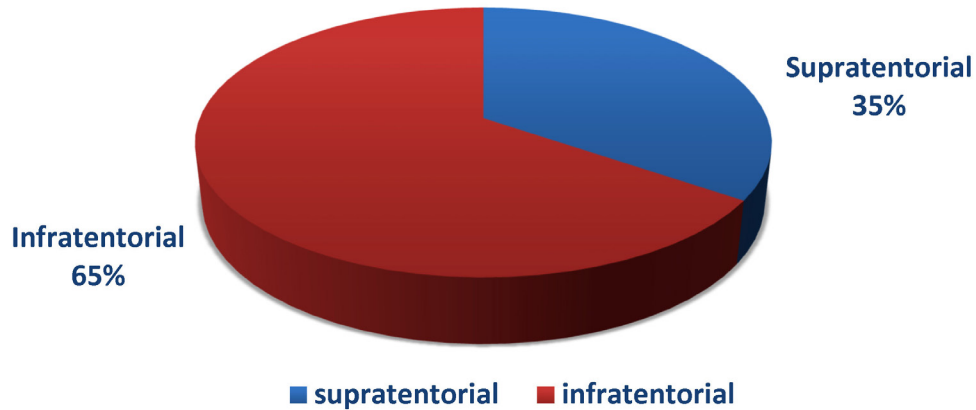
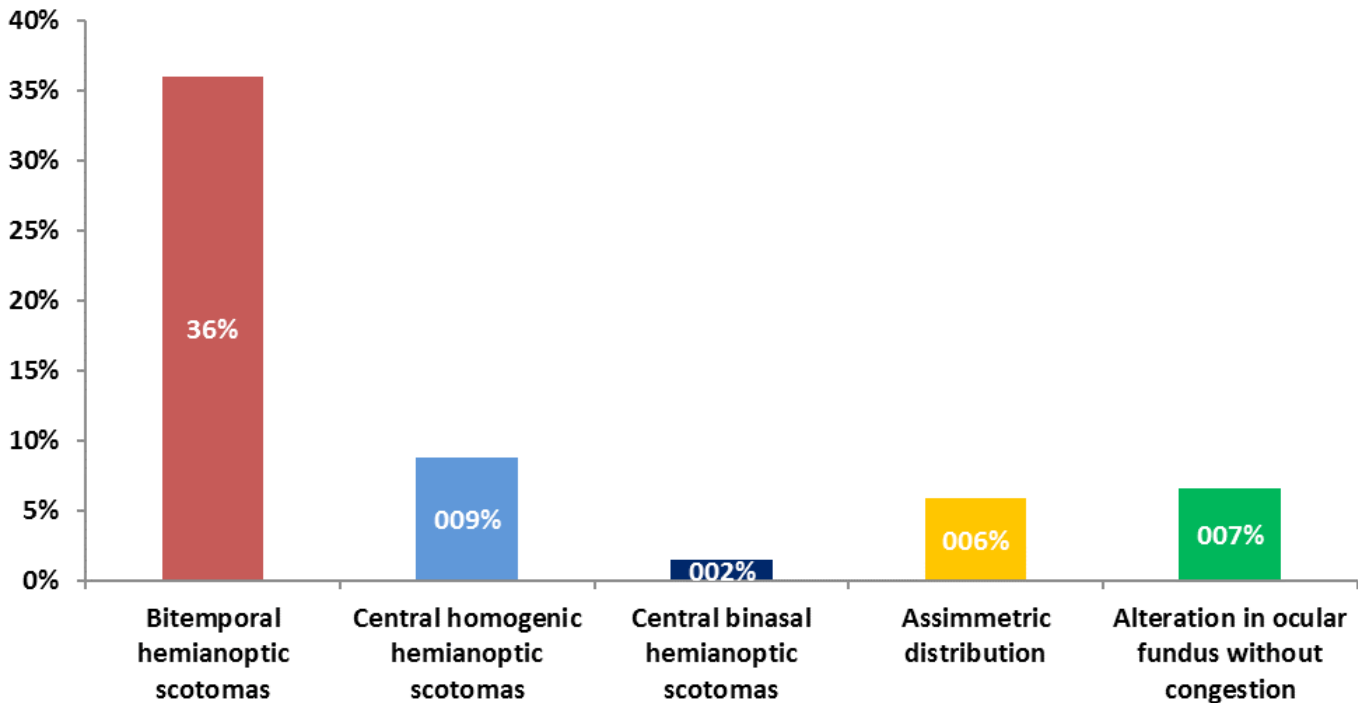


Diagram 1. Distribution of patients by location of brain tumor

The results of the study. The peripheral field of vision was studied in 136 patients with brain tumors. The constriction of vision field – a concentric or bitemporal bias – was observed in 46(33.8%) patients out of 83 with congestive optic nerve discs. Various visual field damages in the form of a concentric con-

striction or irregular constriction along the entire meridian with the presence of blind spot (scotoma) were observed in 22(16.2%) patients with the development of secondary optic nerves atrophy with absence of congestion of ocular fundus, bitemporal visual field constriction was observed in 8 patients (5.9%).



Picture 2. Distribution of patients by neurophthalmic alteration

Under the examination of the central field of vision, changes were found in 71(52.2%) patients with congestion in the ocular fundus. The pattern of changes were following: alteration on the type

of bitemporal hemianoptic scotoma – 49(36%) patients: central homonymous hemianoptic scotoma – 12(8.8%) patients: central binasal hemianoptic scotoma – 2(1.5%) patients: asymmetry of disorders

when there was an alteration in one eye, and were absent in the other 8(59%) patients: among 32 patients without congestion in the ocular fundus, alterations were found in 9(6.6%) patients.

From 47(34.6%) patients with tumors of the posterior cranial fossa, alteration in the central field of vision occurred in 38(27.9%). Among 37 patients with tumors of supratentorial localization without (accompanied) internal hydrocephalus, the peripheral visual field was changed in 6 patients (4.4%). The central field of vision was changed in 8 patients (5.9%).

Thus, in patients with brain tumors which is not accompanied by internal hydrocephalus, alteration in peripheral and central fields of vision were less common.

The studies suggest that changes in the central field of vision in tumors of the posterior cranial fossa with the development of internal hydrocephalus are caused by the direct effect of the expanded ophthalmic bundle of the third ventricle on the chiasm of the optic nerves. It is known that optic recess is located in that part of the optic chiasm where the papillomacular bundle passes with its ceased fibers. Therefore, development of obstructive hydrocephalus is purely mechanical pressure of the fibers protruding optic recess, leading to a violation of their conductivity and then, as a result of compression – violation of microcirculation and ischemia of this area. As our studies have shown, with internal hydrocephalus, the expansion of the optic recess is variable, often asymmetrically. This explains the variability and the asymmetry that occurs in alteration of central vision.

Alteration of the central field of vision in patients with hypertension syndrome due to tumors of the cerebral hemispheres are less common, because in these cases there is an increase of intracranial pressure without occlusion of the ventricular system and the direct effect of the extended optic recess onto chiasm. In case of when these alterations occur, the dislocation of the brain or the direct effect of the tumor to the optic pathways are more important.

Our studies allow us to express certain considerations about the dependence of visual function impairment on the level of pressure of the extended optic recess of the optic chiasm:

- in the initial degree of compression appears depression in the low-temporal parts of the central field of vision:

- in the second degree, a further increase in compression leads to a construction of the peripheral field of vision and the appearance of absolute paracentral scotoma.

- in the third degree of compression visual acuity begins to fall, the field of vision will change even more in the absence of atrophy on the disc of optic nerve:

- in the fourth degree of compression – severe impairment of visual function with the appearance of signs of atrophy on the optic fundus:

- in fifth degree – atrophy of the optic nerves.

In the pathogenesis of the above mentioned disorders factor of compression expanded optic recess of the optic chiasm plays an important role simultaneously with microcirculatory disorder and ischemia of chiasm. At the initial degree of compression, the mechanical factor is crucial and with an increase of internal hydrocephalus – circulatory disturbance and ischemia in the compression zone. Further, altered nerve fibers begins to join, which gradually leads to atrophy of the optic nerves.

Conclusion:

1. The alteration of visual fields in brain tumors is determined not by the increase in intracranial pressure, but by the development of obstructive hydrocephalus accompanied by the expansion of the optic recess of the third ventricle by the direct effect of the latter on chiasm.

2. Alterations in the central field of vision in tumors of the posterior cranial fossa are more often observed, having the character of bitemporal hemianopsia. Changes in the peripheral boundaries of the visual fields are observed in more than 55% of patients and have bitemporal or concentric constriction.

3. The impairment of the central field of vision is caused by the extension of the optic recess which effect on the papillomacular bundle conducting in the dorsocaudal parts of the chiasm, causes both a purely mechanical compression of these structures and the distribution of microcirculation.

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FEATURES OF THE BLOOD LEPTIN INDEX IN PATIENTS WITH CHRONIC PANCREATITIS ASSOCIATED WITH INSULIN RESISTANCE

Abstract. In recent decades doctors of almost all specialties have paid great attention to the problem of rapid increase in the frequency of metabolic syndrome – “pandemic of the 21st century”. The purpose of this research was to study the characteristics of the blood leptin index in patients with chronic pancreatitis associated with insulin resistance. Measurement of the concentration of leptin in blood serum can be recommended for inclusion in the algorithm of examination of patients with CP combined with IR and can serve as additional markers of this condition.

Keywords: chronic pancreatitis, leptin, obesity, insulin resistance, metabolic syndrome.

Introduction

Currently, the rapid increase in the frequency of metabolic syndrome (MS), “pandemic of the 21st century”, continues according to WHO experts. The main characteristics of MS are an increase in visceral fat mass, insulin resistance, hyperinsulinemia [1; 3].

In recent decades, doctors of almost all specialties have paid great attention to this problem. Given current trends, the number of people suffering from MS will exceed half a billion people by the middle of this century. However, with timely diagnosis and treatment, metabolic disorders can be reversible, or the severity of manifestations of MS may be corrected [2; 6].

In the formation of MS, the hyperactivity of the hypothalamic-pituitary – adrenal system and sympathoadrenal reactions plays a role, enhancing insulin resistance (IR) and reducing the production

of adiponectin. Peculiarities of polymorphism of dopamine and leptin receptor genes associated with MS with hyperactivity of the sympathetic nervous system were noted [4; 5].

An important link in the pathogenesis of MS in accordance with the lipocentric theory is abdominal-visceral adipose tissue. One of the main factors in MS can be considered android obesity. According to S. A. Butrov et al. (2004), IR was detected in 88% of patients with the android type of obesity, and with the gynoid type of obesity only in 32% of patients.

Numerous studies have shown that hyperinsulinemia leads to the depletion of the insular apparatus of the pancreas (their mass decreases, the conversion of proinsulin into insulin is impaired). As a result, insulin secretion decreases, gradually reduced glucose tolerance and diabetes mellitus are formed [7; 8; 9].

Objective: To study the characteristics of the blood leptin index in patients with chronic pancreatitis associated with insulin resistance.

Material and research methods

In our work, the object of the study was patients with chronic pancreatitis (CP) associated with the state of IR, who is being treated in the therapy department, RCH No. 1. In the process of research, 58 patients were observed. In accordance with the objectives of the study, 3 observation groups were formed:

1. A group of patients with CP – 40 people.
2. A group of patients with CP associated IR – 18 people.
3. A group of healthy individuals – 14 people.

The average age of patients of all groups was 52.2 ± 2.7 years. In the clinic, an anthropometric examination of patients was also carried out – determining the weight and height of patients, determining the circumference of the waist and hips.

Patients with criteria meeting the “Global Consensus on MS criteria” were included in the experimental study group: central obesity, confirmed by a waist circumference of 102 cm for men and 88 cm for women, and any two of the following criteria:

Exclusion criteria for both groups were severe somatic diseases – type 1 diabetes mellitus, chronic renal failure, severe anemia, respiratory failure, and oncological diseases.

The insulin content was determined by enzyme immunoassay (kit company “DRG-Diagnostika” Germany). The leptin content was also investigated with enzyme immunoassay using kits from Diagnostics Biochem Canada). In addition, the study of free

fatty acids (FFA) was performed by the enzymatic method, as an independent predictor of impaired glucose tolerance, IR and diabetes mellitus.

Statistical data processing was performed on the individual computer using the spreadsheet “Microsoft Excel”.

Research results and discussion

Based on the obtained research results, it should be noted that along with changes in anthropometric data, carbohydrate and lipid metabolism findings in patients with CP associated with IR there is a change in the functional state of the cardiovascular system. So, in 70% of men and 60% of women, an increase in blood pressure is associated with obesity. For every 4.5 kg of body weight, systolic blood pressure increases by 4.5 mm Hg. An important aspect is the link between obesity and type II diabetes mellitus. Obesity leads to the development of peripheral tissue IR, which plays a trigger role in the development of type II diabetes mellitus.

Deposition of fatty tissue in the abdominal region (or central obesity), as it was found in our patients, was more clearly associated with MS, in particular obesity. Visceral adipose tissue, unlike adipose tissue of different localization, is richer innervated, has a wider network of capillaries and communicates directly with the portal system. Visceral adipocytes have a high density of β 3-adreno-corticosteroid and androgen receptors and a relatively low density of α 2 -adrenoreceptors and insulin receptors. These features determine the high sensitivity of visceral adipose tissue to the lipolytic effect of catecholamines and low sensitivity to the antilipolytic effect of insulin, especially in the postprandial period.

Table 1. – FFA findings in the blood serum of the patients with CP associated with IR

| Indicator | Healthy individuals (n = 14) | Group I CP (n = 40) | Group II CP with IR (n = 18) |
|----------------------|---------------------------------|---------------------|---------------------------------|
| FFA content (mmol/l) | 0.28 ± 0.02 | 0.46 ± 0.04 | $1.26 \pm 0.09^*$ |

Note: * – reliability of differences $p < 0.05$ in comparison with control group

As can be seen from the presented results of the study (table 1), in the first group of patients (CP),

there were no significant changes in the concentration of FFA in the blood (0.46 ± 0.04 mmol/L versus

0.28 ± 0.02 mmol/L in healthy individuals). Intensive lipolysis in visceral adipocytes leads to the release of a large amount of FFA, mainly into the portal circulation and liver. In the liver, FFAs inhibit the binding of insulin by hepatocytes, causing the development of IR, a decrease in the extraction of insulin by the liver, and the development of systemic hyperinsulinemia. Once in the systemic circulation, FFA contributes to impaired glucose uptake and its utilization in muscle tissue and, thus, enhance peripheral IR. Excessive content of FFA in the blood serves as a source of accumulation of triglycerides and products of non-oxidative metabolism of FFA in skeletal and cardiac muscles and causes a violation of glucose insulin-dependent utilization in these tissues. Numerous studies in recent years have shown that FFAs have a direct toxic effect on pancreatic β -cells (the effect of lipotoxicity). The highest values of FFA in the examined individuals were revealed in the group of patients with chronic pancreatitis (CP) combined with IR. So, when comparing the results of a study of the level of FFA with a group of healthy individuals, a more than 4-fold increase was noted ($p < 0.001$), where its level averaged 1.26 ± 0.09 mmol/L. The intergroup comparison of patients of various groups

showed an increase in the level of FFA when compared with group I by 40%, and group II – 2.7 times ($p < 0.05$).

As mentioned above, in patients with CP combined with IR there was noted hyperglycemia and hyperinsulinemia. Therefore, high FFA values in patients with a combined form of the disease are apparently associated with impaired insulin receptor function and glucose uptake by cells, which leads to a change in carbohydrate metabolism and the transition of glycolysis to gluconeogenesis, i.e. increased intake of fatty acids and amino acids. A key link in the disorder of lipid metabolism in patients with CP combined with IR is a compensatory hyperinsulinemia, which leads to impaired insulin-mediated utilization of glucose by cells, which is accompanied by the accumulation of FFA, especially in patients of group II. Therefore, IR in patients with CP affects adipose tissue, enhancing the lipolytic effect of insulin – which leads to the accumulation of FFA and glycerol. In this situation, FFA enters the liver, where it becomes the main source of the formation of atherogenic very low density lipoproteins (VLDL) and triglycerides (TG).

The next stage of our researches was the study of the level of leptin in the blood of subjects.

Table 2. – Indicators of blood leptin in patients with CP combined with IR (M ± m)

| Indicator | 3 healthy individuals (control) (n=14) | Patients CP (n=40) | Patients CP combined with (n=18) |
|---------------|--|--------------------|----------------------------------|
| Leptin, ng/ml | 13.94 ± 0.75 | 20.42 ± 1.46* | 33.68 ± 1.74** |

Note: * – reliability of differences $p < 0,05$ in relation to group of control

As it can be seen from the presented research results (table. 2), the concentration of leptin is increased in patients suffering from IR. The elevated leptin level in such patients can be explained by “leptin resistance” – the inability of leptin to penetrate into the cerebrospinal fluid and further to the binding sites in the hypothalamus, which are responsible for regulating appetite. That is, the main cause of obesity is not a lack of leptin, but disturbance of sensitivity to it. There is a close relationship between hyperleptinemia and IR. Based on the inhibitory

effect of leptin on the development of obesity, it is believed that normal production of leptin increases in response to an increase in insulin concentration, which inhibits further production and release of insulin by the principle of negative feedback.

Leptin circulates either in the form of a free hormone or in the form bound to specific binding proteins. One of the main proteins is the extracellular part of the leptin receptor (Ob-R), the so-called soluble receptor. The long Ob-R isoform is expressed in the nuclei of the hypothalamus and other types

of cells, including T cells, pancreatic β -cells and is responsible for leptin clearance.

Findings

1. The level of leptin reflects not only the amount of accumulated fat, but also changes in energy metabolism: with starvation it decreases, with overeating it rises. This is a signal for the ad-

aptation of the organism to the changing conditions of existence.

2. Measurement of the concentration of leptin in blood serum can be recommended for inclusion in the algorithm of examination of patients with CP combined with IR and can serve as additional markers of this condition.

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Section 8. Agricultural sciences

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WATER-SAVING TECHNOLOGIES OF CULTIVATING GRAINS ON SLIGHTLY SALINIZED LANDS OF KARAKALPAKSTAN

Abstract. In this item are given materials and analysis comparison and analysis of the results of the systematic recordings of the supplied water for irrigation of rice indicates a significant difference in the rate of irrigation, depending on the degree of premeditated field and methods of cultivation (seeding) rice.

Keywords: Sary-Altyn, the Republic of Karakalpakstan, groundwater with mineralization, Plough pan, nutritious elements.

Carried out in the Republic of Karakalpakstan organizational and structural measures for consistent transition to market relations in the agricultural sector involve need to improve the use of available water and land resources, to widespread adoption of science-based agro-technology methods, to improve the productivity of irrigation areas and water resources which is spent to increase yield from growing cultivated crops. Considering this and the need to develop science-based water saving and sustainable system of crop rotation of grain crops, during 2005–2007 field experiments were carried out on the territory of the farm “Sary-Altyn” of Chimbay region.

The area of the experimental plot is 3.3 ha. The territory of the farm is consist of meadow-alluvial, slightly saline soils. In the upper 0–100 cm layer of soil salt content before starting experiment (September 2005) was 0.46–0.58% on solid residue

with chloride-sulphate type of salinity. Groundwater with mineralization of 4.0–5.7 g./l. On solid residue in autumn 2005 lied at a depth of 0.9–1.2 m. From the soil surface. The mechanical composition of 0–120 cm of soil layer is presented in the profile of iridescent loamy clay differences. Huge mass of arable soil in its initial state was 1.29 g/cm³, and the subarable soil was 1.49 g/cm³, which is caused by the presence of compacted layer, so-called “Plough pan”.

Nutritious elements content of soil is generally not high. In the arable layer humus content does not exceed 0.8–0.9% of the weight of soil and they are classified as medium provision, and lower horizons are poor provision –0.40–0.73%. According to the content of mobile forms of Nutritious elements of the soil of experimental plot is classified as poor provision. Field experience is laid on the following scheme (Table 1).

Table 1.

| Variants | Background | 2005 | | | 2006 | | |
|----------|---------------------------------|---|---|---------------|---|--|---------------|
| | | The technology of soil preparation for sowing | Variety and productivity of wheat center/ha | Seed-ing time | The technology of soil preparation for sowing | Variety and productivity of wheat center/ha. | Seed-ing time |
| 1. | Zero tillage+ +Planning | Planning, sowing with Brazilian seeding Machine | Chillaki-10,0 | 15.IX | Sowing with Brazilian seeding machine | Polovchan-ka-21,5 | 27.X |
| 2. | Normal plowing+ +Planning | planning, plowing, grading, cultivating. | Chillaki-10,0 | 15.IX | Plowing, grading, sowing, grading | Polovchan-ka-20,3 | 27.X |
| 3. | Zero tillage without planning | Sowing with Brazilian Seeding machine | Chillaki-10,0 | 15.IX | Sowing with Brazilian seeding machine | Polovchan-ka-16,4 | 27.X |
| 4. | Normal plowing without planning | Plowing, grading, sowing, grading | Chillaki-10,0 | 15.IX | Plowing, grading, sowing, grading | Polovchan-ka-16,5 | 23.XI |
| 5. | Traditional Technology | Plowing, grading, sowing, grading | Polovchanka-7,8 | 23.IX | Plowing, grading, sowing, grading | Polovchan-ka-16,1 | 23.XI |
| 6. | Steam | | | | Plowing, grading, sowing, grading | Polovchan-ka- | 2.XI |

In the first year of experiment winter wheat yield at all variants of the experiment was rather low (7.8–10 centner/ha) which to some extent was explained by the unsatisfactory technical condition of existing drainage network. After cleaning, its water-salt regime in rooting layer of soil greatly improved, because of this winter wheat productivity after rice seedlings (2006) was 2 times higher (20.3–21.5 centner/ha.) compared to the previous year.

In 2006 and 2007, after the harvest of winter wheat in all variants of the experiment, was cultivated in regionalized medium ripening varieties of rice “Nukus-2 which is created by the breeders of Karakalpak branch of UzSRI of rice in 1986.

At I–VI variants of the experiment sowing of rice was done by seedling, and at controlled variants sowing was done by usual (seeds) method. Rice seedlings were grown in a seed plot of size 20 × 30 m,

where after seeding at the rate of 80 kg/ha, it was supported by a layer of 10–13 cm of water.

Irrigation of rice in the seed plot and in controlled variant (both variants) were carried with shortened flooding.

Comparison and analysis of the results of the systematic recordings of the supplied water for irrigation of rice indicates a significant difference in the rate of irrigation, depending on the degree of premeditated field and methods of cultivation (seeding) rice. Thus, in 2006, irrigation norm of rice in I variant, where planning was carried out using a laser system, was 14679 m³/ha, and in 2007, 14506 m³/ha, or 36% and 28% less compared to the control variant, respectively. In II variant, where rice was cultivated also in well-planned field, irrigation norm was 26% less compared to the controlled variant.

Noted decrease of rice irrigation norm is also due to the adopted in experiment, seedlings method of growing plants is widely used in the world practice of rice cultivation.

It was noted above that the content of water-soluble salts in the rooting layer of soil of experimental plot belong to the low and medium saline category. According to the data of systematic observation, during the period of the experiment, as a whole significant: changes in soils salt regime did not happen.

During the period of the experiment there was a decrease in mineralization of ground water compared to its initial state. Thus, prior to the experiment mineralization of groundwater varied between 3.9–5.8g/l. when its average value through the pond was 5.0 g/l. through solid residue (01.III.2005). By the fall of 2007 (29.IX) average groundwater mineralization was 2.75 g/l. in the range of its change within the experimental field from 1.80 g/l, to

3.84 g/l, through solid residue. Reduction in ground water mineralization is due outgoing filtering of the irrigation water which constantly takes place on a flooded rice field.

Separate calculation of rice yield according to the method, which is used in similar researches, allowed to establish the presence of significant differences between the variants of experience. The highest yield of rice was received in the I and II variants of the experiment, where rice is grown on carefully planned field by seedling method of seeding – 56.1–60.1 centner/ha. In the III and IV variants, where the planning of the field was not carried out, but was also used seedling method of rice cultivation, amount of yield was significantly lower and amounted to 46.3–55.8 centner/ha. In the control variant, where rice was cultivated by traditional technology, productivity did not exceed 42.3–45.1 centner/ha. (Table. 2)

Table 2. – Irrigation water consumption to create one center of grain yield at various technologies of soil preparation and sowing seeds

| Variants of experiment | 2006 | | | | | 2007 | | | | |
|------------------------|---|--|---|------------------------------------|--|--|--|---|-----------------------------------|--|
| | Irrigation norm of wheat, m ³ /ha. | Irrigation norm of rice, m ³ /ha. | Total volume of water provided for 1 ha, m ³ | Total harvest of grains center/ha. | Water consumptions for production of 1 center of grain, m ³ | Irrigation norm of wheat, m ³ /ha | Irrigation norm of rice, m ³ /ha. | Total volume of water provided for 1 ha, m ³ | Total harvest of grains center/ha | Water consumptions for production of 1 center of grain, m ³ |
| I | 1150 | 14679 | 15829 | 67.2 | 235.5 | | 14506 | 14506 | 81.6 | 177.8 |
| II | 1850 | 17002 | 18852 | 66.1 | 285.2 | | 14871 | 14871 | 77.8 | 191.1 |
| III | 1850 | 21251 | 23101 | 64.7 | 357.0 | | 20104 | 20104 | 71.2 | 282.3 |
| IV | 1850 | 21251 | 23101 | 54.3 | 425.4 | | 17152 | 17152 | 64.3 | 266.7 |
| Control | 1850 | 22900 | 24750 | 52.9 | 467.8 | | 20120 | 20120 | 58.4 | 344.5 |

Note: After harvesting rice the area wasn't watered before planting winter wheat

It was noted above that the main purpose of the organizing the experiment was to study experimentally the possibility of increasing the productivity of irrigated fields and irrigation water during the cultivation of grains on salt affected lands,

by using advanced technology of soil preparation and seeding. Comparison and analysis of results of the experiment shows that the total harvest in the context of variants in 2006 varied in the range of 52.9 centner/ha. (in control method) –

67.2 centner/ha. (in I variant), and in 2007 from 58.4 centner/ha. to 81.6 centner/ha., respectively. The highest total harvest of grains is obtained: at zero tillage and carefully planning of the field, by planting winter wheat in given norms, and rice by planting in seedlings method.

In the experiment, the lowest consumption of water to create a centner of crop (grain) was achieved in variant at zero tillage, by planning the field with laser equipment, by sowing the seeds of wheat in given norms, and planting the rice by seedlings. In the con-

trol variant, water consumption per unit of harvest is almost 2 times higher (Table 2).

Outlined above suggests the possibility of a significant increase in the productivity of water and irrigated hectare by applying modern technology during the preparation of field (zero tillage, laser leveling of fields), by the method of sowing given norm (exact seeding) for seeds of wheat, by planting rice by seedlings, by cultivating grains according to intensive schedule of alternating grains cultures, and by creating favorable conditions for the main crop rotation.

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ALLEY CROPPING SYSTEM UNDER CONSERVATION AGRICULTURE PRACTICES IN TAJIKISTAN

Abstract. Alley cropping is not new approach in Tajikistan as this practice is widely used in the irrigated conditions of the country. Many farmers grow different fruit trees in their farm and do grow alfalfa, wheat, barley and legume crops in the alleyways between widely spaced rows of the fruit trees. However, in rainfed conditions this practice is not common. Alley cropping in rainfed conditions can diversify farm income, increase crop production, decrease soil erosion and provide protection and conservation benefits to crops. Farmers who diversify by growing at least three type of crop are in a better position to tolerate soil-climate conditions or crop failures. By combining cereal and legume crops that yield multiple products and profits at different times, a farmer can use available space, time and resources more effectively and can get additional feed resources. Mulberry (*Morus* spp. L.), can address to increase forage production in Tajikistan.

Keywords: Alley cropping, pea, triticale, conservation agriculture, forage, mulberry, shrub.

Background

Tajikistan is one the most mountainous regions in Central Asia. A strong rugged relief, frequent heavy showers and weak soil resistance enhance the destructive influence of water coming from the mountain slopes, and combined with strong winds, are the primary reasons for the strong soil erosion found in many parts of the Republic of Tajikistan. This susceptibility to erosion highlights the need for technologies to combat soil erosion and degradation, and appropriate agricultural systems to improve soil and crop quality. Alley cropping through shrub transplantation under CA can be an answer to decrease soil and water erosions and provide additional feed resources. The main objectives of this experiment are to 1) improve out-of-season

grazing resources; 2) alleviate soil erosion/water by utilizing mulberry, adapted to local conditions and; 3) increase forage production through alley cropping with mulberry trees.

Materials and methods

The experiment was conducted in the fall from 2014 through 2016 at Sharora village in Gissar valley. Split plot design (main plots mulberry alleys sub-plots are forage monocultures and mixtures). Plot size was 50 m²(20 × 2.5 m). There were three treatments and these are as follows:

1. No till triticale with mulberry trees.
2. No till forage pea with mulberry trees.
3. No-till triticale in no alleys.
4. No till forage pea in no alleys.

5. No till Triticale+forage pea (30 + 70%) with mulberry trees.

6. No till Triticale+forage pea (30 + 70%) in no alleys.

Analysis of variance (ANOVA) used to determine treatment effect.

Soil sampling was done in October 2014 in two different depth 0–30 and 30–60 cm. Different soil parameters analyzed on following sampling methods: humus on I. V. Turin method, GOST 26213–91, easy hydrolyzed nitrogen, on Kornfield (“Methodical directions...”, 1985), mobile compounds of phosphorus and exchange potassium on Machigin method, GOST 26205-91, pH-water extract according to GOST 17.5.01.-84.

Nitrogen 30 kg/ha, ammoniac 60 kg/ha were applied before planting. Ammonium nitrate was used as a nitrogen fertilizer (34%). Field observations were recorded on seed germination, tillering, days to heading, days to maturity, plant height, thousand kernel weight, dry matter yield and grain yield. The crops yields recorded before harvest at one square meter from each plot.

Mulberry cuttings prepared by Khujand branch of Tajik Research Institute of Farming. The mulberry tree is very popular tree in Tajikistan and its leaves will be used to feed a silkworm during the spring season from April to May. The tree tolerates drought in rainfed conditions of Tajikistan. The mulberry tree is palatable for livestock. Small ruminants and cattle consume the fresh leaves and the young stems first. Cuttings age was around three years. The plant height ranged 1–1.2 m. Irrigation was provided through plastic bottles. Nitrogen fertilizer added to the water in order to improve fertilizer use efficiency. Twenty shrubs per row planted (1m gap between trees).

Results

There was no significant difference in plant survival rate of mulberry trees in this experiment. Please see figure 1. It shows that mulberry tree survival rate is high when its root system is good enough to penetrate to the deeper layer of the soil to reach soil moisture. Plant survival rate of mulberry tree in the rainfed conditions of Gissar valley was ranged between 90 and 100%.

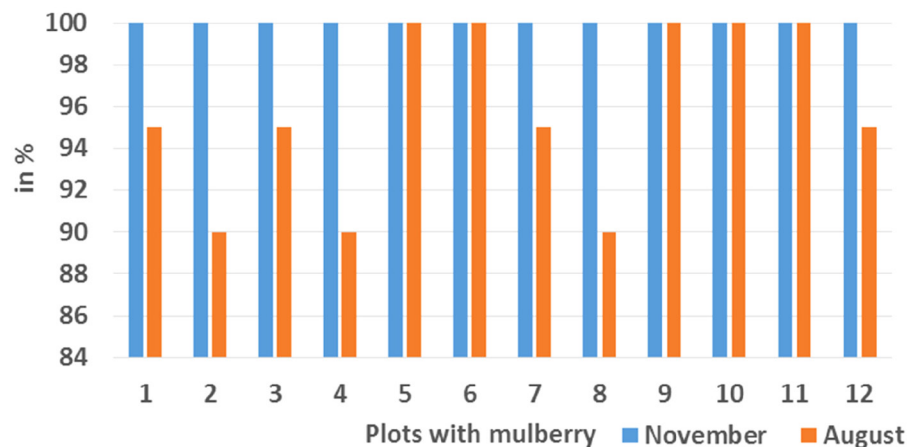


Figure 1. Mulberry survival rate in Gissar valley

Field observation on mulberry plant height was done in this experiment. The observation shows that plant height of mulberry tree ranged between 1.05–1.22 m in November while in August the plant height was fluctuated 1.12–1.45 cm (Figure 1).

The studied forage crops showed excellent growth and development in both with and without mulberry trees. The obtained data was statistically analyzed using GenSTAT program (Please see Table 1) and proved that there is a significant difference between crops (< 0.001). Forage yield of several forage crops

with and without alleys summarized in (Figure 2). Alley cropping increased soil moisture, helped to decrease soil erosion, and consequently, increased forage crops yields with alleys as compared to with-

out alleys. Alley cropping system and crop had not significant statistical difference in this experiment (< 0.553) while in alley cropping it was not seen, please see (Table 1).

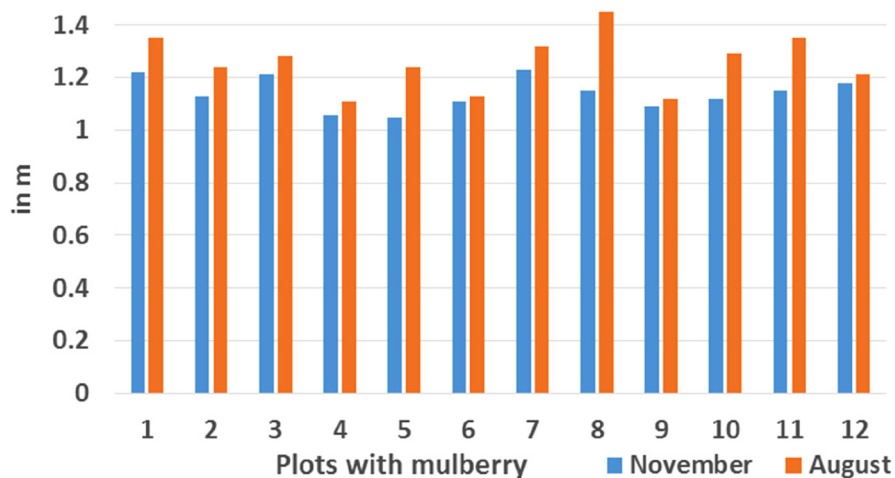


Figure 2. Plant height of mulberry

Table 1.– Analysis of variance of forage yield

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|-----------------------------|------|-----------|----------|-------|--------|
| Replication stratum | 3 | 3786680 | 1262227 | 1.01 | |
| Replication.*Units* stratum | | | | | |
| Crops | 2 | 113208566 | 56604283 | 45.40 | <0.001 |
| Alleys | 1 | 199 | 199 | 0.00 | 0.990 |
| Crops.alleys | 2 | 1535519 | 767760 | 0.62 | 0.553 |
| Residual | 15 | 18703011 | 1246867 | | |
| Total | 23 | 137233976 | | | |

Remarks: *d.f.* – Degree of freedom; *m.s.* – means square; *v.r.* – variance ratio; *F* – F-test statistic

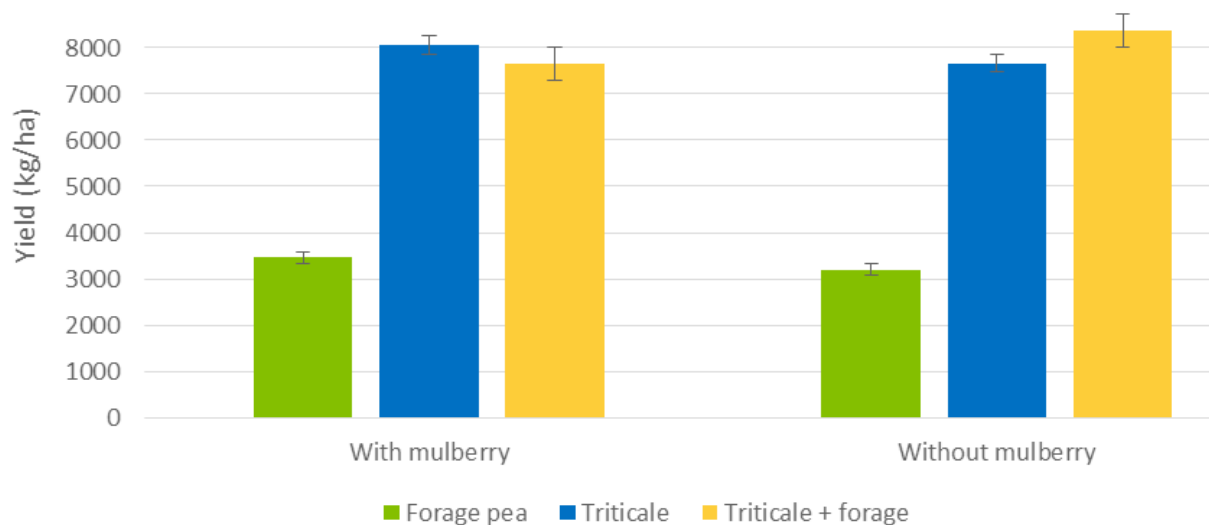


Figure 3. Effect of alleys on forage yield of different agricultural crops (2014–2016)

The (Figure 3) shows the forage yield widely ranged between the crops and range was fluctuated between 3190 and 8375 kg/ha. The highest forage yield was recorded 8375 kg/ha with triticale+forage pea without mulberry alley cropping while the lowest forage yield was recorded (3190 kg/ha) with forage pea in no alleys too. The results shows that alley cropping with mulberry had highest forage yield as compared to in no alleys.

Cost benefit analysis

Triticale (476 USD) in with mulberry alleys followed by Triticale+Forage pea (440 USD) and triticale (439 USD) without mulberry tree. The lowest profits observed with forage pea (219 USD) without mulberry tree (Table 2). In general, the results show that economic profit can be an indicator to determine easy adoption of any intervention in the rainfed conditions of Tajikistan. Integration of crop and livestock production under alley cropping is the most important to increase forage production.

Table 2.– Cost benefit analysis of different forage crops grain yield with and without mulberry

| Cost items | With mulberry | | | No mulberry | | |
|-----------------------|---------------|-----------|----------------------|-------------|-----------|----------------------|
| | Forage pea | Triticale | Triticale+Forage pea | Forage pea | Triticale | Triticale+Forage pea |
| Yield kg/ha | 3477 | 8069 | 7657 | 3190 | 7655 | 8375 |
| Crop price per kg/USD | 0.15 | 0.09 | 0.08 | 0.15 | 0.09 | 0.08 |
| yield USD | 522 | 726 | 613 | 479 | 689 | 670 |
| Total variable costs | 260 | 250 | 230 | 260 | 250 | 230 |
| Profit | 262 | 476 | 383 | 219 | 439 | 440 |

Conclusions

Forage production is increasingly important issue and with the rising demand for fodder from the expanding number of livestock, forage yield of forage pea should be an even more attractive alternative crop than triticale taking into account improving soil fertility in long-term effect. In addition, triticale+forage pea will be alternative to increase forage production in the country.

All obtained data statistically analyzed and proved that there was significant difference among alleys and crops. The results of this experiment show that Triticale+forage pea, Triticale and forage pea

performance with mulberry tree were not always good compared to Triticale+forage pea, Triticale and Forage pea without mulberry.

The profit was good with alleys than without alleys the highest profit was observed (624 USD) with triticale when the cereal legume mixture was grown without alleys while the lowest was recorded (219 USD) with forage pea when the crop was grown in no alleys. These results showed that alley cropping has good potential to increase forage production and increase profit ratio in Tajikistan.

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EFFECT OF PLANTING METHODS ON PRODUCTIVITY OF WINTER WHEAT VARIETIES IN THE IRRIGATED CONDITIONS OF TAJIKISTAN

Abstract. Permanent bed planting systems for wheat are gaining importance in various environments around the world. Planting method was a main plot while winter wheat varieties were sub-plot factors in this experiment. Field observations were recorded on seed germination, tillering, days to heading, days to maturity, plant height, thousand kernel weight, dry matter yield and grain yield. The yields were recorded before harvest at one square meter from each plot. According to the results obtained, permanent bed planting practices improve dry matter and grain and save seed, save on an average of 30% water, and reduce production costs by 25–35% including increased economic profit when permanent beds were used. The objective of this experiment was to test two methods of planting and two different wheat varieties of bed planted winter wheat in irrigated conditions and to adopt the permanent bed planting systems to irrigated conditions of Gissar valley, in order to intensify wheat production system in the Republic of Tajikistan.

Keywords: permanent bed planting, conventional planting, wheat, varieties, irrigation and yield.

Introduction

The permanent bed planting method is present in the irrigated areas of Tajikistan. The introduction of this technique in North Mexico improved the wheat grain yield by at least 10% and water economy by up to 35% compared to the conventional system (Aquino [1]). It is thought that similar results can be achieved in the irrigated conditions of Tajikistan by using winter wheat cultivated on beds.

Proper seedbed preparation and the selection of seeding rate are important management considerations for successful production of wheat and other agricultural crops in Tajikistan. Bed planting of wheat will improve the percentage of germination

of seed in the field conditions. In addition, seed rate can be reduced while fertilizer and herbicide application will be done at sowing. Lodging control of irrigated wheat can be achieved through bed planting practices. Nurbekov [4] reported that permanent bed planting helps to save water in three ways: the soil conserves more moisture at planting, the crop is ready for harvest before the hot season arrives, and irrigation water flows faster over a field that has not been tilled, so less water is pumped.

The permanent bed planting system will be compared to Flat Planting System based on conventional and no-till (permanent) seedbed preparation for planting winter wheat. The experiment was

conducted in experimental station of Farming Research Institute to evaluate the field performance of winter wheat, along with the economics and water use efficiency.

Materials and methods

a) Main Plot Factors: Planting method

- i. Permanent bed planting (130 kg ha)
- ii. Conventional planting (200 kg ha)

b) Sub-Plot Factors: Winter wheat varieties

- i. Ormon
- ii. Alex

A Split-Plot Block Design used in the experiment. Replications = 4; plot size = 100 m² (35 × 2.8) for each sub plot treatment. Standard agronomic practices and fertilizer rates applied during winter wheat growth and development. Analysis of variance (ANOVA) used to determine treatments' effect.

Monitoring over the crop growth and development was conducted from the time of the starting (10%) and full completion (75%) of the different stages during crop season. Field observations on germination, number of grains per spike, number of grains per m², thousand kernel weight, plant height, days to heading, days to flowering, days to maturity, dry matter and grain yield.

Soil sampling done in October 2013 in two different depth 0–30 and 30–60 cm (Table 1). In selected samples the identification was conducted on following – humus on I.V. Turin method, GOST 26213–91, easy hydrolyzed nitrogen, on Kornfield (“Methodical directions..., 1985), mobile compounds of phosphorus and exchange potassium on Machigin method, GOST 26205-91, pH-water extract according to GOST 17.5.01.-84.

Table 1. – Soil parameters of experimental site in irrigated site in Gissar (2014)

| Soil depth | Humus content | Total elements in% | | Available elements mg/kg | | | | pH |
|------------|---------------|--------------------|------------|--------------------------|-----------------|-------------------------------|------------------|-----|
| | | Nitrogen | Phosphorus | NO ₃ | NH ₄ | P ₂ O ₅ | K ₂ O | |
| 0–30 | 1.25 | 0.115 | 0.164 | 12.44 | 3.55 | 10.75 | 13.4 | 8.1 |
| 30–60 | 0.75 | 0.068 | 0.143 | 8.57 | 0.67 | 5.50 | 8.0 | 7.9 |

After the mungbean harvest watering was provided at the norm 700 m³/ha. When soil was ready to plant then soil was ploughed with the depth 25–27 cm on conventional planting while permanent bed planting there was not any tillage method as beds from previous crop used to plant winter wheat. A carefully-selected cropping system (intercropping or mixed cropping) can help reduce pest incidence, and/or, minimize the risks involved in monocultures.

Nitrogen 30 kg/ha, ammonium 90 kg/ha and potassium 60 kg/ha fertilizers were applied before planting. 90 kg/ha of nitrogen in stage of tillering, and last nitrogen was applied at the stage of 7–8 leaves at

the rate 30 kg/ha. Ammonium nitrate was used as a nitrogen fertilizer (34%).

Results

The most obvious benefit of permanent bed planting is decreased seed and irrigation rates. Significant yield difference was found planting method (< 0.001). There was no significant difference on planting method and variety (Table 2).

Analysis of variance (ANOVA) used to determine planting method's effect on grain yield. There was significant effect of planting method on winter wheat grain yield (< 0.001). This experiment confirmed that there is no relationship between planting method and winter wheat variety (Please see Table 3).

Table 2. – Analysis of variance of dry mass yield

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|---------------------|------|---------|---------|-------|---------|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Planting method | 1 | 14.2695 | 14.2695 | 23.05 | < 0.001 |

| 1 | 2 | 3 | 4 | 5 | 6 |
|-------------------------|----|---------|--------|------|-------|
| Planting method.Variety | 2 | 0.1872 | 0.0936 | 0.15 | 0.861 |
| Residual | 12 | 7.4298 | 0.6192 | | |
| Total | 15 | 21.8865 | | | |

Table 3. – Analysis of variance of grain yield

| Source of variation | d.f. | s.s. | m.s. | v.r. | F pr. |
|-------------------------|------|---------|---------|-------|---------|
| Planting method | 1 | 18.3827 | 18.3827 | 22.96 | < 0.001 |
| Planting method.Variety | 2 | 0.0893 | 0.0446 | 0.06 | 0.946 |
| Residual | 12 | 9.6094 | 0.8008 | | |
| Total | 15 | 28.0813 | | | |

Winter wheat development was advanced by 2–4 days for each growth stage in raised beds, which advanced ripening by 8–10 days with NT and raised beds (Kienzler et al. [3]) and yield was a bit higher under no-till technology (Tursunov [5]). In north-western Uzbekistan yields of cotton and winter wheat under no-till (NT) and conventional tillage (CT) were equal at the onset of the experiments, but, long-term results showed gradual increase in wheat yields under NT compared to CT (Egamberdiev [2]; Tursunov [5]). Almost the same trend was observed in our experiment. The mean dry mass yield of the en-

tire experimental field was 4700 kg/ha. The lowest dry mass yield (3520 kg/ha) was achieved at conventional planting with winter variety Alex. Both conventional planting Ormon and Alex resulted in lower yields although the differences between treatments are relatively low. Under both conventional and bed planting, winter wheat variety Ormon had highest yield compared to Alex variety (Figure 1). Grain yield of two winter wheat varieties dominated with permanent bed planting compared to conventional planting. Permanent bed planting method had highest yield against conventional planting (Figure 1).

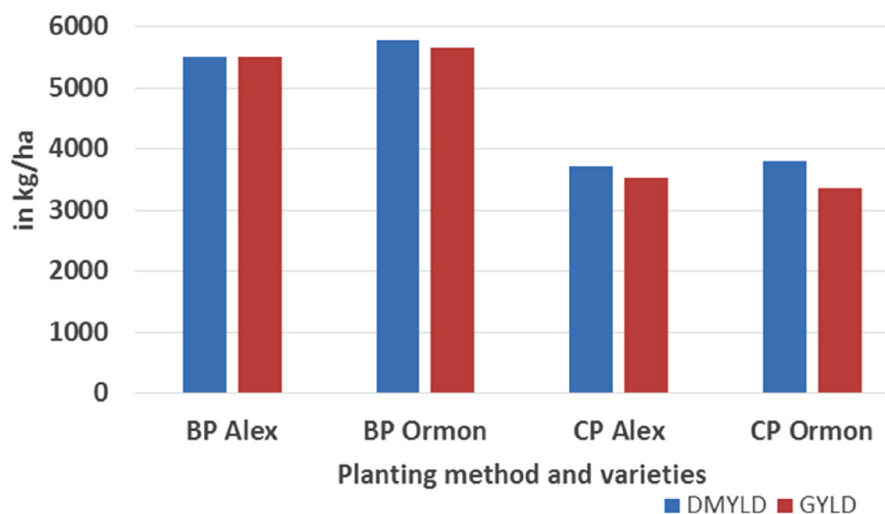


Figure 1. Effect of planting method on productivity of winter wheat (2014–2015)

The economic results were expressed in USD on a per hectare basis for each treatment. The highest economic profit recorded (842 and 873) were for permanent bed planting Alex and Ormon varieties. The low-

est profitability rate was recorded (224 and 189) at conventionally planted winter wheat variety Alex and Ormon respectively (Table 4). The estimated variable costs for the conventional tilled beds and

the permanent beds using the current 2014/2015 production cost. Average variable production costs were 16% higher for the conventionally tilled beds compared to bed planting. Here also, a comparison of the returns over variable costs for the average yield of comparable management practices for both

conventional tilled and permanent bed planting was made. Average returns over variable costs were 842 and 873 USD higher for the permanent bed planting versus 224 and 189 USD for conventional planting. Permanent bed planting produced the highest net benefit and net revenue.

Table 4. – Economics of planting methods on winter wheat productivity

| Cost items | BP | | CP | |
|--------------------------|------|-------|------|-------|
| | Alex | Ormon | Alex | Ormon |
| Yield kg/ha | 5510 | 5650 | 3520 | 3360 |
| Crop price per kg/USD | 0.22 | 0.22 | 0.22 | 0.22 |
| Yield USD | 1212 | 1243 | 774 | 739 |
| Total variable costs USD | 370 | 370 | 550 | 550 |
| Economic profit USD | 842 | 873 | 224 | 189 |

Conclusions

Conclusions of this experiment shows that permanent bed planting are more efficient than conventional planting in case of dry mass and grain yield. Winter wheat dry mass yield had highest yield compared to conventional planting. Dry mass increase will lead to decrease fodder shortage during winter time as most of the farmers and households in Tajikistan kept livestock. Based on obtained results, permanent bed planting can be considered as best planting practices in winter cultivation in the ir-

rigated conditions of Tajikistan. In the irrigated cereal-legume based systems of Gissar valley, no-till proved to be more profitable, resource saving and energy saving.

Preliminary results of cost benefit analysis showed that there is significant effect between permanent bed planting and conventional planting methods. This could be critical in Tajikistan, where agricultural input prices are steady growing from year to year controversially price of agricultural products decreases in the local market.

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Section 9. Technical sciences

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THE GENERALIZATION OF DUPUIS AND DARCY'S FORMULAS

Abstract. It is well-known that, flow resistance forces increase with the increase of the filtration rate. In addition, the filtration process is affected by a set of parameters associated with physical changes of the fluid and collector. In this regard, this article proposes an effective method of full accounting of the influence of all possible physical changes of the reservoir and fluid in the process of filtration and development of deposits in hydro-gas dynamic calculations. The paper also proposes new generalized formulas of Dupuis and Darcy.

Keywords: Darcy's Law., Forchheimer law, Barry-Conway law, Reynolds number, permeability, approximation.

As is known, Darcy's law has the form [1]:

$$-grad p = \frac{\mu \bar{v}}{k}. \quad (1)$$

However, further research has shown that Darcy's law is not universal and has limits to applicability. In the article [2] to reduce the errors of Darcy's law at high velocities, a correction factor is introduced, by which the law of fluid filtration for high velocities is represented as:

$$-grad p = f(Re) \cdot \frac{\mu \bar{v}}{k} = \frac{\mu v}{k_{ef}}. \quad (2)$$

Forchheimer proposed a binomial filtration law [1]:

$$-grad p = \frac{\mu \bar{v}}{k} + \beta \frac{\rho v}{\sqrt{k}} \bar{v} = \frac{\mu \bar{v}}{k} (1 + \beta Re), \quad (3)$$

where $Re = \frac{\rho v \sqrt{k}}{\mu}$, $\frac{k}{k_{ef}} = f(Re) = 1 + \beta Re$.

For large pressure gradients, the binomial Forchheimer's law is also in error. In this connection, R. D. Barry and M. V. Conway [3; 4; 5] proposed a new model containing two additional parameters k_{mr} и α , in addition to the parameters k и β ,:

$$\frac{k}{k_{ef}} = f(\text{Re}) = \frac{(1 + \beta \text{Re})^\alpha}{k_{mr} (1 + \beta \text{Re})^\alpha + 1 - k_{mr}}. \quad (4)$$

Here the parameter k_{mr} can take values from zero to one inclusive. It can be seen from formula (4) if $k_{mr} = 0$ and exponent $\alpha = 1$, then (4) leads to the classical Forchheimer equation (3). However, if $k_{mr} = 1$, then (4) leads to Darcy's linear law (1).

According to the Barry-Conway law, the effective permeability k_{ef} asymptotically falls to a certain minimum level, and according to the law of Forchheimer and Kurshin A. P. [6] k_{ef} falls to zero, which is wrong according to R. D. Barry and M. W. Conway. They experimentally proved that the throughput of a porous medium, quantified by the effective permeability k_{ef} , decreases with the growth of the Reynolds filtration number by a certain law. Notwithstanding that the berry-Conway law (4) serves as the most natural correlation $\frac{k}{k_{ef}} = f(\text{Re})$ for all perme-

able media, the disadvantage of this law is the difficulty of its direct application in order to determine the parameters k, β, k_{mr} и α based on the results of hydrogasodynamic well survey.

In this regard, there is an actual problem for practice to transform the berry-Conway law (4) so that the modified law allows you to obtain hydrogasodynamic research data convenient for processing.

In [2] we recommend the use of polynomial approximations of the Barry-Conway law (4) in the form: $\frac{k}{k_{ef}} = f(\text{Re}) = 1 + c_1 \text{Re} + c_2 \text{Re}^2 + c_3 \text{Re}^3 + \dots + c_n \text{Re}^n$. (5)

Then, in the presence of polynomial approximations of the Barry -Conway law (4), the General equation of nonlinear fluid filtration for high velocities will be presented as [2]:

$$-\text{grad } p = \left[\sum_{i=0}^n c_i (\text{Re})^i \right] \frac{\mu \bar{v}}{k}. \quad (6)$$

Further in work [2] the method that allows us to find out parameters α, β, k_{mr} . is offered.

However, it seems that the main difficulty lies in correct finding the coefficients $c_i (i=1, \bar{n})$ based on hydrogasodynamic research data.

In this regard, the following methodology is proposed.

To do this, we first get some necessary formulas. Using the formulas (1) and (5), one can write:

$$\frac{k}{\mu} \frac{dp}{dr} = \nu f(\text{Re}) = \nu (1 + c_1 \text{Re} + c_2 \text{Re}^2 + c_3 \text{Re}^3 + \dots + c_n \text{Re}^n). \quad (7)$$

$$\text{Given that in this formula } \text{Re} = \frac{\nu \sqrt{k} \rho}{\mu}, \nu = \frac{Q}{2\pi r h} \quad (8)$$

we get:

$$\frac{k}{\mu} dp = \frac{Q}{2\pi h} \frac{dr}{r} + c_1 \frac{Q^2}{4\pi^2 h^2} \frac{\sqrt{k} \rho}{\mu} \frac{dr}{r^2} + c_2 \frac{Q^3}{8\pi^3 h^3} \frac{k \rho^2}{\mu^2} \frac{dr}{r^3} + \dots \quad (9)$$

Integrating the right part of the expression from r_c до r_k , and the left side of p_c до p_k , we obtain:

$$\frac{k}{\mu} (p_k - p_c) = \frac{Q}{2\pi h} \ln \frac{r_k}{r_c} + \frac{Q^2 \sqrt{k} \rho}{4\pi^2 h^2 \mu} \left(\frac{1}{r_c} - \frac{1}{r_k} \right) c_1 + \frac{Q^3 k \rho^2}{8\pi^3 h^3 \mu^2} \left(\frac{1}{r_c^2} - \frac{1}{r_k^2} \right) \frac{c_2}{2} + \dots \quad (10)$$

Since, $\frac{1}{r_k^i} \ll 1$ where, $i=1, n$ then these expressions

can be neglected. By dividing both parts of the expression by r_c and applying the formulas (8), we obtain:

$$\frac{1}{r_c} \frac{k}{\mu} (p_k - p_c) = \nu \ln \frac{r_k}{r_c} + c_1 \frac{\nu^2 \sqrt{k} \rho}{\mu} + \frac{c_2}{2} \frac{\nu^3 k \rho^2}{\mu^2} + \dots + \frac{c_n}{n} \frac{\nu^{n+1} (k)^n \rho^n}{\mu^n}$$

$$\text{or } V' = \nu \left(\ln \frac{r_k}{r_c} + c_1 \text{Re} + \frac{c_2}{2} \text{Re}^2 + \dots + \frac{c_n}{n} \text{Re}^n \right), \quad (11)$$

$$\text{where } V' = \frac{k}{\mu} (p_k - p_c) \cdot \frac{1}{r_c}.$$

According to the method coefficients $c_i (i = \bar{1}, \bar{n})$ and the index n are found out, based on hydrogasodynamic well survey data under steady-state filtration regimes. Indicator lines are drawn in coordinates $\frac{V'}{\nu}$ и Re при $r = r_c$ as knowing the dependence of $Q = Q(\Delta p)$ it is not difficult to plot the graph of function $\frac{V'}{\nu} = f(\text{Re})$. There are three possible cases.

1. $\frac{V'}{\nu}$ does not change depending on Re .

In this case we are dealing with Darcy's linear law:

$$\nu = \frac{k}{\mu} \left(\frac{p_k - p_c}{\ln \frac{r_k}{r_c}} \right) \cdot \frac{1}{r}.$$

In the above coordinates, the resulting horizontal line cuts off a segment equal to $\ln \frac{r_k}{r_c} = y_0$ from the ordinate axis. On this segment it is possible to determine the boundary drainage radius $r_k = r_c e^{y_0}$.

2. $\frac{V'}{v}$ varies depending on Re according to a linear law. Values $\ln \frac{r_k}{r_c}$ и c_1 are determined by the segment cut off on the ordinate axis and the inclination angle of the resulting line, respectively.

In this case we are dealing with Forchheimer's law. Here $c_1 = \beta$. In this case it is also possible to determine the drainage radius r_k and the coefficient b , at the binomial filtration law, $b = \beta \frac{\rho}{\sqrt{k}}$.

3. $\frac{V'}{v}$ varies depending on Re not linearly. And in this case the indicator lines constructed in the specified coordinates extrapolate to the ordinate axis ($Re = 0$), and $\ln \frac{r_k}{r_c}$ is determined by the cut off segment. After the drainage radius r_k is determined, the indicator line should be rearranged in coordinates $\frac{V'}{v} - \ln \frac{r_k}{r_c}$ и Re. Since in this case from the formula (11) we get

$$\frac{V'}{v} - \ln \frac{r_k}{r_c} = c_1 + \frac{c_2}{2} Re + \frac{c_3}{3} Re^2 + \dots + \frac{c_n}{n} Re^{n-1},$$

then, we find the coefficients $c_1, c_2, c_3, \dots, c_n$ by means of MS Excel [7]. We insert these values in (2) and (5), and obtain a General nonlinear law of fluid filtration at large pressure gradients. From these formulas we may easily go to the Barry-Conway formula, however I think that this is not necessary, since the polynomial formula is the most convenient form both for processing based on hydrogasodynamic well survey data and for integration.

From formula (11) we may obtain:

$$\frac{Q}{2\pi r_c h} \left(\ln \frac{r_k}{r_c} + \frac{c_1}{1} Re + \frac{c_2}{2} Re^2 + \dots + \frac{c_n}{n} Re^n \right) = \frac{1}{r_c} \frac{k}{\mu} (p_k - p_c) \quad (12)$$

$$Q = \frac{2\pi h k}{\mu} \frac{p_k - p_c}{\ln \frac{r_k}{r_c} + \sum_{i=1}^n \frac{c_i}{i} Re^i} \quad (13)$$

Formula (13) is represented as a generalized Dupuis Formula:

$$Q = \frac{2\pi k h (\Delta p - \Delta p_v)}{\mu \ln \frac{r_k}{r_c}} \quad (14)$$

where $\Delta p = p_k - p_c$

$$\text{Suppose } A = \frac{2\pi k h}{\mu \ln \frac{r_k}{r_c}} \quad (15)$$

Then using formulas (13) and (14) we get:

$$\frac{Q}{A} = \frac{\Delta p \ln \frac{r_k}{r_c}}{\ln \frac{r_k}{r_c} + \frac{c_1}{1} Re + \dots + \frac{c_n}{n} Re^n} = \Delta p - \Delta p_v \quad (16)$$

or

$$Q = \frac{A \Delta p \ln \frac{r_k}{r_c}}{\ln \frac{r_k}{r_c} + \sum_{i=1}^n \frac{c_i}{i} Re^i} \quad (17)$$

From formula (16) you can also write:

$$\Delta p_v = \Delta p - \frac{\Delta p \ln \frac{r_k}{r_c}}{\ln \frac{r_k}{r_c} + \sum_{i=1}^n \frac{c_i}{i} Re^i} = \frac{\Delta p \sum_{i=1}^n \frac{c_i}{i} Re^i}{\ln \frac{r_k}{r_c} + \sum_{i=1}^n \frac{c_i}{i} Re^i} \quad (18)$$

On the other hand, from (14) and (15) we get:

$$Q = A(\Delta p - \Delta p_v) = \frac{2\pi k h}{\mu \ln \frac{r_k}{r_c}} \Delta p \left(1 - \frac{\Delta p_v}{\Delta p} \right) \quad (19)$$

$$\frac{\Delta p_v}{\Delta p} = \frac{\sum_{i=1}^n \frac{c_i}{i} Re^i}{\ln \frac{r_k}{r_c} + \sum_{i=1}^n \frac{c_i}{i} Re^i} \quad (20)$$

By $\Delta p_v = 0$ from (19) the Dupuis formula is obtained:

$$Q = A \Delta p = \frac{2\pi k h}{\mu \ln \frac{r_k}{r_c}} \Delta p \quad (21)$$

On the other hand, a generalized Darcy's formula is also obtained from (19):

$$v = \frac{Q}{2\pi r_c h} = \frac{A \Delta p}{2\pi r_c h} \left(1 - \frac{\Delta p_v}{\Delta p} \right) = \frac{1}{r_c} \frac{k}{\mu} \frac{\Delta p}{\ln \frac{r_k}{r_c}} \left(1 - \frac{\Delta p_v}{\Delta p} \right) \quad (22)$$

Where $\frac{\Delta p_v}{\Delta p}$ is found out from (20).

Thus, formulas (19), (20) and (22) are new generalized Dupuis and Darcy's formulas.

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THE PROBLEM OF PREVENTIVE MANAGEMENT OF TECHNOLOGICAL RISKS IN THE INDUSTRY 4.0

Abstract. In this article the problem of risks of high-tech development in condition the Industry 4.0 was viewed. Has been presented the backgrounds of information and analytical systems for preventive management of the Industry 4.0 technological risks.

Keywords: Industry 4.0, technological risks, preventive management.

Introduction

The Fourth Industrial Revolution (the Industry 4.0) is the next stage of revolutionary transformations in the Human History. Such revolutionary stages include the emergence of a system of religious beliefs that united large masses of people, the invention and distribution of money, the invention and distribution of printing, the first, second and third industrial revolutions, the spread of radio-electronic, network and digital technologies. In the context of the Industry 4.0, digital technologies, unmanned transport systems, robotic systems, such as robot consultants, blockchain technologies, biomechanical prostheses and exoskeletons, financial internet technologies, internet banking, artificial intelligent systems, intelligent cyber-physical systems of various scales and purposes, smart-house, smart-city, smart-plant, smart-road, intelligent decision support systems, digital biometrics and identity identification, technologies for aggregation and processing of large data streams Big Data, cloud computing technologies, cloud business platforms, cybersecurity systems, convergent bio-, nano-, information and cognitive technologies, entertainment and educational tools based on virtual and augmented reality technologies, additive 3D- and 4D-printing technologies, bioimplantable tools and systems for expanding the human capabilities, “Internet of things”, “In-

ternet of everything”, mind-machines for increasing the human cognitive potential, gerontological technologies for life extension, cryogenic technologies [1; 2]. At the same time the Industry 4.0 has led to the emergence of fundamentally new technological risks and their various combinations. In conditions of the Industry 4.0 it is important to ensure preventive management of technological risks.

In connection with above, the purpose of this study is to characterize the problem of high-technologies risks and substantiate information and analytical systems for preventive management of technological risks into the Industry 4.0.

Possible technological risks of the Industry 4.0

The Industry 4.0 includes many sources of new possible technological risks [3–5], such as:

- nuclear power and proliferation of military and dual-use nuclear technologies;
- technologies for access to space orbit, flights to the planets of the Solar system and beyond;
- technologies of deep space radio and optical communication;
- military technologies based on new physical principles;
- biotechnologies and their products, as well as genetically modified organisms;
- nanotechnology and its products;
- information technologies and their products;

- cognitive technologies for the creation of hybrid intelligence and the expand of human capabilities;
- uncontrolled self-replicating convergent technologies, including nano-, bio-, informational and cognitive systems and its combinations;
- private control of human consciousness and behavior of individuals and social groups;
- non-human logic of management into the manufacturing, economic and social organization systems under control of global artificial intelligence;
- military cyber-physical, unmanned and smart systems of various scales and purposes;
- virtual and augmented reality technologies for manipulative and narcotic purposes;
- additive technologies of 3D- and 4D-printing for uncontrolled distribution and reproduction of psychotropic substances, drugs, weapons systems, including weapons of mass destruction;
- uncontrolled distribution of new agents that cause new forms of chemical and non-chemical dependencies;
- means and methods of modification of the human body and consciousness using products of micro- and nanoelectronics, genetic engineering, bionanocomposition materials;
- means and methods of creating and popularizing disinformation and destructive content in the Internet media environment;
- means and methods of software-technical and socio-engineering attacks on databases and knowledge bases that are critical for maintaining the stability of industrial and social systems;
- means and methods of technospheric and information cryptographic warfare for the interests of individuals, communities or corporations;
- disorganization and destabilization of socio-technical systems of different scales and levels of complexity.

The most important contribution into the formation of possible technological risks in the Industry 4.0 is made by the development of Web-based Internet platforms that provide the development of social

networks (Web 2.0), the possibility of teleconferencing, rapid exchange of large data streams, audio and video resources (Web 3.0), blockchain technology and the Internet of things (Web 4.0), intelligent assistants and remote technologies for expanding human intellectual capabilities (Web 5.0).

The risks of the Industry 4.0 innovative technologies may be prevented. As is well known, the most preventable risks are a risks that are easy to anticipate and that easy to manage. The management by risks of high-tech proliferation is possible only if the following conditions are met:

- 1) dangerous technologies that lead to risks are created only by peoples;
- 2) the localization and extent of the consequences of the risks of such high technologies are well known;
- 3) dangerous technological processes are not associated with benefits for peoples;
- 4) both the moment and the consequences of dangerous technological processes getting out of control are predictable;
- 5) the dangers of high-tech processes are easily recognized;
- 6) there is a resource of time to prevent high-tech risks.

The problem of the loss of stability of social systems due to the technological and humanitarian imbalance of Human Civilization due to the disproportionate an acceleration of technological development remains difficult to predict. At the same time, there are a possibility of global high-tech wars with the use of weapons of mass destruction. Such wars can slow down or even stop the technological development of Human Civilization.

In addition, various combinations of the above-mentioned risks can provoke the degradation of the Human Civilization to the level of “sustainable development” with zero growth of the productive forces, progressive wear and tear of the material assets, a decline in the quality of life, aging and extinction of the population.

Innovative activity of high-tech manufacturing companies and enterprises in the context of the Industry 4.0 requires analysis and risk management at a mega-, macro-, meso- and micro levels. In addition, internal technological risk factors can be identified in the innovation activities of companies and enterprises in the context of the Industry 4.0. Such internal technological risk factors include:

- introduction of digital technologies in production;
- formation of new horizontal and vertical digital integrations between divisions of the industrial organization;
- errors in sociotechnical systems and processes of integration and functioning of innovative high-tech industries and their clusters.

A micro-risks of innovative activity of high-tech manufacturing companies and enterprises are related to the problems of integration of digital technologies between the main stakeholders, the need to create unified information technology platforms for interaction with suppliers, consumers and regulatory structures. A macro-risks are depended on the degree of digital transformation and states of human potential in the surrounding socio-technical environment. A macro-level of risks are formed by the macro-environment of the national economic conditions. A low innovation potential and export-raw material model of development of national economies are more important macro-risks into the Industry 4.0. A mega-level of risks are formed by conditions of transnational socio-cultural, socio-political and socio-economic environment [4; 5].

The backgrounds of the information and analytical systems for preventive management of technological risks in the Industry 4.0

Has been shown into scientific investigation, many modern methods and methods for monitoring, analysis and management of the technological risks do not correspond to the technological levels of the Industry 4.0. An attempts to monitor and ana-

lyze of the risks of individual high-tech processes do not provide systematic management of technological risks of innovative industries. An information uncertainty is an important reason for making of wrong decisions in the risk management of high-tech processes. In this regard, the development of information and analytical systems for managing technological risks of innovative industries in the context of the Industry 4.0 is relevant.

The architectural implementation of such information and analytical systems includes:

- 1) the block of formation of effective scenarios of information and analytical support and reliability of decisions on preventive management of technological risks;
- 2) block of information and analytical support for the activities of decision-makers;
- 3) block of ontological, probabilistic-entropy, fuzzy-cognitive and logical-probabilistic modeling using cognitive complex maps and Bayesian Belief Networks (BBN), method of analysis and prediction by precedents;
- 4) block of hardware and software on the platforms of online analytical processing (OLAP) and wiki technologies.
- 5) the block of situational training and intellectual training of decision-makers in situations of risk management of technological development in the conditions of the Industry 4.0.

The functional organization of such information-analytical systems is based on the use of Big Data, BBN, OLAP, data mining, search technologies in databases and knowledge bases based on the method of precedents, simulation modeling, scenario and situational analysis, ontological, fuzzy and cognitive, information-entropy and logical-probabilistic modeling, evolutionary calculations, genetic algorithms and artificial neural networks.

The conclusion

Thus, the Industry 4.0 has many new objective factors that present various possible technological risks with organizational and sociotechnical

aspects. Preventive management of these risks in the Industry 4.0 is a key condition for guaranteed sustainable technological development of the Human Civilization in the XXI Century.

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ON ADDITIONAL MEASURES TO ENSURE SAFETY OF LIFE ACTIVITY IN THE PRODUCTION OF PRODUCTS OF SPECIAL PURPOSE

Abstract. This article presents the results of an analysis of the materials used with antibacterial properties for light industry products. In recent years, among the basic hygienic requirements for special-purpose products, the requirement for the presence of antibacterial properties has been added. All these requirements are directly related to the materials of the top and lining, as well as to the internal materials of the product. These materials are in direct contact with the surface of the human body, and their hygienic properties form the properties of the product itself. The most commonly used textile materials (cotton, non-woven, knitted fabrics, etc.) and genuine leather, impregnated with various antibacterial compositions.

Keywords: Property, special purposes, life support safety, special products, textile materials, genuine leather, basic composition, compound.

Protecting the health of workers, ensuring safe working conditions, eliminating occupational diseases and occupational injuries is one of the main concerns of the state.

The adopted regulatory documents noted that the creation of special-purpose products with desired properties is an urgent task, and when solving this problem, it is necessary to be based on the use of domestic materials based on import substitution and localization.

The history of the creation of special products, for example, shoes with special preset properties, dates back many centuries. Outerwear is a mandatory part of clothing and its main purpose is to protect it from moisture, dirt and extreme temperatures, as well as from mechanical damage [1].

Special products must meet the requirements of reliability and wear resistance during operation for a specified period, do not change their properties during storage, consumer characteristics of shoes, such as properties that determine heat, gas and moisture exchange of the lower extremities, are becoming increasingly important. with the external environment, the external shape and internal configuration of the product, weight and flexibility, shock absorption and friction properties of the sole, etc. [2–3].

In recent years, the requirement for special products has been supplemented by the requirement of biocidal properties. At the same time, hygiene requirements are being tightened. All these requirements for the product are directly related to the materials of the top and lining, as well as to the internal

materials. These materials directly contact the surface of the skin, and hygienic properties form special properties of the product itself [4–6].

Over the past 20 years, an increase in the number of patients with fungal diseases of the lower extremities has been observed in the world. Fungal diseases belong to the group of infectious diseases that cause pathogenic fungi. They affect the human body, can settle both on the surface of the skin and on the mucous membrane of internal organs. Most often, there are cases of fungal lesions of the feet, creating discomfort and do not contribute to normal life.

The problem of microorganism damage to products made of genuine leather is very urgent: the biological damage process can lead to premature destruction of the product, and in many cases to poor health of the person who wears this product: infection with opportunistic microorganisms, allergies from saprophytic molds, etc.

Intensive damage to materials predominantly by bacterial and fungal microflora is promoted by a temperature of 25–32 °C and humidity of 75–90%, as well as the skin of a person, for example, the foot, which, thanks to the presence of moisture, fatty and protein substances, vitamins and microelements, is an ideal nutrient medium for development microorganisms. Bacterial cultures die in speed, while fungal cultures, on the contrary, continue to multiply intensively. This is due to the fact that the composition of chrome leather, from which shoes are mainly made, includes chromium salts with bactericidal activity.

Tanneries produce shoe leathers, both for the upper and for lining using traditional technologies. It provides for soaking-ash, tanning and dyeing-fatty processes and operations. To give the skin a beautiful appearance, neck and the final formation of physical and mechanical properties, as well as the quality of the skin, finishing finishing operations are carried out.

Today, biocidal leather processing technologies for shoes are known, which include the processing of leather or semi-finished products at the stages of

tanning, dyeing and greasing processes, as well as during finishing operations. Modified skin includes a collagen base of a multilevel structural organization, tanning, fatliquoring compounds and a biocidal additive. Biocidal formulations are used in the form of latexes, emulsions and solutions.

The development of biologically active drugs to prevent the emergence and spread of bacteria and fungi is a global problem that requires an early solution to this problem. In this aspect, the problem of protecting natural leather for shoes from fungus and mold is especially important for our republic, where on warm, sunny days they begin to multiply rapidly.

One of the ways to effectively solve this problem is the use of special chemicals for processing lining materials (leather, fabric, etc.), which provide shoe comfort, protection from fungus, mold and other harmful bacteria and microorganisms.

In this regard, derivatives based on heterocyclic compounds are of theoretical and practical interest because of their high reactivity and widespread use in medical practice as antimicrobial, antiseptic, and other agents.

Heterocyclic compounds, being unique compounds in their biological and practical significant properties, have so far attracted the attention of numerous researchers in the world engaged in the search for new biologically active substances, due to their widespread use and synthetic capabilities. Extensive information on the modification and properties of heterocyclic compounds is covered in many literature. Nevertheless, the possibilities of their chemical modification are far from exhausted and have broad prospects in terms of the synthesis of new biologically active compounds on their basis.

Experimental studies have been carried out on the possibility of using the developed antibacterial tissues as a lining for safety shoes. Teak-twill fabric was made in the “Weaving” laboratory, dyeing and impregnation of the fabric with experimental antibacterial compositions was carried out in the laboratory of the department of “Chemical Technology”.

The results of studies of the effect of antibacterial impregnation and dyeing of twill fabric on its physico-mechanical and hygienic properties, conducted in the TITLP certification laboratory, made it possible to draw the conclusion that it is possible to use unpainted teak twill as materials for the main lining and the insole in safety shoes [7].

Experimental studies of various in structure lining materials of the Italian company "Siretessile". The main composition of the cushioning material

is 100% polyamide with antibacterial impregnation, with a different structure of knitted and polyester film, duplicated by fire or heat.

Thus, the results of studies of heat conductivity, water permeability and breathability, cushioning antibacterial materials made it possible to determine the structure of the composite material, the basic composition and technology of their production, allowing to determine the main directions for further research.

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ACTUAL PROBLEMS OF ENSURING STRENGTH OF FLUID COMPOUNDS FROM COTTON THREAD IN SEWING ITEMS BY THE IMPORT SUBSTITUTION PROGRAM

Abstract. this article presents the results of experimental studies on increasing the strength of cotton sewing threads, to which the demand at manufacturing enterprises increases from year to year. The quality that determines the suitability for the functional purpose of competitive garments depends on many factors, among which more attention is paid to the quality of the sewing threads used in their manufacture. This is primarily due to an increase in the quality of products on the part of consumers. Therefore, an important technological task is the development of new progressive methods of processing sewing threads in order to increase their strength and create the prerequisites for the introduction of innovative technologies based on the localization of production and import substitution.

Keywords: sewing threads, finishing, technological environment, finishing composition, sewing production, quality improvement, property.

It is known that the quality of garments is largely associated with the strength characteristics of thread connections of parts [1–3]. Therefore, ongoing research in this direction are relevant. Special attention is paid to the issues of predicting the strength properties of thread compounds. To date, many scientists [4–6] have devoted their research to solving this problem. Without denying the legitimacy of using previously known methods for ensuring the strength of seams, the authors attempted to create a more advanced method, characterized by simplicity and reliability.

The strength properties of thread joints, which in turn determine the quality of the product as a whole,

largely depend on the execution of a technological operation for grinding parts of garments.

If we analyze the assortment group of garments, then many sewing enterprises use imported sewing threads. Considering that the republic is a major supplier of cotton natural fiber to the world market, much attention is currently being paid to the process of processing raw materials and manufacturing finished products. The present studies are devoted to the development of a method for ensuring the strength of finished cotton sewing threads.

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tention is paid to the quality of the sewing threads used in their manufacture. This is primarily due to an increase in the quality of products on the part of consumers. Therefore, an important technological task is the development of new progressive methods of processing sewing threads in order to increase their strength and create the prerequisites for the introduction of innovative technologies based on the localization of production and import substitution.

Currently, in order to improve the quality of sewing threads, in addition to developing new compositions for finishing sewing threads (applying highly elastic, durable films), researchers are trying to create technological processes in which the processing medium is not only liquid, but also foam and gaseous.

However, the application of these methods encounters a number of difficulties, namely, the need to install additional special equipment, increase the length of the technological process for processing sewing threads, and also the difficulty in choosing finishing reagents corresponding to their economic and environmental efficiency.

Therefore, the most effective solution to this problem is to improve the physical and mechanical properties of sewing threads directly in the field of sewing production. Currently, in order to improve the quality of sewing threads, in addition to developing new compositions for finishing sewing threads (applying highly elastic, durable films), researchers are trying to create technological processes in which the processing medium is not only liquid, but also foam and gaseous.

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properties of sewing threads directly in the field of sewing production.

A promising development of this direction may be the implementation of finishing operations using a liquid-phase technological medium. The first and, perhaps, the main advantage compared to most other technologies is the continuous, rather than discrete, deposition of them on the surface of the thread. In addition, the use of a liquid-phase polymer composition allows you to control the amount of applied fluid on the sewing threads, to accumulate it in the necessary areas: the inner spaces of the threads, the places where some of the fibers deviate from the body of the thread, as a result of which the threads acquire better physical and mechanical properties compared to traditional processing. And the most important advantage of this method is the combination of applying a polymer composition with the process of grinding parts of garments [7–9].

The purpose of the subsequent stages of the research will be aimed at the scientific justification, research, development and implementation of a practically significant technological process for the final finishing of sewing threads, which ensures high quality of thread connections. More attention will be paid to the selection and justification of active components for the development of the optimal composition of the finishing polymer composition, theoretical and experimental studies of the interaction of the liquid-phase polymer composition with the surface of the sewing threads, the study of the influence of technological modes of liquid-phase processing on the physic mechanical properties of the threads, production testing of the developed technological and technical solutions and making recommendations for their implementation in production.

Using the results of this work allows to obtain high-quality thread compounds in the field of sewing production.

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Section 10. Physics

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AGENCY OF SURFACE RECOMBINATION ON VOLT-AMPERE CHARACTERISTIC OF THE DIODE WITH DOUBLE INJECTION

Abstract. The current-voltage characteristic of a three-layer semiconductor structure, base of which is made of a compensated semiconductor was calculated. Where taken into account the surface recombination of free charge carriers.

Keywords: free charge carriers, compensated semiconductor, the volt-ampere characteristic, surface recombination, S – diode.

The properties of long diodes with injection of minority charge carriers and with double injection, as well as multilayer semiconductor structures, have been researched in many works [1–6].

The volt – ampere characteristic of the diode, the base of which is made of a compensated semiconductor, has been considered in a number of works (see, for example, [1–3] and the literature cited there).

Below we list a number of phenomena explaining the appearance of a negative resistance (NR) section in the volt – ampere characteristics of S diodes: a) a change in the injection coefficient of the p – n junction; b) an increase in the lifetime of minority carriers during injection; c) decompensation of the

space charge in the diode base; d) radiative recombination of further reabsorption of photons; e) an increase in ambipolar and drift mobility; f) a change in the screening radius of charged impurity centers during carrier injection.

In these works, the effect of surface recombination on the volt – ampere characteristic is neglected. It can be proved that a change in the effective recombination leads to a change in the shape of the volt – ampere characteristic. In this work, this case is considered for S – diodes.

In this report, we show that a change in the effective rate of surface recombination of the emitter and collector junctions of the diode by double injection

leads to a change in the volt – ampere characteristic. In the stationary case, the distribution of charge carriers in the base of S – diodes, which is made of a semiconductor compensated by impurities that create deep levels in the band gap, are described by the following equations:

$$I_p = e\mu_p(p + p_0)E - gD_p \frac{dp}{dx}, \quad (1)$$

$$I_n = e\mu_n(n + n_0)E - gD_n \frac{dn}{dx}, \quad (2)$$

$$-\frac{1}{2} \frac{dj_p}{dx} = \frac{p}{r_p}. \quad (3)$$

Here τ_p, τ_n are the lifetime, μ_p, μ_n are the mobilities, D_p, D_n are the diffusion coefficients, n_0, n and p_0, p are the equilibrium and nonequilibrium concentrations of electrons and holes J_p and J_n are hole and electronic components of a full current J

$$J = J_p + J_n. \quad (4)$$

The dependence between the electron and hole concentrations is determined by the solution of the Poisson's equation, and can easily be obtained using the conditions of quasi neutrality

$$-\frac{\varepsilon}{4\pi e} \frac{dE}{dx} \ll n + n_0 \quad (5)$$

and assuming that the deep levels as sticking level for holes, the relationship between the electron and hole concentrations can be written as [2; 3]:

$$n = p \frac{p + N_1}{p + N_2}, \quad (6)$$

where

$$N_1 = \frac{\theta N f_-^0 + \theta(1 + \delta)p_0 + (1 + \delta^{-1})n_0}{\theta + 1}, \quad (7)$$

$$N_1 - N_2 = \frac{\theta N (f_-^0 - f_0^0)}{\theta + 1}, \quad (8)$$

θ – is the ratio of the capture cross section of electrons and holes to a deep level, δ is the ratio of minus f_-^0 and zero charged f_0^0 atoms of a deep impurity in an equilibrium state. From equations (1–4), taking into account (5), (6), we obtain dimensionless expressions for E and J_p at a high level of injection. Then it is easy to obtain a system of equations which can be calculate the volt – ampere characteristic of the structure under consideration

$$E = \frac{2 \cdot j \cdot b}{y[1 + b(a + 1)] + b} - \frac{y'[b(a + 1) - 1]}{y[1 + (a + b)b] + b}, \quad (9)$$

$$J_p = \frac{y}{y[1 + b(a + 1)] + b} J - \frac{y(a + 1) + \frac{1}{2}}{y[1 + b(a + 1)] + b} y'. \quad (10)$$

$$\text{There } y = \frac{p}{n_0}, a = \frac{N_1 - N_2}{N_2}, b = \frac{\mu_n}{\mu_p}, J = \frac{I L_p}{2eD_n n_0}.$$

Statement (10) in (3) leads to the following equation at high injection levels for the case $y^2 \varepsilon \gg 1$

$$y'' - 2y \cdot y' - y = 0 \quad (11)$$

At high currents, it is necessary to take into account not only the properties of the transition, but also the properties of the contact, which requires taking into account the recombination process on the surface. If we take into account that the rear contact of the diode is anti-locking, then the spatial distribution along the length of the base of the structure of current carriers is determined as

$$y = Ae^{k_2 x} + Be^{-k_1 x}, \quad (12)$$

$$\text{where } k_{1,2} = \sqrt{j^2 + 1} \mp j, J = j \frac{\varepsilon ab}{2(a + 1)[1 + b(a + 1)]}, A$$

and B are integration constants determined from the following boundary conditions

$$\begin{cases} j_p(d) = es_p^* [p(d) - p_n] \approx es_p^* n_0 y(d), \\ y'(0) = -b_1 \cdot j. \end{cases} \quad (13)$$

To simplify, $j_p(d)$ write in dimensionless form

$$j_p(d) = \aleph \cdot y(d), \quad (14)$$

$$\text{where } \aleph = \frac{es_p^* L_p}{eD_p},$$

$$S_p^* = \frac{S_p}{e \frac{e(V_m \pm V_k)}{kT} + \frac{S_p}{D_p} \int e^{\frac{eV(x)}{kT}} dx} \quad (15)$$

is the velocity of the surface distribution, V_m is the drop in the external voltage at the contact with the metal, $\pm V_k$ is the contact potential difference, “+” and “–” refer to the barrier and anti-blocking layers, respectively.

According to (13), (13) and (12) we have

$$A = \frac{\gamma + \left(\sigma - \frac{\aleph}{k_1}\right) \cdot m \cdot e^{-k_1 d}}{\left(\frac{\aleph}{k_2} + \sigma\right) \cdot e^{k_2 d} + \left(\frac{\aleph}{k_1} - \sigma\right) e^{-k_1 d}} \cdot \frac{1}{k_2},$$

$$B = \frac{\gamma + \left(\sigma + \frac{\aleph}{k_2}\right) \cdot m \cdot e^{-k_1 d}}{\left(\frac{\aleph}{k_2} + \sigma\right) \cdot e^{k_2 d} + \left(\frac{\aleph}{k_1} - \sigma\right) e^{-k_1 d}} \cdot \frac{1}{k_1} \quad (16)$$

where

$$y(x) = \frac{\gamma / k_2}{\left(\frac{\aleph}{k_2} + \sigma\right) e^{k_2 d} + \left(\frac{\aleph}{k_1} - \sigma\right) e^{-k_1 d}} \left[\left(1 + \left(\sigma - \frac{\aleph}{k_2}\right) \frac{m}{\gamma} e^{-k_1 d} \right) e^{k_2 x} + \left(1 + \left(\sigma + \frac{\aleph}{k_2}\right) \frac{m}{\gamma} e^{-k_1 d} \right) e^{-k_2 x} \right], \quad (19)$$

Taking into account $j_p(0) = j$ we obtain the expression for the maximum current value determined by the relation $j = -\beta \frac{dy}{dx}$

$$y_0 = \frac{k_1 \left[1 + \left(\sigma - \frac{\aleph}{k_2}\right) \frac{m}{\gamma} \exp(-k_1 d) \right] + k_2 \left[1 + \left(\frac{\aleph}{k_2} + \sigma\right) \frac{m}{\gamma} \right] e^{k_2 d}}{k_1 \cdot k_2 \left[\left(\frac{\aleph}{k_2} + \sigma\right) e^{k_2 d} + \left(\frac{\aleph}{k_1} - \sigma\right) e^{-k_1 d} \right]}, \quad (20)$$

where $\beta = \frac{y_0(1+a) - \frac{1}{2}}{b[y_0(1+a) + 1]}$. Then the voltage drop in the $p-n$ junction is determined by the expression

$$V_{pn} = \ln \left| \frac{\gamma k_1 \left[1 + \left(\sigma - \frac{\aleph}{k_2}\right) \frac{m}{\gamma} e^{-k_1 d} \right] + k_2 \left[1 + \left(\sigma + \frac{\aleph}{k_2}\right) \frac{m}{\gamma} e^{k_2 d} \right] \gamma}{\gamma_n k_1 \cdot k_2 \left[\left(\frac{\aleph}{k_2} + \sigma\right) e^{k_2 d} + \left(\frac{\aleph}{k_1} - \sigma\right) e^{-k_1 d} \right]} \right| \quad (21)$$

where it is taken into account that

$$y(a) = y_n e^{\frac{eV_{pn}}{kT}}, \quad y_n = \frac{p_n}{n_0} y(a) e^{\frac{eV_{pn}}{kT}}. \quad (22)$$

The voltage drop in the thickness is determined by the formula

$$V_1 = \frac{1-b(a+1)}{1+b(a+1)} \ln \left| \frac{k_1 e^{k_2 d} + k_2 e^{k_1 d} + \frac{m}{\gamma} \sigma (k_2 - k_1) e^{(k_1 - k_2) d}}{k_1 + k_2 + \frac{m}{\gamma} \sigma (k_1 e^{-k_1 d} + k_2 e^{k_2 d}) + \frac{\aleph m}{\gamma} (e^{k_2 d} - e^{-k_1 d})} \right| \quad (24)$$

and V_2 (for long diodes) takes the form:

$$V_2 = \frac{1-b(a+1)}{1+b(a+1)} \cdot \frac{1}{B} \cdot \frac{\pi}{k_1 + k_2} \left(\frac{A}{B} \right)^{-\frac{k_1}{k_1 + k_2}} \cdot \operatorname{cosec} \frac{\pi k_1}{k_1 + k_2} \quad (25)$$

$$\sigma = \frac{a+1}{1+b(a+1)} \cdot \frac{eD_p n_0}{L_p}, \quad \gamma = \frac{I \cdot L_p}{eD_p n_0} \cdot \frac{1}{1+b(a+1)}.$$

At $\aleph = 0$

$$A = \frac{\gamma + m \cdot e^{-k_1 d}}{e^{k_2 d} - e^{-k_1 d}} \cdot \frac{1}{k_2}, \quad B = \frac{\gamma + m \cdot e^{k_2 d}}{e^{k_2 d} - e^{-k_1 d}} \cdot \frac{1}{k_1} \quad (18)$$

If $m = 1$ (18) and (19) correspond to the results [2; 3].

Substituting (16) and (17) into (12) we obtain the expressions for the distribution of current along the length of the base of the structure

If the surface recombination rate is too low ($s_p^* \ll 1$), then expressions (20), (24), (25) will go over to the results obtained in [3; 4].

At an infinitely high rate of surface recombination V_1 and V_2 , it tends to zero, but V_{pn} has the form

$$V_{pn} = \ln \frac{m(e^{k_2 d} - e^{-k_1 d})}{\gamma_n(k_1 e^{k_2 d} + k_2 e^{-k_1 d})} \quad (26)$$

Thus, taking into account the surface recombination of current carriers can greatly change both the nature of the change in the volt – ampere characteristic of the structure and the current distribution (also of current carriers) along the length of the base of a three-layer structure, in a diode switch, the base of which is made of a compensated semiconductor.

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TO THE THEORY OF CURRENT-VOLTAGE CHARACTERISTICS OF THE THREE-LAYER STRUCTURE OF SEMICONDUCTORS IN DIODE SWITCHING

Abstract. A generalized theory of the current-voltage characteristics of a three-layer semiconductor structure in a diode inclusion is proposed. It was believed that the base of this structure is made of compensated semiconductor.

The obtained results are generalized for structures with different conductivities.

Keywords: current-voltage characteristic, three-layer semiconductor structure, diode, compensated semiconductor.

The current-voltage characteristic of the three-layer structure of semiconductors in a diode inclusion, in which the base is made of a compensated semiconductor, has been considered in a number of works (see, for example, [1–4] and the references therein). In [4], in particular, a number of phenomena are listed that explain the appearance of a section of negative resistance in the current-voltage characteristic in the through direction in $p-n-p$ structures.

In this work, following [2], expressions are obtained for the distribution of current densities and concentrations of current carriers along the length of the base. To determine the relationship between these parameters, the Poisson equations, the conditions of electroneutrality and continuity of flows for current carriers in the stationary case are taken into account [1–3]. Then the distribution of current den-

sities along the length of the base of the three-layer structure is described by the equation (in the one-dimensional approximation, i.e., along the axis Ox):

$$L_n^2 \frac{2n + \delta\theta p_0 + n_0}{(1 + b\delta\theta)p + \delta\theta(p_0 + bn_0)} \frac{d^2 j_n}{dx^2} - j_n + \frac{b(n + n_0)}{\left(b + \frac{1}{\delta\theta}\right)p + n_0 b + p_0} j = 0, \quad (1)$$

where is used the notation of [1; 2], $j = j_n + j_p$ is the density of the total current of electrons and holes. Here it is believed that the base of the structure is made of a semiconductor compensated by impurities that create deep levels in the band gap. Then in the region of strong injection (1) takes the form

$$\frac{2L_n^2}{1 + b\delta\theta} \frac{d^2 j_n}{dx^2} - j_n + \frac{b}{\left(b + \frac{1}{\delta\theta}\right)} j = 0. \quad (2)$$

To solve the latter, it is convenient to go to $y = j_n/j = j_n/(j_n + j_p)$. Then it's easy to get

$$\frac{d^2 y}{dx^2} - \frac{b\delta\theta + 1}{2} \left(y - \frac{b\delta\theta}{b\delta\theta + 1} \right) = 0, \quad (3)$$

whose solution we are looking for in the form

$$y = \frac{b\delta\theta}{b\delta\theta + 1} + c_1 chx\sqrt{a} + c_2 chx\sqrt{a}, \quad (4)$$

where $a = \frac{b\delta\theta + 1}{2}$; $L = \sqrt{\frac{2L_n}{b\delta\theta + 1}}$. From the condi-

tion $y(0) = j_n(0)/j = m_1$ (electron fraction of the total current density in $x = 0$) we have

$$c_1 = \frac{(m_2 + 1)b\delta\theta + m_2 - [b\delta\theta(m_1 - 1) - m_1]ch\frac{d}{L}}{(b\delta\theta + 1)sh\frac{d}{L}}, \quad (5)$$

Then, introducing the electron fraction in the total current density at $x = d$ (d is the base length), i.e.

$$n(0) = \frac{jL_n}{eD_n\sqrt{2(1+b\delta\theta)}sh\frac{d}{L}} \left\{ [(m_2 - 1)b\delta\theta + m_2]ch\frac{d}{L} - [(m_1 - 1)b\delta\theta + m_1] \right\},$$

$$n(d) = \frac{[(m_2 - 1)b\delta\theta + m_2]ch\frac{d}{L} - [(m_1 - 1)b\delta\theta + m_1]}{(m_2 - 1)b\delta\theta + m_2 - [(m_1 - 1)b\delta\theta + m_1]ch\frac{d}{L}} n(0) \quad (8)$$

Hence the distribution of electrons over the thickness of the base for structures of the type, $p^+ - n - n^+$, $n^+ - n - p^+$ and $n^+ - n - n^+$ is written in the form

$$n(x) = \frac{jL_n}{eD_n\sqrt{2(1+b\delta\theta)}sh\frac{d}{L}} \left[ch\frac{x}{L} + b\delta\theta ch\frac{d-x}{L} \right]$$

$$n(x) = \frac{jL_n \left[ch\frac{d-x}{L} - b\delta\theta ch\frac{x}{L} \right]}{eD_n\sqrt{2(1+b\delta\theta)}sh\frac{d}{L}},$$

$y(d) = j_n(d)/j = m_2$ we get the expression for j_n (see table 1)

$$\frac{j_n}{j} = \frac{b\delta\theta}{b\delta\theta + 1} + \frac{(m_1 + 1)b\delta\theta + m_1}{(b\delta\theta + 1)sh\frac{d}{L}} sh\frac{d-x}{L} + \frac{(m_2 + 1)b\delta\theta + m_2}{(b\delta\theta + 1)sh\frac{d}{L}} sh\frac{x}{L}, \quad (6)$$

Then, in the diffusion approximation, the electron distribution along the length of the base of the structure has the form

$$n = \frac{jL_n sh^{-1}\frac{d}{L}}{eD_n\sqrt{2(1+b\delta\theta)}} \left\{ \begin{array}{l} [(m_2 - 1)b\delta\theta + m_2] sh\frac{x}{L} - \\ - [(m_1 - 1)b\delta\theta + m_1] sh\frac{d-x}{L} \end{array} \right\}, \quad (7)$$

whence the electron concentrations in the contacts are determined by the relations

$$n(x) = \frac{jL_n \left[ch\frac{x}{L} + ch\frac{d-x}{L} \right]}{eD_n\sqrt{2(1+b\delta\theta)}sh\frac{d}{L}}, \quad (9)$$

The current - voltage characteristic of a three-layer semiconductor structure, determined by the voltage drop at the base of the structure, in the diffusion approximation has the form

$$V = \int_0^d Edx = V_1 + V_2 \quad (10)$$

where

$$V_1 = -\frac{kT}{e} \cdot \frac{b\delta\theta - 1}{b\delta\theta + 1} \cdot \ln \left| \frac{ch\frac{d}{L} - \aleph_1}{1 - ch\frac{d}{L} \cdot \aleph_1} \right|, \quad \aleph_1 = \frac{(m_1 - 1)b\delta\theta - m_1}{(m_2 - 1)b\delta\theta + m_2},$$

$$V_1 = \frac{\varphi_{T1}}{\left\{ \left(1 - \aleph \cdot \exp\frac{d}{L} \right) \left[1 - \aleph \cdot \exp\left(-\frac{d}{L}\right) \right] \right\}} \left\{ \arctg \left[\sqrt{\frac{1 - \aleph \cdot \exp\left(-\frac{d}{L}\right)}{1 - \aleph \cdot \exp\frac{d}{L}}} \right] \cdot e^{d/L} - \arctg \sqrt{\frac{1 - \aleph \cdot \exp\left(-\frac{d}{L}\right)}{1 - \aleph \cdot \exp\frac{d}{L}}} \right\}$$

$$\aleph = \frac{(m_1 - 1)b\delta\theta - m_1}{(m_2 - 1)b\delta\theta - m_2}, \quad \varphi_{T1} = \frac{kT}{e} \cdot \frac{4 \cdot sh \frac{d}{L}}{\alpha(1+b\delta\theta)}. \quad (11)$$

For example, for the structure, $n^+ - n - p^+$ we have

$$V_1 = \frac{kT}{e} \cdot \frac{4 \cdot sh \frac{d}{L}}{1+b\delta\theta} \cdot \frac{\eta_1 \cdot b\delta\theta}{\left\{ \left[1+b\delta\theta \exp \frac{d}{L} \right] \cdot \left[1+b\delta\theta \exp \left(-\frac{d}{L} \right) \right] \right\}^{\frac{1}{2}}}, \quad (12)$$

where

$$\eta_1 = \text{arctg} \left\{ \frac{\left[\left(b\delta\theta + e^{\frac{d}{L}} \right) \left(b\delta\theta + e^{-\frac{d}{L}} \right) \right]^{\frac{1}{2}}}{1+b\delta\theta} \cdot th \frac{d}{2L} \right\}.$$

Then the electric field strength in the structure

has the form

$$E = \frac{j \cdot L_n}{eD_n} \cdot \frac{(m_2 - 1)b + m_2}{\sqrt{2(1+b)ch \frac{d}{L}}} \left[ch \frac{x}{L} - \aleph \cdot ch \frac{d-x}{L} \right] \quad (13)$$

and for the minimum value of the voltage drop at the base

$$V_{\min} = \frac{kT}{e} \cdot \frac{\frac{4b}{b+1} \cdot sh \frac{d}{L} \cdot \left[\text{arctg} \left\{ \frac{\left(1 - \aleph^1 \cdot e^{\frac{d}{L}} \right) \left(1 - \aleph \cdot e^{-\frac{d}{L}} \right)^{1/2}}{\left(1 - \aleph \right) ch \frac{d}{L}} \right\} \right] \eta_i}{\left(1 - \aleph^1 \cdot e^{\frac{d}{L}} \right) \left(1 - \aleph \cdot e^{-\frac{d}{L}} \right)^{1/2} \cdot ((m_2 - 1)b + m_1)} + \frac{b-1}{b+1} \cdot \frac{kT}{e} \ln \frac{1 - \aleph \cdot ch \frac{d}{L}}{ch \frac{d}{L} - \aleph} \quad (14)$$

In conclusion, we note that the discussion of our theoretical results on specific three-layer semiconductor structures in a diode inclusion requires a separate consideration.

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Section 11. Chemistry

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SUPRAMOLECULAR COMPLEX OF MONOAMMONIUM SALT OF GLYCIRRIZINIC ACID WITH NORSULFAZOL

Abstract. This article presents the results of studying the composition and nature of the intermolecular interactions of the components of the complex compound of the monoammonium salt of glycyrrhizic acid with norsulfazole sodium using the isomolar series method. Also calculated is the change in Gibbs energy and the stability constant of the complex.

Keywords: Licorice, glycyrrhizic acid, monoammonium salt of glycyrrhizic acid, isomolar series method, sulfonamides.

From ancient times, plants are considered the main raw material base of medicines. One of the famous medicinal plants is licorice. This plant belongs to the genus *Glycyrrhiza*, a family of legume Fabaceae.

In the world flora there are more than ten types of licorice. The most widespread and practical applications are found by *Glycyrrhiza glabra* L., *Glycyrrhiza uralensis* Fich, *Glycyrrhiza Korshinskyi* Grig [1–5].

Naked licorice is the most popular among them, its roots contain the largest number of biologically active substances [6; 7]. Licorice preparations were included in the pharmacopeias of eastern countries long before our era. The results of treatment based on tinctures of licorice root in medieval medicine are summarized by the great scientist Avicenna [1; 8].

The main active ingredient of licorice root – glycyrrhizic acid (GA) has attracted the attention

of many researchers because of its high biological activity, as well as its ability to enhance the effects of other drugs in various medicinal compositions [9–10]. So, many researchers have obtained complex compounds of GA or its monoammonium salt (MASGA) with various drugs. There was a decrease in dose, thereby undesirable effects, as well as improved solubility of drugs. The ability of GA to affect the properties of drugs in the pharmacological literature is usually associated with complexation, while more often than not giving physico-chemical data on the nature of the interaction of a pharmacoon with a complexing agent [11–12].

Molecular encapsulation of biologically active substances with complexing organic substances is being studied as one of the convenient and effective ways to improve solubility (bioavailability) and reduce the undesirable effects of the biologically active substance [3; 11; 13].

Sulfanilamide drugs are widely used in medicine, as chemotherapeutic drugs for the treatment and prevention of infectious diseases in humans and animals. One of these drugs is norsulfazole sodium, which is used for pneumonia, meningitis, sepsis, dysentery and other infectious diseases. The effectiveness of this drug against streptococcus, gonococcus, staphylococcus and *Escherichia coli* was noted [14].

In previous works, we obtained molecular complexes of the monoammonium salt of the glycyrrhizin salt with sulfanilamide preparations such as phthalazole, urosulfan, sulfalene, sulfadimesin and studied their interferon-inducing activity [3; 10; 15]. In addition, molecular complexes of MASGA with other sulfonamides were obtained and the intermolecular interaction of the components of the complexes by spectral methods was studied. This work presents the results of a study of the molecular complex of MASGA with norsulfazole sodium by spectrophotometric and IR spectroscopic methods.

The molecular complex of MASGA with norsulfazole-sodium was obtained by the previously described method. The composition of the complex was determined by the method of isomolar series. This method is recommended for determining the composition of metal complex compounds, and has been used recently to study the composition of molecular complexes [13; 16; 17]. The curve of the isomolar series is shown in (Fig. 2). The electronic absorption spectrum has an absorption maximum at 240 nm (Fig. 2). The composition of the complex was determined by the isomolar series method (Ostromyslensky-Zhob method) [16–17]. The stability constant of the complex is calculated on the basis of the isomolar curve.

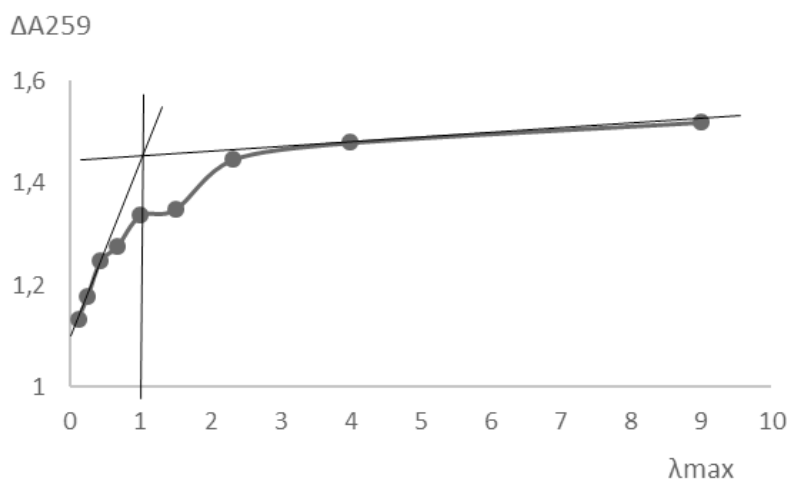
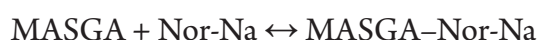


Figure 1. The dependence of the change in optical density ΔA on the ratio of the components of the isomolar series at $\lambda = 259$ nm: $c(\text{Nor-Na}) = 10^{-4}$ M, $c(\text{MASGA}) = 10^{-4}$ M (pH 7.2, 25 °C)

To study the nature of intermolecular bonds in the complex, the IR spectroscopic method was used. So, in the IR spectrum of the complex, two bands are observed at 3352 and 3255 cm^{-1} . In the spectrum of the MASGA itself, vibrations characteristic of OH groups appear in the form of a single band at 3228 cm^{-1} . In the IR spectrum of norsulfazole, the $-\text{NH}-$ vibrations of the primary amino group appear as a broad band at 3184 cm^{-1} . This band is not observed in the IR spectrum of the complex.

Thus, in an aqueous solution, an equilibrium is established between MASGK and norsulfazole:



Based on the isomolar curve, the stability complex of the complex at $\lambda = 259 \text{ nm}$ was calculated using the following formula.

$$K = \frac{\Delta A_0 \Delta A_1}{c(\Delta A_0 - \Delta A_1)}$$

where c is the total concentration equal to 10^{-4} M , ΔA_0 is the change in optical density corresponding to the complex in the complete absence of dissociation, ΔA_1 is the change in optical density corresponding to the value on the actual curve.

$$c = 0.0001, \Delta A_0 = 1.67, \Delta A_1 = 1.4;$$

$$K = 8.6 \cdot 10^5 \text{ J/mol}$$

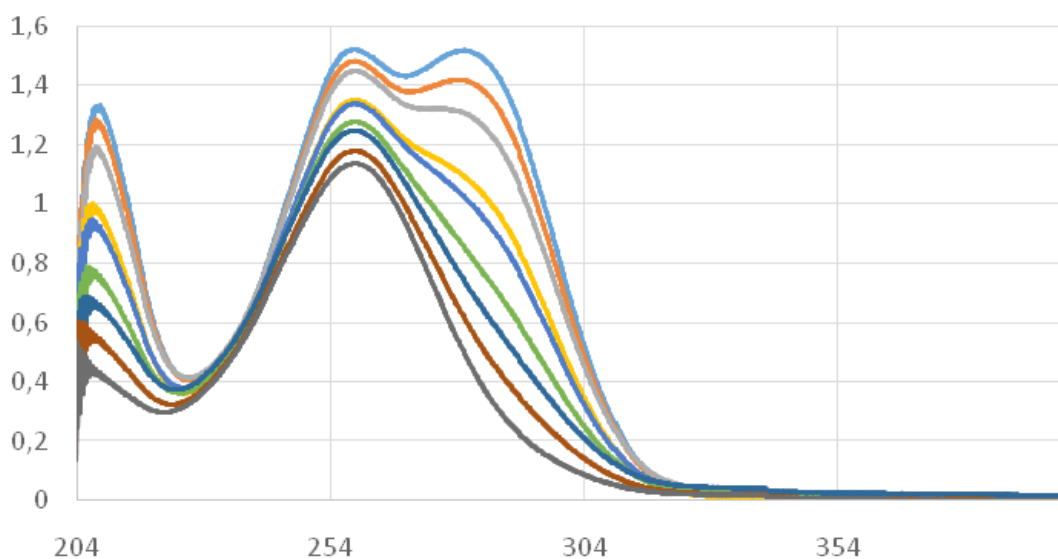


Figure 2. UV absorption spectrum of an isomolar series of solutions of MASGA and Norsulfazole sodium (pH 7.2; 25°C)

The change in Gibbs energy ΔG for the complexation process is calculated by the formula:

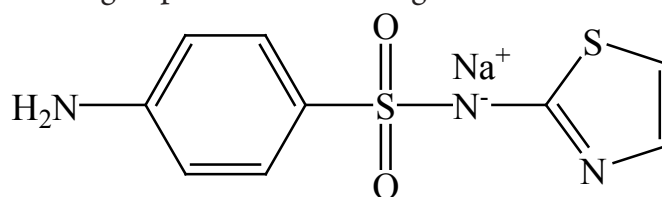
$$\Delta G = -2.3 RT \lg K$$

$$\Delta G = -2.3 \cdot 8.314 \cdot 298 \cdot 8.6 \cdot 10^5 = -23166.9 = -2.32 \cdot 10^4 \text{ kJ/mol}$$

The value of ΔG confirms that the equilibrium in the process of complex formation is shifted towards the formation of a complex compound.

In the IR spectrum of the complex, the position of the absorption bands of the MASGA carbonyl groups at 1714 and 1656 cm^{-1} , the C – S bond at 670

cm^{-1} , and the C = N bond intensity of the thiazole ring at 1440 cm^{-1} change. These changes confirm the participation in the complexation of the carboxyl and hydroxyl groups of MASGA, as well as the primary amino group and thiazole nitrogen atom.



The results of quantitative and qualitative composition of complex compounds are shown in (table 2).

Table 2. – Qualitative and quantitative determination of the composition of the complex compound MASGA: Norsulfazole-Na method by HPLC

| Theoretically% | | Practically% | | Retention time min. |
|----------------|----------------|--------------|----------------|---------------------|
| MASGA | Norsulfazol-Na | MASGA | Norsulfazol-Na | |
| 91.7 | 8.3 | 90.8 | 8.2 | 7.509 |

From the data given in (table No. 2) it can be seen that the results obtained coincide with the theoretically calculated data, which were confirmed by the results of IR and UV spectroscopy.

Experimental part.

For experiments, MASGA of 92% purity (by HPLC) obtained by the known method [8] and the substance of norsulfazole sodium (2- (p-aminobenzenesulfamido) thiazole sodium) were used. IR spectra were recorded on an IRTracer-100 IR Fourier spectrometer (Shimadzu, Japan). UV spectra were recorded on a Shimadzu-1280 spectrophotometer in quartz cuvettes ($l = 10$ mm); aqueous solutions of MASGA and norsulfazole were used to prepare solutions of the isomolar series (pH 7.2; $c = 10^{-4}$ M phosphate buffer). HPLC was performed on an Agilent 1200 autosampler and gradient pump.

IR spectrum of HC (ν , cm^{-1}): 3228(OH, NH), 2927(CH), 1714(C = O), 1656($\text{C}^{11} = \text{O}$; C = C), 1593(COO^-), 1039(COC).

IR spectrum of norsulfazole (ν , cm^{-1}): 3184 (NH), 1440(C = N), 1238(NH), 1122(CHAR), 677(C-S).

Quantitative determination of monoammonium salt of glycyrrhizic acid (MASGA) and norsulfazole-sodium by HPLC

To determine the content of MASGA and norsulfazole-Na, the HPLC method using a diode-matrix detector with an autosampler was used. Chromatography conditions:

Mobile phase: acetonitrile – water – glacial acetic acid in a ratio of 35: 64.5: 0.5 (by volume).

Detector: diode array (wavelength 254 nm);

Solvent system: acetate buffer: acetonitrile (65:35);

Column XDB –C18, 5 μm , 4.8 \times 150 mm,

Flow – 1ml/min;

The regime is isocratic. Column temperature – 30 °C.

Output

Thus, for the first time, a complex compound of the monoammonium salt of HA and norsulfazole sodium was obtained. In aqueous solutions at pH 7.2 it was found by the isomolar series method that the components of the complex were found to be in a 1:1 ratio. The stability constant of complex K and the change in Gibbs energy ΔG of the complexation process are calculated.

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RHEOLOGICAL PROPERTIES OF PULPS AND SOLUTIONS OF ZINC CHLORIDE CONVERSION PROCESS

Abstract. The article provides information on rheological properties of pulps and solutions of conversion of zinc chloride obtained from zinc-containing concentrate and hydrochloric acid. Rheological properties in time and temperature variations in laboratory conditions are described in detail. The main parameters that determine the rheology process are the fluidity of pulps and solutions in the production of zinc chloride. The conclusion is made about the technological possibility of transporting the reaction pulp of zinc chloride in production conditions, since the pulps and solutions of the process are quite tangible.

Keywords: zinc containing ore, concentrate, rheological properties, solution, pulp.

Introduction: Zinc has been used by man since ancient times. The first information about metallic zinc refers to the V century BC. Initially, it was obtained in the form of an alloy with copper-brass, which was smelted in India, China and other countries of the Ancient East.

Zinc chloride is widely used in Uzbekistan, but today is not produced, although it has a large number of raw materials zinc [1].

The largest zinc producers are: China, Canada, Australia [2]. These countries are the main exporters of zinc. The largest importers of zinc are the USA, Taiwan, Germany. The largest consumers of zinc are (million tons per year): China (1.3–1.4); USA (1.1–1.3); Japan (0.7–0.8); Germany (0.4); great Britain (0.3); France (0.2–0.24); Belgium, Canada, Italy, Australia, India-0.1–0.17.

Given the volume of production of zinc concentrate, it is now necessary to make a comprehensive processing of sphalerite concentrate, because at the moment the zinc concentrate produced by the plants

in addition to zinc may contain additional valuable components such as gold, silver, indium, cadmium, copper and other metals that are not extracted.

Objects and methods: The investigations were carried out with zinc-containing ore of Khandiza deposit containing zinc concentrate 39.45–40.50% Zn. Chemical analysis of initial, intermediate and final products was carried out by known methods [3–5].

Manufacturability and efficiency of the individual stages of the process of obtaining zinc chloride is largely determined by the rheological characteristics of the initial, intermediate and final solutions and suspensions. The most important, from the point of view of the analysis of the possibility of transportation of saturated solutions, are the density and viscosity.

The density of solutions and pulps was determined using a PJ-2 pycnometer with a measurement accuracy of 0.05 ratio%. Kinematic viscosity of solutions and pulps was measured by glass capillary viscometers VPJ-1 and VPJ-2 with an error of 0.2 ratio%.

The density value was calculated by the formula:

$$\rho = \frac{m}{v};$$

where m – mass of the pulp, g; v – the capacity of the pycnometer, cm³.

Viscosity was determined according to the following formula:

$$\eta = \kappa \cdot \rho \cdot \tau;$$

where κ – viscometer constant and it is equal to 0.3262 and 3.404, respectively, for VPJ –1 and VPJ –2 with a capillary diameter of 1.31 mm. ρ – pulp

density in g/cm³. τ – time of the pulp passing through the capillary of the viscometer, s.

Determination of pulp viscosity and density was carried out at temperatures from 20 to 80 °C and Zn: HCl ratios from 1:0.6 to 1: 2.0. The results are presented in (tables 1–2). According to the obtained research results, empirical equations with correlation coefficient (R^2) are derived. The corresponding coefficients are in the range of 0.9269 and 1.000 indicate that the experimental data are well shuffled with the established values.

Table 1. – Density of pulps obtained by conversion of zinc concentrate with hydrochloric acid

| № | Ratio Zn: HCl | Density (g/cm ³) | | | | Empirical equation | R ² |
|-----|---------------|------------------------------|-------|-------|-------|-------------------------|----------------|
| | | 20 °C | 40 °C | 60 °C | 80 °C | | |
| 1. | 1:0.6 | 1.698 | 1.690 | 1.685 | 1.683 | $y = -0.0050x + 1.7015$ | 0.9328 |
| 2. | 1:0.8 | 1.689 | 1.683 | 1.677 | 1.674 | $y = -0.0051x + 1.6935$ | 0.9797 |
| 3. | 1:0.9 | 1.684 | 1.676 | 1.670 | 1.661 | $y = -0.0075x + 1.6915$ | 0.9947 |
| 4. | 1:1.0 | 1.680 | 1.671 | 1.664 | 1.654 | $y = -0.0085x + 1.6885$ | 0.9959 |
| 5. | 1:1.1 | 1.676 | 1.668 | 1.659 | 1.651 | $y = -0.0084x + 1.6845$ | 0.9994 |
| 6. | 1:1.2 | 1.644 | 1.622 | 1.599 | 1.581 | $y = -0.0212x + 1.6645$ | 0.9974 |
| 7. | 1:1.4 | 1.592 | 1.566 | 1.541 | 1.514 | $y = -0.0259x + 1.6180$ | 0.9998 |
| 8. | 1:1.5 | 1.550 | 1.518 | 1.491 | 1.472 | $y = -0.0261x + 1.5730$ | 0.9876 |
| 9. | 1:1.7 | 1.508 | 1.472 | 1.452 | 1.434 | $y = -0.0242x + 1.5273$ | 0.9699 |
| 10. | 1:2.0 | 1.476 | 1.442 | 1.424 | 1.408 | $y = -0.0222x + 1.4930$ | 0.9645 |

Analysis of the data indicates changes in pulp density depending on changes in the Zn: HCl ratio, i.e. decrease in the Zn: HCl ratio, and temperature (table 1). With an increase in the amount of hydrochloric acid and temperature, the density of solutions decreases. Thus, at 20 °C, the pulp density at the ratio Zn: HCl=1:0.6 is 1.698 g/cm³, and at Zn: HCl=1:2.0–1.476 g/cm³.

Whereas, at the same Zn: HCl ratio, an increase in temperature leads to a decrease in the pulp density. For example, at a ratio of 1:1.1 and a temperature of 20 to 80 °C, the density value varies from 1.676 to 1.651 g/cm³.

Table 2. – Viscosity of pulps obtained by conversion of zinc concentrate with hydrochloric acid

| № | Ratio Zn: HCl | Viscosity, MPa·s | | | | Empirical equation | R ² |
|----------|---------------|------------------|----------|----------|----------|---------------------------|----------------|
| | | 20 °C | 40 °C | 60 °C | 80 °C | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. | 1:0.6 | 8.45 | 5.58 | 4.38 | 3.58 | $y = -3.53\ln(x) + 8.303$ | 0.9905 |
| 2. | 1:0.8 | 8.42 | 5.49 | 4.30 | 3.50 | $y = -3.57\ln(x) + 8.262$ | 0.9892 |
| 3. | 1:0.9 | 8.38 | 5.39 | 4.21 | 3.42 | $y = -3.60\ln(x) + 8.208$ | 0.9876 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|-------|------|------|------|------|---------------------------|--------|
| 4. | 1:1.0 | 8.36 | 5.33 | 4.10 | 3.38 | $y = -3.63\ln(x) + 8.176$ | 0.9858 |
| 5. | 1:1.1 | 8.33 | 5.29 | 4.05 | 3.35 | $y = -3.63\ln(x) + 8.143$ | 0.9851 |
| 6. | 1:1.2 | 8.30 | 5.15 | 3.98 | 3.30 | $y = -3.65\ln(x) + 8.079$ | 0.9800 |
| 7. | 1:1.4 | 8.25 | 5.04 | 3.87 | 3.25 | $y = -3.66\ln(x) + 8.001$ | 0.9759 |
| 8. | 1:1.5 | 8.15 | 4.92 | 3.80 | 3.20 | $y = -3.62\ln(x) + 7.894$ | 0.9726 |
| 9. | 1:1.7 | 7.94 | 4.81 | 3.73 | 3.15 | $y = -3.50\ln(x) + 7.690$ | 0.9723 |
| 10. | 1:2.0 | 7.70 | 4.72 | 3.60 | 3.02 | $y = -3.43\ln(x) + 7.482$ | 0.9774 |

A similar pattern is observed in the study of viscosity (table. 2). Pulp viscosity at 20 °C at a ratio of Zn: HCl=1:0.6 decreases from 8.45 MPa·s to 7.70 MPa·s at a ratio of Zn: HCl=1:2.0, respectively, with an increase in temperature from 20 to 80 °C. In addition, with a constant ratio of Zn: HCl and an increase in temperature, it reduces the viscosity from 8.45 to 3.58 and from 7.70 to 3.02 MPa·s. All pulps have good rheological properties. Experiments

show that the pulp has sufficient transportability. From the obtained data the most optimal is the ratio Zn: HCl = 1: 1,1.

Further, the rheological properties were studied depending on the conversion time of zinc-containing concentrate and hydrochloric acid in the preparation of zinc chloride at a ratio of Zn: HCl=1:1,1 and the time was varied from 0 to 12 hours. The data are shown in (tables 3 and 4).

Table 3. – Density of pulps obtained at the stage of preparation of zinc chloride at molar correlation Zn: HCl = 1: 1, 1

| № | Conversion time, h | Density (g/cm ³) | | | | Empirical equation | R ² |
|-----|--------------------|------------------------------|-------|-------|-------|-------------------------|----------------|
| | | 20 °C | 40 °C | 60 °C | 80 °C | | |
| 1. | 0 | 1.780 | 1.771 | 1.762 | 1.754 | $y = -0.0087x + 1.7885$ | 0.9992 |
| 2. | 1 | 1.766 | 1.757 | 1.749 | 1.740 | $y = -0.0086x + 1.7745$ | 0.9995 |
| 3. | 2 | 1.752 | 1.743 | 1.735 | 1.727 | $y = -0.0083x + 1.7600$ | 0.9991 |
| 4. | 3 | 1.741 | 1.732 | 1.724 | 1.716 | $y = -0.0083x + 1.7490$ | 0.9991 |
| 5. | 4 | 1.730 | 1.721 | 1.713 | 1.705 | $y = -0.0083x + 1.7300$ | 0.9991 |
| 6. | 5 | 1.720 | 1.711 | 1.702 | 1.694 | $y = -0.0087x + 1.7285$ | 0.9992 |
| 7. | 6 | 1.709 | 1.700 | 1.692 | 1.685 | $y = -0.0080x + 1.7165$ | 0.9969 |
| 8. | 7 | 1.699 | 1.691 | 1.683 | 1.675 | $y = -0.0080 + 1.7070$ | 0.1000 |
| 9. | 8 | 1.690 | 1.682 | 1.674 | 1.666 | $y = -0.0080x + 1.6980$ | 0.1000 |
| 10. | 9 | 1.682 | 1.674 | 1.666 | 1.658 | $y = -0.0080x + 1.6900$ | 0.1000 |
| 11. | 10 | 1.676 | 1.668 | 1.659 | 1.651 | $y = -0.0084x + 1.6845$ | 0.9994 |
| 12. | 11 | 1.672 | 1.664 | 1.656 | 1.648 | $y = -0.0080x + 1.6800$ | 0.1000 |
| 13. | 12 | 1.670 | 1.662 | 1.654 | 1.646 | $y = -0.0080x + 1.6780$ | 0.1000 |

Table 4. – The viscosity of pulps obtained at the stage of preparation of zinc chloride at the molar ratio Zn: HCl = 1: 1, 1

| № | Conversion time, hour | Viscosity, MPa·s | | | | Empirical equation | R ² |
|----------|-----------------------|------------------|----------|----------|----------|---------------------------|----------------|
| | | 20 °C | 40 °C | 60 °C | 80 °C | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. | 0 | 8.59 | 5.45 | 4.17 | 3.45 | $y = -3.75\ln(x) + 8.396$ | 0.9850 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|----|------|------|------|------|---------------------------|--------|
| 2. | 1 | 8.57 | 5.44 | 4.16 | 3.44 | $y = -3.74\ln(x) + 8.377$ | 0.9852 |
| 3. | 2 | 8.54 | 5.42 | 4.15 | 3.43 | $y = -3.73\ln(x) + 8.347$ | 0.9851 |
| 4. | 3 | 8.52 | 5.41 | 4.14 | 3.42 | $y = -3.72\ln(x) + 8.329$ | 0.9853 |
| 5. | 4 | 8.49 | 5.39 | 4.12 | 3.40 | $y = -3.71\ln(x) + 8.301$ | 0.9855 |
| 6. | 5 | 8.46 | 5.37 | 4.11 | 3.39 | $y = -3.70\ln(x) + 8.271$ | 0.9854 |
| 7. | 6 | 8.43 | 5.35 | 4.09 | 3.38 | $y = -3.69\ln(x) + 8.241$ | 0.9852 |
| 8. | 7 | 8.40 | 5.33 | 4.08 | 3.37 | $y = -3.67\ln(x) + 8.211$ | 0.9852 |
| 9. | 8 | 8.37 | 5.31 | 4.07 | 3.36 | $y = -3.66\ln(x) + 8.181$ | 0.9851 |
| 10. | 9 | 8.35 | 5.30 | 4.06 | 3.36 | $y = -3.64\ln(x) + 8.161$ | 0.9849 |
| 11. | 10 | 8.33 | 5.29 | 4.05 | 3.35 | $y = -3.63\ln(x) + 8.143$ | 0.9851 |
| 12. | 11 | 8.30 | 5.27 | 4.03 | 3.33 | $y = -3.63\ln(x) + 8.114$ | 0.9853 |
| 13. | 12 | 8.27 | 5.25 | 4.01 | 3.31 | $y = -3.62\ln(x) + 8.086$ | 0.9855 |

The filtrate densities decrease from 1.780 to 1.670 g/cm³ and to 1.646 g/cm³, respectively, as the conversion time increases and the temperature rises from 20 to 80 °C.

Similarly, solution viscosities decrease from 8.59 MPa·s to 8.27 and to 3.31 MPa·s, respectively, with increasing conversion time and increasing temperature from 20 to 80 °C.

Zinc chloride pulps have acceptable rheological properties and are quite transportable.

Tables 5 and 6 provide data on the density and viscosity of zinc chloride solutions in the process of evaporation of saturated solutions.

As can be seen from the table, increasing the temperature significantly reduces the density of mother

solutions at a constant concentration of ZnCl₂. For example, at a concentration of 45%, an increase in temperature from 20 to 80 °C contributes to a decrease in density from 1.369 to 1.337 g/cm³. At the same time, increasing the amount of evaporated water at a constant temperature, on the contrary, increases the density values in all studied temperatures. For example, at temperatures of 20 and 80 °C, the density increases from 1.350 to 1.466 g/cm³ and from 1.327 to 1.403 g/cm³, respectively, i.e. from 0.92 to 1.06 times.

Similarly, the viscosity of solutions decreases from 3.82 to 1.42 MPa·s and increases to 4.75 MPa·s, respectively, with an increase in temperature from 20 to 80 °C and the amount of evaporated water.

Table 5. – The density of the pulps obtained at the residue stage of zinc chloride solution at the ratio Zn: HCl = 1: 1,1

| № | Effect of conc. ZnCl ₂ , % | Density (g/cm ³) | | | | Empirical equation | R ² |
|----|---------------------------------------|------------------------------|-------|-------|-------|-------------------------|----------------|
| | | 20 °C | 40 °C | 60 °C | 80 °C | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. | 30 | 1.350 | 1.340 | 1.333 | 1.327 | $y = -0.0076x + 1.3565$ | 0.9857 |
| 2. | 35 | 1.358 | 1.343 | 1.334 | 1.329 | $y = -0.0096x + 1.3650$ | 0.9481 |
| 3. | 40 | 1.363 | 1.347 | 1.338 | 1.332 | $y = -0.0102x + 1.3705$ | 0.9527 |
| 4. | 45 | 1.369 | 1.351 | 1.342 | 1.337 | $y = -0.0105x + 1.3760$ | 0.9269 |
| 5. | 50 | 1.376 | 1.358 | 1.349 | 1.344 | $y = -0.0105x + 1.3830$ | 0.9269 |
| 6. | 55 | 1.384 | 1.367 | 1.358 | 1.353 | $y = -0.0102x + 1.3910$ | 0.9339 |
| 7. | 60 | 1.392 | 1.375 | 1.366 | 1.362 | $y = -0.0099x + 1.3985$ | 0.9198 |
| 8. | 65 | 1.401 | 1.384 | 1.375 | 1.370 | $y = -0.0102x + 1.4080$ | 0.9339 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----|----|-------|-------|-------|-------|-------------------------|--------|
| 9. | 70 | 1.410 | 1.394 | 1.384 | 1.379 | $y = -0.0103x + 1.4175$ | 0.9460 |
| 10. | 75 | 1.428 | 1.406 | 1.393 | 1.382 | $y = -0.0151x + 1.4400$ | 0.9721 |
| 11. | 80 | 1.446 | 1.420 | 1.405 | 1.393 | $y = -0.0174x + 1.4595$ | 0.9667 |
| 12. | 85 | 1.466 | 1.437 | 1.416 | 1.403 | $y = -0.0210x + 1.4830$ | 0.9718 |

Table 6. – Viscosity of pulps obtained at the stage of zinc chloride solution evaporation at the ratio Zn: HCl = 1: 1,1

| № | Effect of conc. ZnCl ₂ , % | Viscosity, MPa·s | | | | Empirical equation | R ² |
|-----|--|------------------|-------|-------|-------|---------------------------|----------------|
| | | 20 °C | 40 °C | 60 °C | 80 °C | | |
| 1. | 30 | 3.82 | 2.66 | 1.94 | 1.42 | $y = -1.73\ln(x) + 3.834$ | 0.9997 |
| 2. | 35 | 3.90 | 2.76 | 2.03 | 1.46 | $y = -1.75\ln(x) + 3.928$ | 0.9984 |
| 3. | 40 | 3.98 | 2.84 | 2.12 | 1.49 | $y = -1.77\ln(x) + 4.017$ | 0.9967 |
| 4. | 45 | 4.04 | 2.92 | 2.20 | 1.54 | $y = -1.78\ln(x) + 4.086$ | 0.9949 |
| 5. | 50 | 4.10 | 2.99 | 2.27 | 1.60 | $y = -1.77\ln(x) + 4.149$ | 0.9941 |
| 6. | 55 | 4.17 | 3.07 | 2.34 | 1.67 | $y = -1.78\ln(x) + 4.222$ | 0.9937 |
| 7. | 60 | 4.24 | 3.15 | 2.42 | 1.74 | $y = -1.77\ln(x) + 4.296$ | 0.9928 |
| 8. | 65 | 4.32 | 3.24 | 2.51 | 1.81 | $y = -1.78\ln(x) + 4.382$ | 0.9913 |
| 9. | 70 | 4.41 | 3.33 | 2.59 | 1.90 | $y = -1.78\ln(x) + 4.471$ | 0.9917 |
| 10. | 75 | 4.51 | 3.44 | 2.69 | 1.97 | $y = -1.80\ln(x) + 4.580$ | 0.9895 |
| 11. | 80 | 4.62 | 3.57 | 2.81 | 2.10 | $y = -1.78\ln(x) + 4.693$ | 0.9890 |
| 12. | 85 | 4.75 | 3.70 | 2.93 | 2.23 | $y = -1.79\ln(x) + 4.823$ | 0.9894 |

It is relevant to note here that in all studied conditions (influence ratio, conversion time and concentration) temperature and concentration are the main factor. Changes in density under the influence of temperature and concentration lead to volume changes and other thermodynamic properties [6–8]. The decrease in density with increasing temperature is explained by the relaxation of the “solute-solvent” interaction between Zn⁺² ions and water molecules. Whereas, an increase in density with an increase in the concentration of zinc chloride is an increase in “solute-solute” interactions, the formation of an Association and the displacement of water molecules from the hydrate shell.

In any case, all solutions have good rheological properties. This is evidenced by the mobility and high fluidity of the pulps and that they can be transported in production conditions by existing devices without any restrictions.

Conclusion: Thus, the conducted researches have shown possibility of processing of zinc-containing concentrates of the Khandiza Deposit on zinc chloride. To do this, the process of decomposition of zinc-containing concentrate must be carried out with hydrochloric acid at a ratio of Zn: HCl = not less than 1: 1,1 and the duration of the process is not less than 10 hours.

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Section 12. Science of law

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PRINCIPLE OF PARTY AUTONOMY IN CONTRACTUAL OBLIGATIONS UNDER ROME I REGULATION IN COMPARISON WITH KOSOVO CURRENT LAW AND FORTHCOMING DRAFT-LAW

Abstract. The aim of this paper is to analyse party autonomy under Rome I Regulation on the law applicable to contractual obligations in comparison with Kosovo law. During this analysis, similarities and differences of this regulation when compared to Kosovo law will be pointed out in order to make clear the position of the party autonomy principle under both jurisdictions. Due to the fact that Kosovo is not part of the mentioned regulation and has recently been in the process of adopting new legislation that has, as its legal base, EU developments in the field of private international law, it will be considered also the Kosovo Draft-Law on Private International Law. Moreover, special attention will be given to the limitations of the party autonomy that represents the central cornerstone of this very well-known principle.

Keywords: Private international law, party autonomy, contractual obligations, Rome I Regulation; Kosovo law.

I. Introduction

Contractual relationships do not recognise the borders of the states. People move from one state to another and create different types of contracts outside of their national residence. It has to be admitted that the effect of the contract is not the same under each jurisdiction (i.e., under German, French, Swiss, Austrian or Kosovo law). In previous times, nationalism also deeply reflected the contractual effects of the parties. This created dilemmas and problems with regard to the effects (rights and duties) of the contractual parties. In the modern world, the harmonization of contract law rules from an international perspective is a very well-known process with the aim of avoiding

legal divergences created as a consequence of every country having its own legal system. It is worth mentioning that the unification of the contractual choice of law rules started with the Rome Convention of 1980 [22] while the non-contractual obligations remained under jurisdiction of national legal systems. Recently, contractual and non-contractual obligations are regulated with two EU Regulations: (i) Regulation No 593/2008 on the Law Applicable to Contractual Obligations – called Rome I; and (ii) Regulation No 864/2007 on the Law Applicable to Non-Contractual Obligations – called Rome II). It has to be mentioned that these regulations have influenced the approach of the legal doctrine being subject of different legal com-

mentaries [11; 15; 16]. Pursuant to these regulations, currently contractual and non-contractual obligations are unified in the EU countries – excluding Denmark. In particular, these two regulations give a special legal space to the party autonomy – also known as ‘*freedom of choice*’ [20, 470], which is internationally recognised as a principle of contract choice of law [17, 20]. Furthermore, it should be noted that this principle can mostly be found in the general sections of national codifications in private international law despite the fact that other solutions were present [19, 138 *et seq*]. The freedom of choice in non-contractual obligations remain a topic for a forthcoming article as this paper covers only the contractual obligations.

From a historical point of view, party autonomy has not always been recognised. On the contrary, it has been met with doubts from public authorities and legal scholars. Nevertheless, we can summarise that four factors were crucial for the existence of this principle: (i) The principle of freedom of contract; (ii) Private parties actually enjoy an even greater autonomy on an international level; (iii) The legislator is the full and exclusive sovereign of his territory; (iv) The promotion of certainty and efficiency [14, 49–51].

Party autonomy under Rome I Regulation is widely recognised [3, 438]. Parties in principle have an unlimited choice. This is evident when making three decisions: (i) how to choose the law; (ii) when to choose the law; and (iii) which law to choose. This principle was previously regulated by Article 3 of the Rome Convention and there was a tradition. Nevertheless, the rule under Rome I has established some features that make such a solution extremely innovative, and party autonomy is the central legal tool chosen by the parties. However, this does not mean that there are not limitations. On the contrary, there are established several limitations that limit the party autonomy [18, 232]. and which will be introduced in details in the below treatments.

Contrary to at the EU level, Kosovo as a non-member of EU and as a state in consolidation of all fields, also has its specificities in the legal system. A

very important sphere of the legal system is international private law, which is considered to be one of the most complex parts of legislation in Kosovo. After the destruction of Yugoslavia, Kosovo did not approve a new law but went ahead with the same law – *Act on Resolving the Conflict of Law with the Regulations of Other Countries in Certain Relations* [1]. In order to avoid this situation and modernise this field of law according to the new European legal trends, currently the initiative is being taken by the Government of Kosovo to promulgate the new Law on Private International Law [13]. This draft-law is approved by the Government and it is in the last procedure within the Assembly of Kosovo.

The Act on Resolving the Conflict of Law with the Regulations of Other Countries in Certain Relations (*hereafter referred as: KPIL*) provides different organisations of rules compared to Rome I Regulation. It is separated into six sections: (i) Basic principles (Article 1–13); (ii) Applicable law (Article 14–45); (iii) Jurisdiction and procedure (Article 46–85); (iv) Recognition and Enforcement of Foreign Decisions (Article 86–101) and (vi) Special provisions (102–108); Transitory and final provisions (Article 107–109). As a result of this form of regulation, section two (applicable law) is the subject of this paper. However, in several cases it has to be connected with section one in which the general principles that are applicable also for the principle of party autonomy are found. Furthermore, as can be seen from the above treatments, the KPIL regulates both contractual and non-contractual obligations in the same section. Nevertheless, a distinction must be made with regard to the application of the party autonomy principle. The KPIL recognises party autonomy to contractual obligations contrary to non-contractual obligations in which this principle cannot be used. By contrast to this, it seems that the draft-law (*hereafter referred to as: DKPIL*) has as its base the above-mentioned EU regulations and is completely harmonised with regard to law which is applicable to contractual and non-contractual obligations.

This article will deal with party autonomy in contractual obligations, its limitations, as well as any differences and similarities between the mentioned EU Regulation (Rome I) and Kosovo law. Firstly, the Rome I Regulation will be illustrated and after this the situation under current Kosovo law will be pointed out and accompanied with the new trends according to the draft-law.

II. Party autonomy under the Rome I Regulation on the Law Applicable to Contractual Obligations

The most important conflict rules regarding contracts are found in the Rome I Regulations on the Law Applicable to Contractual Obligations. It should be noted that Rome I Regulation does not give the definition of the contractual obligations. Moreover, this concept has to be understood in line with national law [6, 206]. Pursuant to Article 1 of this regulation, it is determined that it shall apply in situations involving a conflict of laws, to contractual obligations in civil and commercial matters, and it has four chapters and, in total, twenty-nine articles. The Rome I Regulation recognises the well-established principle of party autonomy, or the right of the parties to come to an agreement with one another on the legal system applicable to their contract, although there are certain restrictions [5, 123]. This principle of party autonomy states that parties may make a choice as to the applicable law [10, 344] and when a choice is made by the parties this should be decisive; only in situations in which no choice is made should courts resort to determining objective connections [17, 31]. This principle is very well described in Article 3 (1) of the Regulation that is called “*freedom of choice*” and states: “*A contract shall be governed by the law chosen by the parties. The choice shall be made expressly or clearly demonstrated by the terms of the contract or the circumstances of the case. By their choice the parties can select the law applicable to the whole or to part only of the contract*”.

Compared to this definition provided by Rome I, Article 19 of the KPIL determines a narrower concept

as shown by the following: “*The law applicable to contracts shall be the law chosen by the parties, unless otherwise provided for in this law or in an international treaty*”. Contrary to this current regulation, under DKPIL Article 75 is clearly shown that the Rome I and DKPIL are identical, or in other words, the Kosovo draft-law is a copy-paste regulation of Article 3 (1) Rome I Regulation. It is worth mentioning that regional countries (i.e., North Macedonia) have also made the same solution taking the full regulation by Rome I Regulation. As a summarisation of the rules provided by these three acts, it is necessary to illustrate the following issues.

2.1. The law chosen by the parties

The wording “*the law chosen by the parties*” is determined by three mentioned legal acts and its meaning requires interpretation. In principle, under Rome I Regulation, it is considered that the parties can choose any existing legal system they wish (i.e., a system with widely known and particularly developed rules for the type of contract involved, a legal system they perceive as neutral, or simply a legal system they both happen to be familiar with) [5, 122]. The legal system has to be understood as a legal system of every state. It should be pointed out that parties cannot choose a non-state law, nor the principles and rules of the substantive law of contract recognised internationally or in the Community [14, 254]. Under Kosovo law, regarding these situations, there are no doubts that parties decide on the law that will govern for their contractual obligations. Such a conclusion is not treated under Kosovo legal doctrine which is very limited on this issue. However, in the author’s opinion, as a consequence of similar regulation, the same legal approaches can be concluded for Kosovo law just as for the above-mentioned Rome I Regulation.

2.2. The way to choose the law

This regulation by Article 3 (1) of the Rome Regulation I, clearly gives the power to the parties in the choice of law for contractual obligation. Furthermore, under this article such a freedom to choose has to be made expressly or clearly demonstrated by

the terms of the contract or the circumstances of the case. This means that the choice can be made in writing or orally [23, 272; 12, 2] but it has to be made expressly, and this does not mean that the parties are totally free to choose the law, because they have to choose the law lawfully and effectively [2, 516].

So far, Article 10 (1) of Rome I determines that *“the existence and validity of a contract, or of any term of a contract, shall be determined by the law which would govern it under this Regulation if the contract or term were valid”*. Moreover, in paragraph 2 it is mentioned that *“nevertheless, a party, in order to establish that he did not consent, may rely upon the law of the country in which he has his habitual residence if it appears from the circumstances that it would not be reasonable to determine the effect of his conduct in accordance with the law specified in paragraph 1”*. In comparison to Rome I Regulation, under the KPIL the way in which the law has to be chosen is not regulated. By contrary, as can be seen by the above compared notes, the DKPIL has the same wording as the Rome I Regulation. Nevertheless, the situations under Rome I and DKPIL have to be valid also for the KPIL despite the fact that there is a lack of such a written requirement. From a forthcoming legal regulation, it has to be mentioned that the DKPIL Article 82 (1 and 2) provides an identical regulation to that of Article 10 (1 and 2) of the Rome I Regulation.

2.3. By their choice the parties can select the law applicable to the whole or to only part of the contract

Pursuant to the regulation provided by the last sentence of the Article 3 (1), parties are allowed to subject different parts of their contract to different legal systems. In such a way, the parties can achieve such a *dépeçage* (In English: *splitting*, in German: *Spaltung*) by choosing different legal systems for different parts of the contract or by limiting their choice of applicable law to only a part of the contract [5, 124; 21, 353].

This regulation is provided in an identical form in the last sentence of Article 75 (1) DKPIL. By contrast, the KPIL does not recognise such a rule and in fact it is an unknown solution under Kosovo law.

Nevertheless, from a legal and practical point of view, provided that such a choice is not forbidden, the solution to choose the law applicable to the whole or to only part of the contract [4, 303] can also be applicable under current law.

III. Restrictions to party autonomy

Despite the fact that Rome I has advanced party autonomy, this does not mean that the choice of law is unlimited. Some limitations (restrictions) have been mentioned (not treated) above. Inter alia, in this regulation some limitations are provided that are determined by:

- Article 3 (1, 3 and 4);
- Article 4;
- Article 6 (2);
- Article 8 (1);
- Article 9; and
- Article 21.

Pursuant to the legal characteristics, all these restrictions can be separated into three categories such as the following.

3.1. Restrictions under Article 3 (1), 3 (3 and 4), 6 (2) and 8 (1)

Firstly, there is a limitation or restriction regarding the chosen law that is foreseen in Article 3 (1) of Rome I Regulation. Such a regulation means that parties cannot choose rules of non-states, but are forced to choose the law of a country. The use of the word “any law” is generally understood as underlining the conclusion that the choice must be for the laws of state [6, 133] and not for non-state. This requirement is fully recognised also under Kosovo law as a consequence that, under Article 19, the selection of law is clearly mentioned and has to be interpreted as a law issued by a state. The same situation is determined under DKPIL Article 75 (1).

Another restriction is provided under Article 3 (3) that states: *“Where all other elements relevant to the situation at the time of the choice are located in a country other than the country whose law has been chosen, the choice of the parties shall not prejudice the application of provisions of the law of that other country which cannot*

be derogated from by agreement". This is a restriction in the form of imperative norms [17, 73] and provides that the mandatory rules of a country will be applicable and will override any different rules in the law of another country [17, 74; 10; 345]. As can be seen in this regulation, the concept of mandatory rules is mentioned nowhere, so it can also be as *ius cogens* norms that cannot be changed from the agreement of the parties. Contrary to this situation covered by Rome I, under current Kosovo law this limitation is not applicable. Of course, the DKPIL provides the same regulation as the Rome I Regulation.

Another restriction is determined by Article 3 (4) which states: "*Where all other elements relevant to the situation at the time of the choice are located in one or more Member States, the parties' choice of applicable law other than that of a Member State shall not prejudice the application of provisions of Community law, where appropriate as implemented in the Member State of the forum which cannot be derogated from by agreement.*" This paragraph is strongly linked with the restriction and foresees that the selection of the non-Member State law by the parties will not prejudice the application of Community law. In addition, both provisions are concerned with the situations in which a choice of foreign law is the only international element in an otherwise purely domestic relationship [14, 75]. In fact, this provision is focused on the protection provided by the Community law to those legal relationships that are closely connected to any Member State of European Community and its goal is to prevent the efforts of the party to avoid mandatory rules. As for this regulation, it should be noted that under both the KPIL and DKPIL, such a rule is not determined. In this situation it is necessary to explain the position of the DKPIL. In the author's opinion, such a lack of regulation is due to the fact that Kosovo is not a member of the EU, and such a rule would not help such a selection of the law.

Articles 6 (2) and 8 (1) that deal with consumer contracts and individual employment contracts provide other restrictions as a consequence of the

provisions that cannot be derogated by a contractual agreement. This solution is not allowed under current law contrary to the DKPIL which provides an identical regulation to the Rome I Regulation (Compare Rome I Regulation, Article 6 (2) and 8 (1) and KPIL, Article 80 (3) and 81 (1).)

3.2. Restrictions under Article 9

Party autonomy is also restricted by overriding mandatory provisions. The concept of mandatory provisions is provided by Article 9 (1) of Rome I. It is worth mentioning that the mandatory provisions are different in nature from the imperative norms. Consequently, recital number 36 of the Rome I Regulation states: "*The concept of 'overriding mandatory provisions' should be distinguished from the expression provisions which cannot be derogated from by agreement' and should be construed more restrictively*". Where overriding mandatory provisions have to be applied, the court will not be required to decide which law would be applicable; by contrast, the court will automatically apply mandatory provisions of the law of the forum [21, 379; 17, 75]. Despite this, where a mandatory rule of law other than the applicable law is applied, this will not mean that the parties' choice of law is invalid, rather that it remains effective for all substantive issues, excluding for those aspects covered by the mandatory laws [17, 75].

As for Kosovo law, it should be reaffirmed that the current law does not contain such a regulation. Nevertheless, the Kosovo legal doctrine supports such a regulation, but very often it is considered near the public order [4, 345]. Finally, the DKPIL recognises this regulation in its identical form as a limitation. However, as it is a law that regulates different aspects of private international law, this limitation is provided by DKPIL Article 15 in the section of general principles. Consequently, it should not be seen as a separate rule but rather as a common rule in the meaning of legal effects.

3.3. Restrictions under Article 21

Another restriction within Rome I regarding party autonomy is the issue of public policy

[7, 130–159] in the forum that is determined by Article 21 of Rome I. Pursuant to this regulation, it allows courts to refuse the application of provisions of the applicable law determined by contractual parties, in the case that such an application would not be in line with the public policy of the forum.

Under Kosovo law, such a restriction of party autonomy under the rules of public policy (*ordre public*) is recognised. Consequently, under Article 4 of the KPIL it is determined that: “*The law of a foreign country shall not apply if its effects would be contrary to the fundamentals of the social system established by the Constitution of the Federal Republic of Yugoslavia*”. In this context, Yugoslavia does not exist anymore. Thus, in such a case the Constitution of the Republic of Kosovo has to be understood and which replaces the Constitution of the Federal Republic of Yugoslavia. Returning to the comparison of these two rules (Rome I and KPIL) with regard to public policy (order), generally we can conclude that there are no differences despite linguistic orientation, due to the fact that every state has its public policy. Lastly, the DKPIL provides an identical text to that of the Rome I regulation and there is therefore no comparison to be made between these two acts.

IV. Conclusion

Rome I is a big step forward towards the unification of private international law within the European Union. This regulation is directly in force in the EU and resolves almost all issues with contractual obligations, and a special place is given to the principle of party autonomy. The doctrine of party autonomy

has, since its introduction in the sixteenth century, evolved to become an internationally accepted conflict of laws principle. This principle now constitutes a fundamental choice of law rule. Compared to the aforementioned regulation, it has to be pointed out that under current Kosovo law that has been in force since the Yugoslavian time, the principle of party autonomy in contractual obligations is recognised, but its content with regard to this principle is much narrower compared to the Rome I Regulation. Recently, in Kosovo a new law has been drafted that is in the assembly and it seems likely that it will be approved very soon. Generally, we can conclude that with regard to the contractual obligations, the draft-law is a translation of Rome I and no difference between these three legal acts can be found.

Under Rome I, parties in principle have an unlimited choice of determine the applicable law, so party autonomy is known as dominant in the choice of law regarding contractual obligations. The parties can in fact choose any existing legal system they would like, pursuant to their legal interests. Nevertheless, there are also some restrictions on the party autonomy, for example concerning: (i) the choice of law made by the parties, (ii) the way in which the choice is made, (iii) the choice of law which must not contravene the application of the provisions that cannot be derogated from by agreement, in the event of a close connection with a single country, (iv) imperative norms of Community law, (v) overriding mandatory provisions, (vi) public policy of the forum and some other particular restrictions.

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