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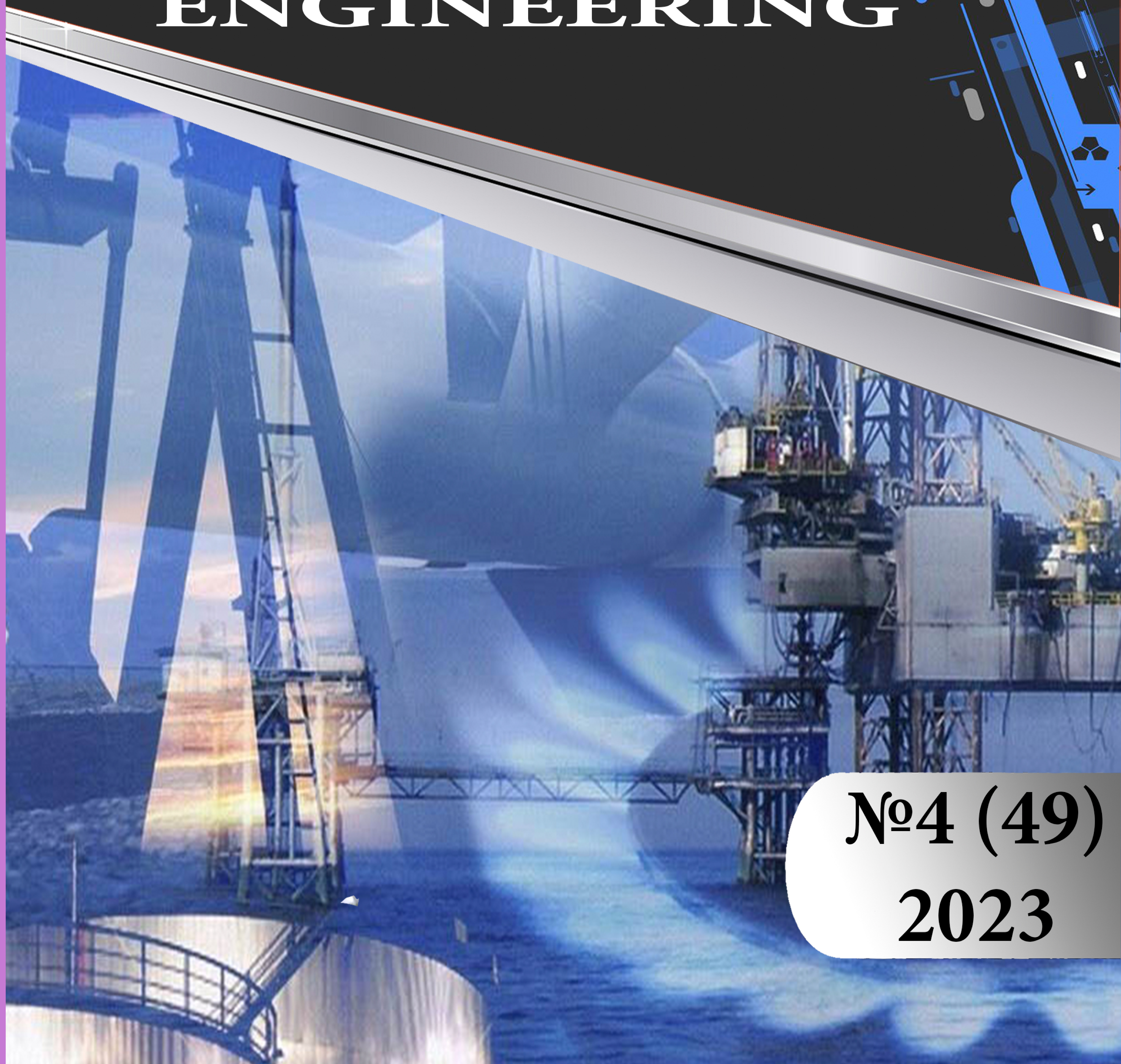

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Address:
Tauke khan avenue, 5
160012 Shymkent, Kazakhstan
Phone/Fax: +7 (7252) 21-19-82/21-19-89.
E-mail: ite_sksu@mail.ru

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Gulnora Ikhtiyarova - Dr.Chem.Sci., Professor, Tashkent State Technical University, Tashkent, Uzbekistan

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THE ROLE OF ENTREPRENEURSHIP IN THE NATIONAL ECONOMY IN THE REPUBLIC OF KAZAKHSTAN

Aidarova A.B.*, Tugizov E.T.
M. Auezov South Kazakhstan University, Shymkent, Kazakhstan
***Corresponding author's e-mail:** ab_moon@mail.ru

ABSTRACT

The purpose of the study is to identify the role of entrepreneurship in the national economy and propose ways to develop it.

In the course of the study, an economic analysis of the activities of small and medium-sized businesses using economic-statistical and systematization methods was carried out on the basis of official data.

The research paper considers the role of small and medium-sized businesses in the national economy in conditions of economic instability, which can be caused by the influence of internal and external factors. Especially in the crisis situation that has arisen due to the current geopolitical tensions, the objective need for the development of small and medium-sized businesses has been identified. The classification features of business entities are indicated and the state of comparative assessment with foreign experience is considered. In addition, the study of the external environment of entrepreneurship in the system of the national economy was carried out, the main indicators determining the role of small and medium-sized businesses were calculated, analyzes and conclusions were made.

The main conclusions that reflect the role and importance of small and medium-sized businesses in the system of the national economy are presented through the data of the conducted research and analysis. As a result of the analysis of business entities vertically and horizontally, their specific features and development prospects, potential are identified. Conclusions and proposals for the development of small and medium-sized businesses have been prepared.

Keywords: entrepreneurship, business environment, national economy, authorized capital, state support

INTRODUCTION

The continuity of the globalization process has brought the national economy and geopolitics closer together. Therefore, the current geopolitical tensions have had a negative impact on the economic system and have led to instability. In this regard, each state began to develop an operational action plan to prevent a deep crisis and heal the economy, taking into account the specific characteristics of the national economy. In particular, specific tasks were set to ensure the stability of the financial system, control and reduce inflation, improve the transport and logistics system, and support sectors of the economy. The importance of small and medium-sized businesses in solving these tasks is high. After all, it allows you to solve a number of important socio-economic tasks. The development of small and medium-sized businesses will contribute not only to reducing unemployment through the creation of new jobs, preventing the emergence of food shortages as a result of the development of domestic production, but also to improving the social situation of the population. That is why the president of the Republic of Kazakhstan K. K. In Tokayev's address to the population last year, he noted: «the share of small and medium-sized businesses in the gross domestic product by 2025 will increase by 35%, the number of employed people will increase by 4 million. «in the address» «New Kazakhstan: update and modernization» this year it was said: «it is important to ensure food security in the face of an extremely unstable international situation» [1; 2]. That is, the role of small and medium-sized businesses in the national economy is high and has not lost its relevance at any stage of economic development.

The purpose of the research work is to scientifically substantiate the role of small and medium-sized businesses in the economy in crisis situations using research methods. To achieve this goal, it is planned to substantiate the objective need for the development of small and medium-sized businesses, determine their role in the national economy, economic analysis of the development trends of small and medium-sized businesses, solve the tasks of determining development directions taking into account the specific characteristics of business entities.

MATERIALS AND METHODS

Scientific works of domestic and foreign scientists on the research topic, laws, regulatory acts, official statistical data of the National Bureau of Statistics form the theoretical, methodological and informational basis.

When preparing a small research paper, methods of collecting, grouping, processing, systematization of information, comparative assessment, methods of economic and statistical analysis were used.

RESULTS AND DISCUSSION

The business environment is the basis of the country's social development and determines the content and direction of possible actions of business people. The task of the company is to create a favorable business environment for entrepreneurs. Society in the material and spiritual sense, the more effective the economic process, the higher it is. The impact of the economic process depends on the number and quality of already existing entrepreneurs, as well as on those who are ready for this type of activity. The quality of existing entrepreneurs and the involvement of new entrepreneurs in this process depends on the rules of the game established by the state for this sector of public life. Consequently, the state should establish the rules of the game that are most consistent with the interests, desires and aspirations of entrepreneurs who are already functioning and are ready to enter the economic process.

The entrepreneurial environment is divided into an external environment independent of the entrepreneurs themselves and an internal environment directly formed by the entrepreneurs themselves.

The external environment of entrepreneurship is a complex multifaceted knowledge that includes a wide range of elements associated both with the subject of entrepreneurial activity – the company, and with each other, creating a kind of space in which processes that limit or activate entrepreneurial activity operate and develop. The microenvironment not only feels the influence of a particular entrepreneurial organization and adequately responds to its behavior in the market, but also has a significant formative impact on the style and nature of entrepreneurial activity. Together with elements of the microenvironment, the influence of factors of a «rigid» nature is manifested in the external environment of entrepreneurship. The macro-central external environment includes a wide range of elements such as natural, demographic, economic, environmental, scientific and technological, legislative, national, etc. To highlight the factors that determine the parameters of a particular entrepreneur, there must be a scientifically based classification that reflects the structure of macrofactors. Such a classification can be based on five large groups of elements reflecting various aspects of socio-economic relations: legal, economic, scientific and technical, social and environmental. Each of these elements has its own multicomponent structure.

The legal factor is the rules of the game in the business sphere, which are established by society for entrepreneurs.

Economic factors determine, first of all, the amount of cash that the consumer can direct to the market of a particular product, which forms the conditions of demand and the capacity of this market.

The group combining scientific and technical factors reflects the level of scientific and technical development, which imposes technical and technological restrictions on a particular type of entrepreneurship.

From the point of view of modern socio-ethical necessity, the social factors of the macroeconomic environment deserve special attention. An extended set of elements is united by environmental factors that represent the relationship between society and nature. Political factors are sometimes considered as independent environment-forming factors, but their influence on the state of a particular business is usually expressed through other factors.

The internal environment of entrepreneurship includes a wide range of elements that represent a set of conditions for the functioning of an entrepreneurial organization and is completely dependent on the entrepreneur.

When forming the internal environment of entrepreneurship, two of its components are distinguished: situational factors and elements of the internal environment. Elements of the internal environment-components of the enterprise necessary to achieve the goal. The main elements of the internal environment of the enterprise are marketing, R & D, personnel, finance and production. Production, in turn, includes supply, production and sale. Production consists of the following interrelated elements: objects of labor, means of labor, labor, functions and structure. Situational factors of the internal environment of an entrepreneurial organization are internal variables created by an entrepreneur on the basis of an analysis of the external environment and used to determine the boundary conditions for the functioning of an entrepreneurial organization. The main situational factors include: the goals of entrepreneurship; ethics and culture of entrepreneurial activity; intra-firm entrepreneurship.

To assess the role of small and medium-sized businesses in the country's economy, it is necessary to pay attention to a number of indicators::

- specific weight of small and medium-sized businesses in the total number of all entities;
- the share of small and medium-sized businesses in gross domestic product;
- number of people employed in small and medium-sized businesses;
- the share of products produced in small and medium-sized businesses in the total volume of production.

In the system of the national economy, small and medium-sized businesses have always been a priority.

As a result of the economic reforms implemented in the first years of independence, the necessary prerequisites for the formation and development of small and medium-sized businesses were formed. In connection with the market economy, the number of business entities increased and began to develop rapidly through the implementation of programs of nationalization and privatization. Especially in the first years, when the share of intermediary activities increased, gradually more entrepreneurs were involved in the sphere of production and trade. The rich mineral resources and raw material base of Kazakhstan have contributed to the development of business. Small and medium-sized businesses are reflected in various forms of economy in the sectors of the economy. Especially since the 2000s, an integrated approach to Business Development has been developed and special attention has been paid.

In the practice of developed countries, small and medium-sized businesses are characterized as a tool for the formation of the middle class. They account for more than 90% of all business entities, and their share in the gross domestic product is quite high compared to our country.

Based on the official data available from the Bureau of national statistics of the agency for Strategic Planning and reforms of the Republic of Kazakhstan, let's analyze the dynamics of the development of small and medium-sized businesses by the share of gross domestic product, regions and types of services [14].

One of the most important indicators that allows us to assess the role of business entities in the national economy is their share in gross domestic product. We can see it in Table 1.

Table 1-The share of small and medium-sized businesses in the gross domestic product, %

	2017y	2018y	2019y	2020y.	2021y.	Growth rate, %
Share of small and medium-sized businesses in GDP, %	26,8	28,4	31,7	32,8	33,5	6,7
Note - stat.gov.kz according to the website[14]						

As can be seen from the data presented in the table, the growth over the past 5 years has been 6.7%. Although growth dynamics are observed, this is a very small value for six years. In 2020, this indicator was calculated according to the new methodology. Therefore, there is an increase. As for the real situation, in 2020, due to the pandemic, business activity decreased, and due to quarantine measures, many business entities were forced to temporarily suspend their activities. In this regard, such unfavorable conditions as a decrease in demand, a decrease in revenues, the presence of interruptions in the activities of counterparties, nonfulfillment of obligations in full, and termination of contracts have occurred. All this had a negative impact on the results of the activities of small and medium-sized businesses, respectively.

In order to reflect the dynamics of development of small and medium-sized businesses, it is advisable to analyze the actual functioning of small and medium-sized businesses, not registered ones. It can be seen in Table 2.

As can be seen from the calculations made in the second table, over the past 5 years, the number of active small and medium-sized businesses has increased by 285,653 units or 24.9%. But, this does not mean a high intensity for the period in which the analysis is being carried out. The annual growth is only 1%. We see that the highest growth is in small enterprises, while the number of active medium-sized enterprises, on the contrary, decreased from year to year and increased in 2021.

Table 2 – In 2017-2021 years, active small and medium-sized businesses (SMEs), units

	2017y.	2018y.	2019y.	2020y.	2021y.	Growth (decline) dynamics	
						+/-	%
Active SMEs	1145994	1241328	1330244	1357311	1431647	+285653	124.9
Small business	208742	231325	258365	280200	299737	+90995	143.6
medium-sized businesses	2618	2620	2502	2486	2754	+136	105.2
Individual entrepreneurship	747107	809115	855920	857910	907722	+160615	121.5
Peasant farming	187527	198268	213457	216715	221434	+33907	118.1
Note - stat.gov.kz according to the website [14]							

In 2021, 63.4% of existing small and medium - sized businesses in the country were individual entrepreneurs, 20.9 % - small enterprises, 15.5 % - peasant (farm) farms, 0.2 % - medium-sized enterprises. As can be seen from the calculations, individual entrepreneurship has become a priority in number due to its own characteristics and advantages. The number of medium-sized enterprises has a very small share. However, this does not indicate the inefficiency of medium-sized enterprises. On the contrary, it is necessary to identify and propose solutions to current problems inherent in medium-sized enterprises. In our opinion, the dynamic development of small businesses is influenced not only by its advantages, but also by special attention from the state, the availability of state support tools.

During the crisis, the role of small and medium-sized businesses in the national economy will increase. This is due to the fact that the country has a direct impact on creating new jobs and reducing unemployment. The number of people employed in small and medium-sized businesses during the analyzed period is set at 3 times.

As can be seen from the calculations made in the 3rd table, over the past 5 years, the number of people employed in small and medium-sized businesses has increased by 321485 people or 10.1%. The highest growth in the number of employed (+186994 units or 14.4 %) is typical for small businesses. The number of people employed in individual entrepreneurship increased by 126264 people or 10.2%, in peasant farming-by 18517 people or 6.5%, in medium-sized businesses-by 10290 people or 2.8% over five years. These data indicate the need to pay attention to improving the efficiency of small and medium-sized businesses.

Table 3-Number of people employed in small and medium-sized businesses (SMEs), people

№		2017y.	2018y.	2019y.	2020y.	2021y.	2021y. 2017y.	
							+/-	%
1	Number of employed in SMEs	3190133	3312457	3448727	3472606	3511618	+321485	110,1
2	Small business	1301826	1351882	1408192	1462391	1488820	+186994	114,4
3	Medium-sized businesses	361393	364888	364865	355934	351103	-10290	97,2
4	Individual entrepreneurship	1240876	1315162	1378884	1353776	1367140	+126264	110,2
5	Peasant farming	286038	280525	296786	300505	304555	+18517	106,5
Note - stat.gov.kz according to the website[14]								

Structurally, in 2017, the share of employed people worked in small businesses – 40.8%, medium - sized businesses – 11.3%, individual businesses - 38.9%, peasant or farm farms - 9%, in 2021 - 42.4%, medium – sized businesses - 10.0%, individual businesses-38.9%, peasant or farm farms-8.7%. Calculations show that for 5 years, no significant structural changes have occurred.

One of the most important indicators characterizing the role of small and medium-sized businesses in the national economy is the volume of products produced. It is shown in Table 4.

Table 4-Volume of products produced in small and medium-sized businesses, mln. tenge

№		2017y.	2018y.	2019y.	2020y.	2021y.	2021y. to 2017y	
							+/-	%
1	Number of employed in SMEs	23241125	26473049	32386960	33626992	41952637	+18711512	180,5
2	Small business	16488047	18272335	22947233	23401108	28446662	+11958615	172,5
3	medium-sized businesses	4045875	5118377	5929183	6462457	7681356	+3635481	189,8
4	Individual entrepreneurship	1554704	1764985	1902754	1729842	3404453	+1849749	219
5	Peasant farming	1152499	1317352	1607790	2033585	2420166	+1267667	210
Note - stat.gov.kz according to the website[14]								

As can be seen from the calculations made in table 4, over the past 5 years, the volume of manufactured products has increased by 80.5%. In peasant farming, it increased by 2 times, in medium-sized businesses-by 89.8%, in small businesses-by 72.5%. And the growth of production in individual entrepreneurship increased by 2 times. However, in 2021, small and medium-sized businesses accounted for 67.8% of the output, medium-sized businesses accounted for 18.3%, peasant or farm farms accounted for 5.8%, individual businesses accounted for 8.1%. All this indicates the high production potential of small and medium-sized enterprises. They accounted for 86.1% of the products produced in small and medium-sized businesses.

CONCLUSION

Based on the conducted research and calculations, the role of small and medium-sized businesses in the system of the national economy is beyond doubt. Arguments can be given to it based on specific quantitative data such as:

- the number of active small and medium-sized businesses in the total number of all active economic entities in the country is 84.3 % ;

- over the past 5 years, the number of existing small enterprises has increased by 24.9%;

- during the analyzed period, the volume of products produced in small and medium-sized businesses by 10.1% increased by 80.5%, while 72.5% of products produced accounted for 89.8% of small and medium-sized enterprises.

Thus, despite the High role of small and medium-sized businesses in the national economy, the real results are not at a satisfactory level. The number of people employed, especially in medium-sized enterprises, remains low. But the production potential is high. Therefore, it is necessary to pay special attention not only to small businesses, but also to medium-sized businesses in the country. This was stated by the president of the Republic of Kazakhstan K. K. Tokayev in his address to the people of September 1, 2023, «there are not many successful medium-sized enterprises actively operating in the country's market. They need support. It is necessary to develop a clear plan for each of such enterprises. Thus, it is necessary to increase their production capacity and increase the volume of products two or three times.

It is advisable to combine the programs «business roadmap» and «economy of simple things». It should be transformed into a comprehensive program that supports small and medium - sized businesses» [15].

Support measures taken by the state, in particular the presence of a moratorium on various inspections, exemption from corporate income tax for small businesses, the provision of subsidies and other benefits, have a positive impact on the development and efficiency of business. However, small and medium-sized businesses are also gaining priority in the sphere of trade and services. Therefore, active work should be done to diversify the development of business entities, develop them in the production sphere. It is possible to achieve real results only if the state support is carried out comprehensively and systematically.

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ANALYSIS OF APPROACHES TO UNDERSTAND THE ESSENCE OF THE ECONOMIC POTENTIAL OF THE CONSTRUCTION INDUSTRY

Aidarova A.B.[*], Isaev K.A.
M. Auezov South Kazakhstan University, Shymkent, Kazakhstan
[*]**Corresponding Author's Email:** ab_moon@mail.ru

ABSTRACT

Today, one of the main problems facing modern Kazakhstani construction enterprises is the search for ways to increase competitiveness, ensuring their optimal development and maintenance of activity in a continuously changing external environment. This problem, combined with a whole range of similar problems, does not seem to be new for a modern enterprise, and one of the reasons for this situation, in our opinion, is the inability to assess the economic potential at the disposal of the enterprise and manage its development.

Despite the variety of theoretical, methodological and methodological approaches to the formation and quantification of the level of economic potential, an integrated management system for its development, taking into account the peculiarities of the construction industry, has not yet been proposed.

Meanwhile, the interest of construction organizations operating in an unstable operating environment in adequately assessing and finding ways to fully realize their economic potential is very strong.

Determining the level of use of economic potential and reserves for its increase will allow construction companies to improve not only technologies, but also ways of organizing the construction process in order to gain additional competitive advantages and gain leading positions in the market.

Keywords: potential, economic potential, construction, construction industry, analysis, enterprise

INTRODUCTION

In modern conditions of development of Kazakhstan and the world economies, the development of many enterprises in the construction industry cannot be considered as sustainable and effective. The reasons for this situation are the insufficient use of modern innovative technologies by construction organizations, the low level of use of available resources, underestimation of various external factors, losses in production due to the lack of necessary control over technological processes. The response of each enterprise to changes in the micro and macro environment should be the development of an optimal strategy for the formation and development of the economic potential of the enterprise.

The problem of developing economic potential is complicated by the strengthening of intra-sectoral differentiation of enterprises in the construction industry. According to the author, the key factor determining such differences in the results of financial and production activities of construction organizations is a different level of economic potential, in other words, a different combination of available resources and the ability to use them effectively.

There is still no single approach in science to understanding the essence of the concept of «potential» in the broadest sense of the word. It is necessary to turn to the etymology of the concept of «potential» in order to most scientifically and reasonably assess one or another definition of «economic potential». Initially, the term «potential» was interpreted from the Latin word potentia, meaning hidden possibilities, powers, forces, and implies a set of available means, capabilities in any field [1].

If we consider the history of the emergence of this category in our country, then initially the economic potential was characterized by the power of the state as a whole. That is, at first the category of economic potential appeared at the macro level. The modern economic dictionary defines economic potential as «the aggregate ability of a country's economy, its industries, enterprises, and farms to carry out production and economic activities, produce products, goods, and services, meet the needs of the population, social needs, and ensure the development of production and consumption».

In the economic literature, there is no unambiguous interpretation of the economic potential of an enterprise in the construction industry, its components and factors determining its magnitude, although a number of foreign and domestic economists have addressed this problem. In particular, Olve N., Roy J., Vetter M. [2], Ryan B., Bogataya I.N., Kovalev V.V., Sosnenko L.S., Simionov, R.Yu., Asaul A.N., Muravyev A.S., Oleinikov E.A., Filin S.A., Yunusova I.I., Zhigunova O.A., Tatarkin A.N. et al.

There is a wide range of opinions and interpretations in the works of the above-mentioned scientists and practitioners.

For example, B. Ryan [3] gives the following definition of the organization's potential. «The potential of an organization represents its real or probable ability to perform purposeful work. The potential of an organization can be created by its participants, who consistently invest their individual efforts, or through the contribution of external participants».

Kovalev V.V. [4] under the economic potential of an enterprise, he understands «the ability of an enterprise to achieve its goals using its available material, labor and financial resources».

Bogataya I.N. [5] defines the potential of an enterprise as assets, sources of asset formation and their ability to bring certain financial results during the implementation of production and economic activities.

Sosnenko L.S. [6] draws attention to the fact that for an enterprise as an open system, the possibilities of using available resources are associated not only with internal conditions, but also with a set of external factors (political, legal, social, economic). The economic potential of an automobile is defined as the ability of an enterprise to continue its activities based on the availability of resources. A cost estimate of resources is proposed, the effectiveness of further use of which is determined by the degree of financial stability of the enterprise and environmental conditions.

Simionov R.Yu. [7] defines economic potential as «the ability of an enterprise to create, preserve, develop and actively use tangible and intangible assets, human resources and business environment opportunities to ensure competitive activity».

According to O.A. Zhigunova [8], «the economic potential of an enterprise is an integral characteristic of the possession of aggregate abilities and the availability of real opportunities (as a result of the creation of certain conditions and (or) the occurrence of circumstances) caused by the interaction of the external and internal environment, to ensure its sustainable development and the achievement of strategic goals based on the rational use of the system of available resources».

MATERIALS AND METHODS

Scientific works of domestic and foreign scientists on the research topic, laws, regulatory acts, official statistical data of the National Bureau of Statistics form the theoretical, methodological and informational basis.

RESULTS AND DISCUSSION

The considered approaches to the definition of economic potential allowed us to identify the following areas in the interpretation of this term:

– economic potential as a set of available resources (resource direction);

– economic potential as the ability of production forces to achieve a certain result (effective direction);

– economic potential as a complex structured economic category, including a set of available opportunities, means and resources, interacting with the external and internal environment, allowing for sustainable development and achievement of set goals (an integrated approach).

In the resource direction, the assessment of economic potential is reduced to determining the cost of available resources without determining the purpose of use. In the second case, attention is focused only on the results of using the economic potential. Therefore, an integrated approach deserves attention, according to which the features are generalized and the contradictions between resource and productive directions are erased. It is on the basis of this approach that the economic potential is considered as the ability of an enterprise to produce competitive products with the effective use of available resources, taking into account the set goals and environmental conditions.

In order to understand the nature of economic potential in more detail, it is necessary to consider its composition or how the authors reveal the scope of this concept.

Many scientists [9], [10] suggest using a system of indicators to assess the economic potential of an enterprise, which covers two types of potential: production and financial.

To assess the production component of the economic potential, the following groups of indicators are used:

– indicators that characterize the state of the main production assets of the enterprise (the coefficient of renewal of fixed assets; the coefficient of depreciation of fixed assets; capital return; profitability of the use of fixed production assets);

– indicators that characterize the state of the company's workforce (profit per employee, labor productivity);

– indicators that characterize the state of innovative activity of the enterprise (the share of the amount of research costs in the total amount of capital investments, the share of innovative goods in the total volume of goods sold, research costs per employee, the coefficient of availability of qualified personnel).

The following groups of indicators are used to assess the financial component of economic potential:

– indicators that characterize the structure and condition of the company's capital (equity ratio, the proportion of borrowed capital in total investments, the coefficient of financial independence; the structure of sources of borrowed capital).

– the indicator that characterizes the security of the company's obligations with available resources is the current liquidity ratio;

– indicators that characterize the state of business activity of the enterprise (the coefficient of turnover of assets of the enterprise, the coefficient of capital turnover);

– indicators that characterize the level of efficiency of the company's capital management (return one quity, assets, sales, etc.).

The criteria proposed above allow us to evaluate and consider various aspects of the company's activities, namely:

– the effectiveness of the application and the level of depreciation of fixed assets, the importance of this area is due to the fact that the state of fixed assets directly affects the prospects of the enterprise for the production of competitive products, since it is impossible to produce modern equipment on morally and physically outdated, unsuitable for operation, high-quality products in demand in the commodity markets;

– the level of development of labor resources, the importance of indicators of the company's provision with highly qualified personnel is characterized by the fact that they depend on the efficiency of the staff: the final volume of products, their quality and, as a result, the implementation of various production programs on time, the effectiveness of the use of fixed production assets;

– the innovative activity of the enterprise, which is currently a priority indicator, contributing to the establishment of opportunities for the enterprise to produce products that are in high demand, meet the modern needs of customers, as it allows the use of all modern innovative and technical achievements in production;

– financial resources of the enterprise, which provide ample opportunities to improve all the other above-mentioned indicators: modernization and purchase of new production assets, introduction of technological innovations in the manufacturing process, training of personnel potential, organizational changes in the enterprise, etc. The complex of these changes allows to increase the efficiency of activities, competitiveness of products.

Some authors believe that in order to assess the economic potential, it is necessary to investigate three aspects of the company's activities:

– the financial and economic aspect of the activity, which is characterized by the enterprises' own resources - the summarized financial result and the attracted resources - the size of investments in the fixed capital of the enterprise;

– the labor aspect of the activity, which is characterized by the number of staff and the turnover rate;

– the innovative and technological aspect, expressed through the costs of the enterprise aimed at the development of innovative technologies and the volume of innovative products produced and sold.

According to O.A. Zhigunova [8], the formation of economic potential occurs both in the internal and external environment. According to the author, it is necessary to distinguish the following levels in its structure: production and technological, organizational and managerial, financial, marketing and environmental potentials. In turn, the production and technological potential is formed by property, labor, and innovation potentials, and organizational and managerial - organizational potential, management potential, and accounting potential.

In addition to the listed blocks as part of the economic potential, the authors also identify scientific and technical, informational, market, personnel, commercial potentials, etc. This proves once again that there is no consensus on the content and structure of economic potential, and this leads to different approaches to its analysis.

Thus, in order to achieve a full understanding of the economic potential of a construction company, it is necessary to determine the final composition of its structural elements (local potentials), as well as to identify their place and role in the overall structure of economic potential.

Taking into account the above, the author proposes to identify such components of economic potential as production, financial, personnel, organizational and managerial and competitive local potentials.

One of the main components of the economic potential of a construction enterprise is the production potential, an integral element of which in the activity of any enterprise is the production process. The production process is not a material element of production, but, nevertheless, forms of communication of the elements of production and is characterized from the qualitative side [8], which will increase the economic potential of the construction enterprise due to the optimal use of the technical characteristics of the equipment used, material and production stocks and compliance with construction technology.

The inclusion of financial potential in the structure of the economic potential of a construction enterprise is explained by the fact that the basis for the normal functioning of any enterprise is the availability of sufficient financial resources. Financial potential management will allow you to favorably influence the economic potential of a construction company through the rational use and distribution of financial flows.

The competitive potential ensures the connection of the enterprise with the external environment. The analysis of the competitive potential by means of studying the external environment will allow us to identify changes that affect various aspects of the construction company's activities, as well as determine which environmental factors may pose a threat, and which factors can be used to achieve the goals set.

Organizational and managerial potential contributes to the pooling of resources of a construction company in the process of economic activity in order to preserve and create competitive advantages. This potential is determined by the organizational structure and management methods.

And the most important component directly influencing the formation of the economic potential of a construction company is human resources. The human resource potential of a construction company occupies the main place, being its productive force. Absolutely all economic indicators of all other types of resources depend on the level of use of human resources, since the formation of a market management system in the country as a whole and in construction in particular creates conditions under which the importance of the human factor increases, therefore, knowledge, experience and skills of employees become the main source of efficiency and competitiveness of a construction enterprise.

CONCLUSION

In conclusion, it should be noted that the economic potential is not a constant value, and tends to decrease if, for a certain period of time, no actions are taken aimed at maintaining the economic potential and its development. Therefore, for the development of economic potential, it is necessary to constantly purposefully influence the management apparatus on the elements of potential. It is only through constant analysis and monitoring of key performance indicators, taking into account changing external macroeconomic indicators, that it is possible to respond promptly to the appearance of any manifestations of a decrease in all components of the economic potential of a construction industry enterprise.

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STADY OF COLLECTORS BASED ON LOCAL RAW MATERIALS OF UZBEKISTAN FOR FLOTATION BENEFICIATION OF MINERAL ORES

Abdikamalova A.B.*, Jumayeva G.Y., Kuldasheva Sh.A., Eshmeto I.D., Bukharov Sh.B.
Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, Tashkent, Uzbekistan
***Corresponding Author's Email:** aziza . abdik @ gmail . com

ABSTRACT

The study on creation and use of collectors based on liquid paraffins (LP) for flotation enrichment of sylvinite ore are devoted in this article. The flotation method of minerals beneficiation, including sylvinite ore, remains one of the key processes for increasing the concentration of valuable components. Although some collection reagents are available, there is a need to develop effective and cost-effective alternatives. In this regards it was offered a new approach to the use of LP-based apolar collectors and evaluates their performance in flotation under various conditions, including the presence of clay impurities and temperature changes.

Experiments carried out using modern analytical methods, including chemical analytical and chromatographic analysis, as well as physical and mechanical methods, have obtained results that represent important contributions to the field of flotation processes. Analysis of the activity of LP in comparison with imported collectors and their effectiveness under different flotation conditions emphasizes the significance of present study. The article also describes a new approach to the use of apolar collectors based on liquid LP for separation of potassium chloride from mixtures with different contents of the main component and clay impurities. Research on the influence of temperature and inorganic waste composition on collector efficiency provides new knowledge about the factors influencing the flotation process and suggests ways to optimize flotation conditions to increase concentrate yield. A significant difference from imported collectors is the optimal consumption, which ensures maximum separation of potassium chloride in the presence of clay impurities.

Keywords: collector, liquid paraffin, sylvinite, apolar collector, sludge, bottoms.

INTRODUCTION

In modern scientific and technical literature, the term "flotation" is widely used, which is used for various purposes, such as purifying water from organic substances and suspended solids, separating mixtures and accelerating sedimentation in various industries, including chemical, oil refining, food and others. Flotation is also one of the main technological processes for the beneficiation of most minerals, allowing the separation of fine particles in mixtures [1-4]. Flocculation processes have long been successfully used in ore processing processes, and probably the most extensive theoretical and practical experience has been accumulated in this area. Selective flocculation is the most promising method for the concentration and enrichment of minerals, allowing the extraction of especially valuable substances from natural raw materials [5].

The method of flotation enrichment of minerals is one of the most common processes that obeys the laws of colloidal chemistry. Currently, this method is becoming increasingly important, since it allows the enrichment of non-magnetic and fine ores with a complex composition, which cannot be enriched by other classical methods [6].

The flotation process is widely used to separate a wide variety of sulfide, carbonate and oxide minerals before their subsequent purification. Flotation technologies are also used to process phosphate minerals and coal feedstocks. Despite advances in these areas, active research continues to improve flotation processes for mineral processing. The problems and prospects of processing fine particles were investigated, methods were developed to optimize the processes of beneficiation of sulfide mineral raw materials, their stability and surface condition in aqueous solutions and pulps were studied, and the mechanism of oxidation and formation of chemical compounds under various flotation conditions was studied [7] .

In the chemical industry, one of the important stages of ore processing is the concentration and enrichment of metal compounds. For this purpose, flotation reagents are used, which are often imported. The main components of these flotation reagents are high-molecular aliphatic amines and liquid paraffins with the number of carbon atoms from C_{11} to C_{22} [8-11].

Sylvine flotation uses cationic reagents, including primary aliphatic amines, to form a hydrophobic shell on the surface of KCl, which ensures its connection with air bubbles and the rise of the concentrate into foam. However, the presence of clay impurities in the source ore can negatively affect the flotation process due to their dispersing effect and active adsorption of amines. From a scientific point of view, the fine clay fraction and salt slurries formed during ore preparation and flotation are of particular interest [12].

Instead of using aromatic hydrocarbons and kerosene, which can negatively affect selectivity and contain carcinogens, the authors suggest using fatty amines and mixtures of hydrocarbons. JSC "Dekhkanabad Potash Plant" in its work on the flotation of potassium chloride from sylvinite uses liquid paraffins with the number of carbon atoms from C_5 to C_{18} as part of flotation reagents.

Based on the above, this paper presents the results of research on the creation of flotation reagents for the flotation of sylvinite ore.

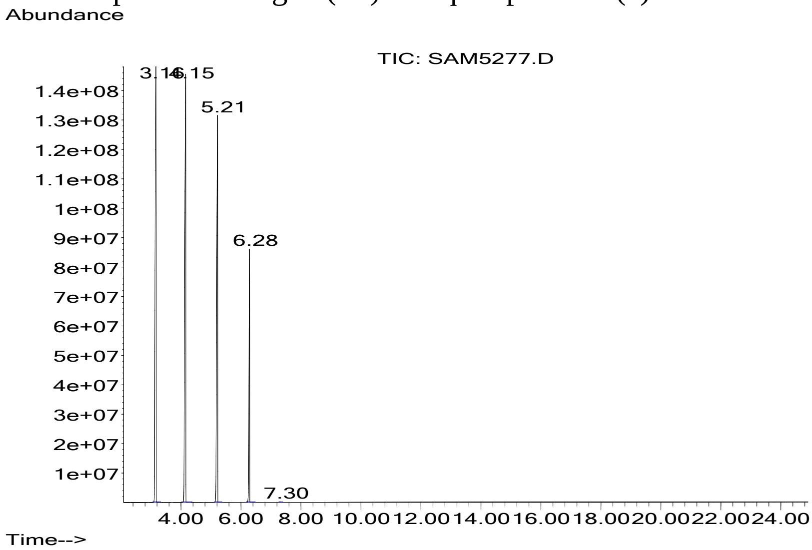
METHODS AND MATERIALS

For experimental studies, waste from Uz-KorGasChemical LLC was used, which is liquid paraffin and is formed by dissolving various hydrocarbons in hexane. Distillation was carried out to separate the liquid paraffin mixture, resulting in the highly volatile part and the main part of the product. The bottom residue remaining after distillation was separated by filtration. To identify the composition of the initial and resulting flotation reagent, chromium mass spectroscopy was used using an Agilent Technology GC 6890 / MS 5973N instrument. A 30 m×0.25 mm capillary column containing 5% phenylmethylsiloxane in dimethylsiloxane was used for analysis. Hydrogen was used as a gas carrier, and the temperatures of the injector, MS source and MS quadrupole were 280, 230 and 180°C, respectively. The column oven temperature was programmed from 100°C to 280°C with a temperature rise rate of

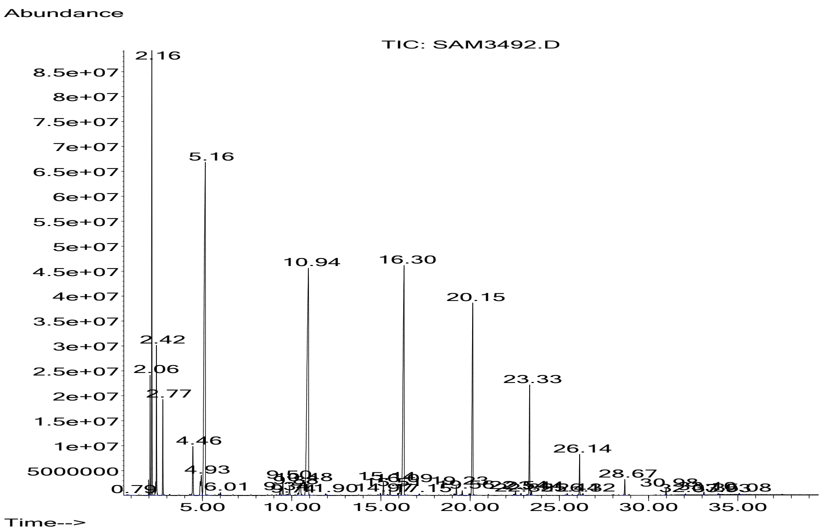
10°C/min. The sample volume was 1 µl. 3 model solutions were prepared with different concentrations, in which the mass ratios of NaCl and KCl were: 1:1 (P1), 1:0.5 (P2) and 1:0.25 (P3), and the total salt content in the solution was not exceeded 50.

RESULTS AND DISCUSSION

The resulting chromatogram is shown in Fig. 1(b). At the same time, this figure shows a chromatogram of an imported analogue (IA) of liquid paraffin (a).



a) 1 - Tetradecane; 2-Pentadecane; 3-n-Cetane; 4 - n-Heptadecane; 5 - n-octadecane;



b) 1) 2-methyl pentane; 2) 3- methylpentane; 3) hexane; 4) cyclopentane; 5) c yclohexane ; 6) 2-Ethylhexane ; 7) trans-1- e thyl-3- m ethylcyclopentane ; 8) n - octane; 9) e thylcyclohexane ; 10) octane; eleven) 5- m ethylnonan ; 12) 9-methyleicosane; 13) 3- methylnonan; 14) 2-heptenal; 15) decane **;** 16) 1- cyclohexyl ; 17) 4- e thyldecane ; 18) u ndecane ; 19) 3- methyl-undecane; 20) 1- hexyl -3-methylcyclopentane ; 21) dodecane **;** 22) 1- hexylcyclohexane; 23) tridecane; 24) 3-methyl- t ridecane ; 25) n- tetradecane; 26) 5-methyl t etradecane ; 27) p entadecane ; 28) n -hexadecan ; 29) nonyl - cyclohexane ; 30) 5-methyl- pentadecane; 31) n-octadecane ; 32) cyclohexylmethane; 33) n-eicosane ; 34) n- docosane; 35) 2- methyl - cyclodecanone; 36) n-Tetracosane ; 37) Z,Z-3,13- octadecedien -1-ol ; 38) hexacosane

Fig. 1. Chromatogram of the studied samples: a) IA; b) LP.

The results obtained show that the composition of the imported paraffin analogue includes hydrocarbons from C_{14} to C_{18}. However, the composition of the waste is multicomponent. It consists of low and medium molecular weight hydrocarbons of cyclic and acyclic structure. The chromatograms show peaks characteristic of unsaturated hydrocarbon radicals, as well as hydroxyl radicals, which disappear after the separation of the bottom residue. After distillation, the peaks characteristic of the isomers of pentane, hexane, and heptane also disappear.

The resulting low-boiling mixture consists mainly of the C_5-C_9 fraction. The presence of hydrophilic functional groups is not observed in their composition. Therefore, they can be recommended as a hydrophobic solvent for organic substances.

Liquid paraffins (LP) were studied as an apolar collector, and for comparison, an imported analogue (IA) was used, which is currently used for the enrichment of sylvinite ore at JSC “Dekhkanabad Potash Plant”. The results of the investigations are presented in Table 1.

As seen from Table 1 that the best results for the extraction of potassium chloride are achieved when using solutions with a higher content of the main component. If we compare the efficiency of these apolar collectors in terms of concentrate yield and KCl content , then with the same consumption of imported and developed collectors, the concentrate yield under the influence of the imported collector is 3.2% higher compared to the developed collector. However, when using the developed collector, the amount of KCl in the concentrate is 0.9% higher, which indicates its more selective action and high quality of the resulting product.

The obtained result has important practical significance and indicates the high selectivity of apolar LP based on local waste. A change in the mass ratio of the initial salts in model solutions leads to a noticeable change in the yield of the concentrate, but in the case of using LP, the purity of the concentrate remains relatively high.

Table 1. Results of flotation of model solutions at 22±1ºC

Index	Model solutions					
	P1		P2		P3	
	IP	LP	IP	LP	IP	LP
Exit, %:						
Concentrate	42.3	39.1	31.5	31.2	17.5	19.4
tail	57.7	60.9	68.5	68.8	82.5	80.6
Mass fraction of KCl, %:						
Concentrate	89.2	90.1	89.4	88.9	87.4	87.9
tail	21.26	24.25	7.55	8.12	5.70	3.84
KCl extraction, %:						
Concentrate	75.46	70.46	84.5	83.21	76.56	85.26
tail	24.54	29.54	15.5	16.79	23.44	15.74

It is known that increasing the temperature of the system increases the solubility of salts, especially potassium chloride, and increases its content in the mother solution. However, rising temperatures can also affect the activity of contaminants and collectors. Therefore, it is advisable to study the activity of apolar collector at different temperatures. In Fig. Table 2 shows data reflecting the results of such studies.

A b

Fig. 2. Concentrate yield during P3 flotation depending on temperature: a – collector consumption 10 g/t; b – collector consumption 15 g/t; 1) IA; 2) LP.

Under all temperature conditions studied, the use of IA leads to fairly high concentrate yields. An increase in temperature from 10 to 40ºC helps to increase this indicator by 23%, and an increase in IS consumption by 5 g/t increases the yield of concentrate from solution P1 by 5% even at low temperatures of the flotation process. A further increase in temperature to 45ºC does not cause significant changes.

Although at low temperatures the use of LP as an apolar reagent is significantly inferior to IS in terms of concentrate yield, increasing the temperature leads to an increase in the degree of concentrate formation. However, when using solution P3, the opposite effects are observed: a decrease in the concentration of the main component correspondingly leads to a decrease in the concentrate yield, but the KCl recovery values may exhibit opposite effects.

A comparison of the results of experiments on sylvite flotation showed that the apolar collector based on local liquid iron exhibits higher flotation activity compared to the imported analogue. This may be due to the presence of a larger amount of heavy fractions of closed-cycle paraffins in the composition of the liquid product. It is known that increasing the number of carbon atoms in the carbon chain increases the hydrophobicity of these apolar collectors and their ability to form hydrophobic films on the surface of sylvinite particles.

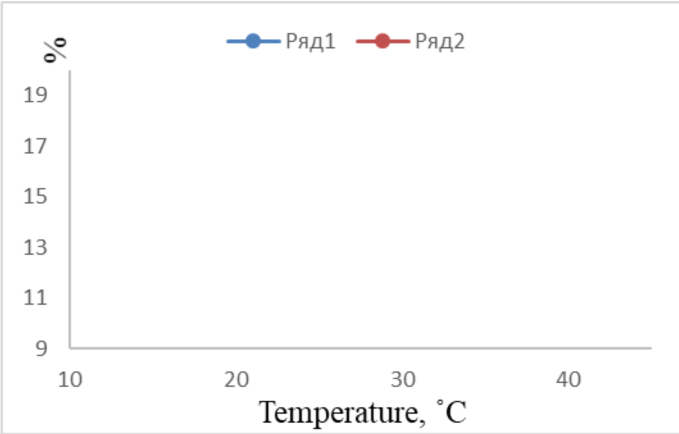
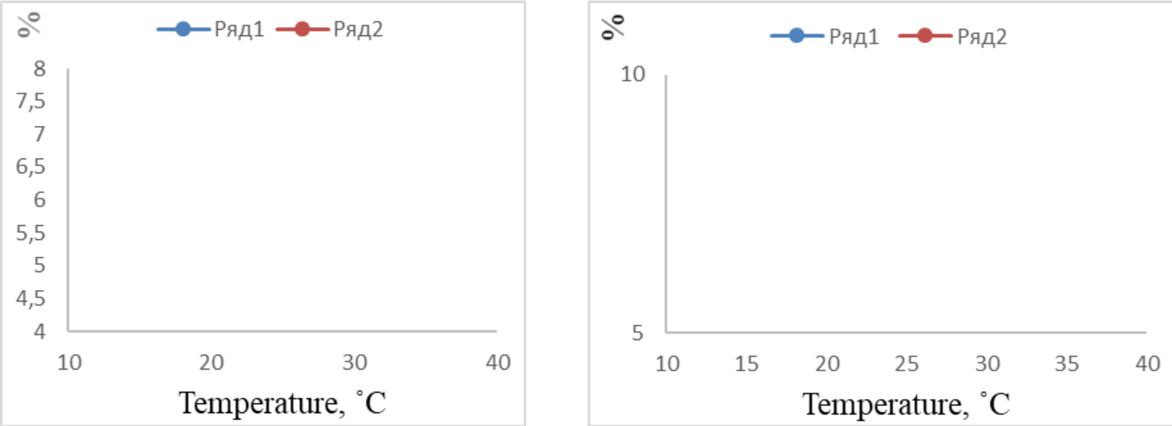


Fig. 3. Concentrate yield during flotation P1 depending on temperature (collector consumption 10 g/t): 1) IA; 2) ZhP.

Insoluble residue is a significant negative factor in the flotation process of mineral ores. Its quantity and composition, which can vary widely, affect the yield of the concentrate, the degree of its purification and the selectivity of flotation reagents. As noted earlier, the presence of clay impurities with temperature changes leads to a significant decrease in the relative extraction of potassium chloride. Therefore, experimental studies were conducted to determine the influence of the amount and composition of insoluble sediment on the efficiency of apolar collectors. Below are the results of these studies.

As seen from Fig. 4 that the studied LP sample is capable of creating conditions for the extraction of potassium chloride in the presence of both non-clayey and clayey impurities, which are close to the conditions created by standard apolar collectors, for example, IS. For this collector, the optimal flow rate, ensuring maximum extraction (89.1%) of KCl, is 14-18 g/t in the presence of non-clayey impurities. However, an increase in the content of clay minerals leads to an increase in collector consumption by 10-100% depending on temperature. Under such conditions, the optimal consumption of liquid iron is 15-30 g/t, and the extraction of KCl into the rough concentrate is 0.5-1.5% lower.



A b

Fig. 4. Effect of solution temperature and composition of the no. in an amount of 5% by weight of salts for a relative decrease in the degree of extraction of KS1: a) non-clayey impurities; b) clay impurities; 1) individual entrepreneur; 2) LP.

The obtained research results are important for the practice of flotation of sylvinite ore. They confirm the high selectivity of an apolar collector based on local liquid paraffin (LP). Even with a change in the mass ratio of the initial salts in model solutions, a relatively high purity of the concentrate is observed when using LP.

The temperature conditions of flotation also have a significant impact on the process. The use of an imported collector (IC) at low temperatures provides a good concentrate yield, and increasing the temperature improves this indicator. On the other hand, LP shows lower concentrate yield at low temperatures, but its efficiency increases significantly with increasing temperature.

CONCLUSION

An apolar collector based on local liquid paraffin exhibits higher flotation activity compared to its imported counterpart. This can be explained by the higher content of heavy fractions of closed-cycle paraffins in the composition of the liquid product. An increase in the number of carbon atoms in the carbon chain increases the hydrophobicity of apolar collectors and their ability to form hydrophobic films on the surface of sylvinite particles.

Research also confirms the important influence of the presence of clay impurities on the efficiency of apolar collectors. In the presence of clay minerals, the optimal consumption of liquid iron for maximum extraction of potassium chloride increases. These results provide important information for optimizing flotation conditions and increasing concentrate yield when beneficiating sylvinite ore.

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UDC 622.24.063.2

THERMAL STABILITY OF SYNTHESIZED WATER-SOLUBLE POLYMERS FOR DRILLING FLUIDS

Artykova Zh.K.*, Isa A.B., Kydyralieva A.Sh.
M.Auezov South Kazakhstan University, Shymkent, Kazakhstan
***Corresponding Author's Email:** articova@mail.ru

ABSTRACT

This article presents the results of experimental data on the preparation of a composite heat-resistant reagent for drilling fluids, including a modified copolymer based on polyacrylonitrile (PAN, by hydrolysis in the absence of a mixture of sodium hydroxide) and vinylsulfonic acid. A thermally stable composite reagent to polyvalent cations has been obtained, which reduces filtration and improves the anti-wear properties of clay suspensions. The thermal stability of the synthesized water-soluble polymers was determined by the results of thermogravimetric tests performed on a derivatograph. The ratio of monomers and modification conditions are selected, this ensures a high conversion of monomers, and also increases the yield of the final product. The synthesized polymer of acrylonitrile and in the presence of fatty acids of gossypol resin and sulfuric acid in the pH range = 3.5-5.5, with subsequent modification. The synthesized water-soluble polymer has a diphilic structure throughout the structure, the macromolecules of which contain a hydrophobic group and a hydrophilic part. They are able to adsorb and lower the interfacial free energy, which allows them to be classified as high-molecular surfactants.

Keywords: drilling fluids, rheological properties, composite materials, emulsifier-stabilizer, polyacrylonitrile

INTRODUCTION

Synthesis of composite highly acidic acrylic polyelectrolytes resistant to salt aggression and temperature for drilling deep wells in complicated conditions is the only way to solve the problem in a promising way. It is known that the creation of thermo-salt-resistant composite polymer stabilizers to regulate the rheological properties of drilling fluids can be achieved by using the method of copolymerization of strongly acidic monomers or the introduction of sulfo- and hydrophobic groups into the polymer chain. One of the methods for obtaining such polymers is the copolymerization of acrylonitrile with monomers of the corresponding nature (vinylsulfonic acid). Unlike weak acids, which include acrylic and methacrylic acids, the effect of the nature of intermolecular interactions on the radical polymerization of strong unsaturated acids has been studied to a much lesser extent. The literature mainly contains data on copolymerization of acrylamide and vinylsulfonic acid, as well as styrene sulfonic acid and its salts [1-3].

In this regard, the main regularities of copolymerization of acrylonitrile and vinyl sulfonic acid have been studied, or the introduction of sulfonic acid groups into the main polymer chain by sulfonation of weakly acid acrylic polymers, as well as the study of the properties of aqueous solutions of synthesized polymers to regulate rheological and filtration-technological properties, is very relevant.

The use of such methods allows the creation of multifunctional composite polymer stabilizers resistant to salt aggression and various temperature values. In addition, changing the composition of copolymers containing weak and strong acid functional groups, as well as the use of polymeralogical transformation methods, allows the production of new multifunctional composite polymer stabilizers consisting of macromolecules of various sizes, structure and composition. It should be noted that, unlike weak acids, which include acrylic acids, the effect of the nature of intermolecular interactions on the radical polymerization of strong unsaturated acids, as noted above, has been studied to a lesser extent. Each of these compositions determines the properties of multifunctional composite polymer stabilizers by enhancing the synergistic effect in the system.

The purpose of this work is an experimental study of the thermal stability of the previously synthesized water-soluble polymers (WSP) for drilling fluids.

MATERIALS AND METHODS

The thermal stability of the synthesized WSP was determined by the results of thermogravimetric tests carried out on a derivatograph of the F. system.Paulik, N.Paulik, A.Erdei. The method is based on the measurement of thermal effects depending on the temperature [4,5] of heat treatment at a heating rate of 5 ° C per minute.

RESULTS AND DISCUSSION

Figures 1-5 show the derivatograms of synthesized sulfonic acid WSP and the thermolysis stages of polymers.

To study the thermal stability of the proposed drilling fluids, samples were selected from 15% of the aqueous dispersions of montmorillonite clays of the Darbaza deposit, in the presence of synthesized sulfonic acid WSP, depending on the concentration in the system (0.01 – 1.0%). The results of the study of dynamic heat treatment show that all the samples subjected to destruction have basically two temperature regions. At the same time, the samples (Fig.1 - 0.01%, Fig.2 - 0.25%, and Fig.4 - 0.5%) have a similar character, i.e. It has a pronounced endothermic effect, which characterizes the removal of surface and hydrated moisture, which indicates an intense weight loss curve (TG)-70°C -220°C - 14.1% (Fig.6) and 60°C - 210°C – 15% (Fig.3).

The second endoeffect at 400oC is polymorphic transformations of siliceous and aluminate phases.

Vague exothermic effects in the 280 – 350°C region are characteristic of the process of burning out volatile and other organic compounds, weight loss (TG) -220 °C- 830°C – 13.4% (Fig.1) and 60°C - 210°C – 15% (Fig.3), and at 450°C and above, insignificant exoeffects of decomposition of sulfur compounds of weight loss (TG) -830°C - 880°C – 5.1%. (Fig.1) and 770°C - 890°C – 13% (Fig.3).

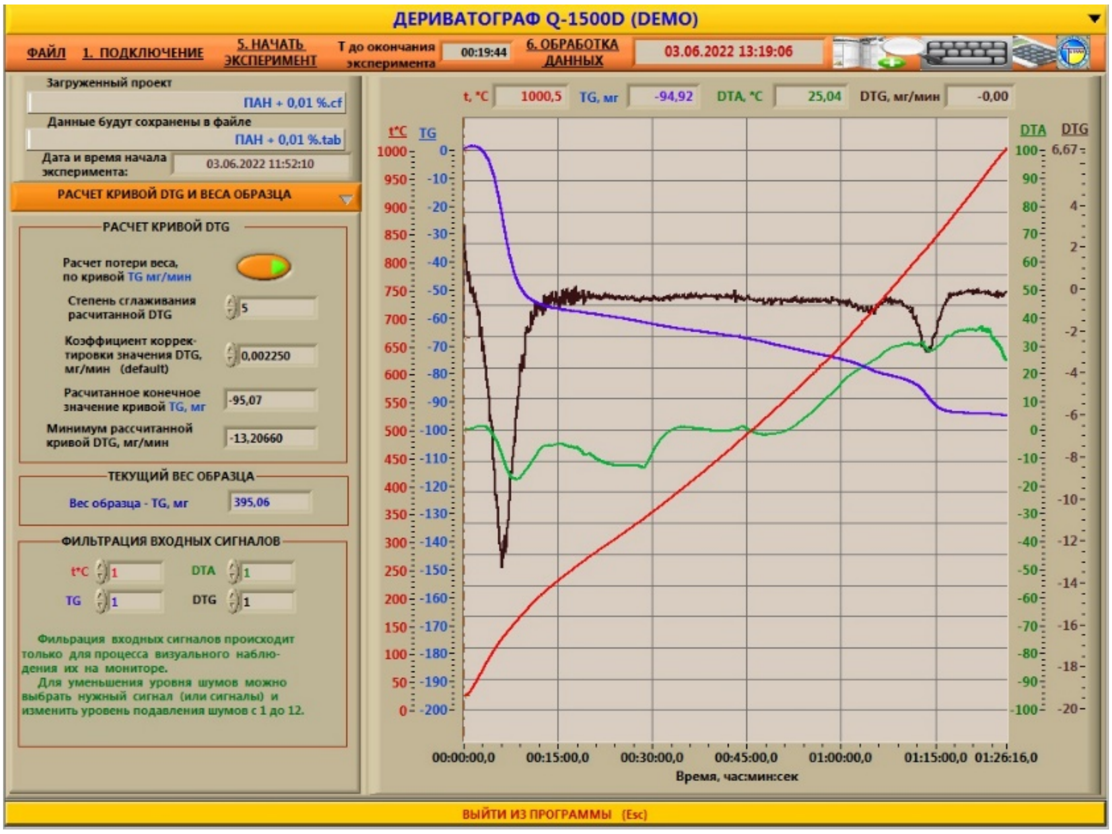

Fig.1. DTG 15% of water dispersions of montmorillonite clays of the Darbaza deposit in the presence of 0.01% synthesized sulfonic acid WSP

A sample of 15% water dispersions of montmorillonite clays of the Darbaza deposit in the presence of 0.1% synthesized sulfonic acid WSP (Fig.2) is characterized by three endoeffects and two exoeffects. The endoeffect in the region of 120 – 130°C is characterized by a pronounced change in weight, weight loss is (TG) -80 ° C -220 °C - 14.6%, which indicates the process of dehydration and removal of surface and crystallohydrate moisture.

Insignificant step-like endoeffects in the region of 320-350°C are characteristic of polymorphic transformations of aluminosilicate phases. The third curve of the endoeffect in the region of 830-850°C is characteristic of the decarbonization of magnesium – calcium carbonate compounds. At the same time, the weight loss was (TG) –220°C- 860°C – 56 %

A pronounced exoeffect in the 400oC region is associated with the burnout of organic and volatile compounds, and a non-intensive exoeffect in the 900°C region, apparently, characterizes the destructurization of sulfur–containing minerals, weight loss (TG) - 860 °C – 890 °C - 12.2%.

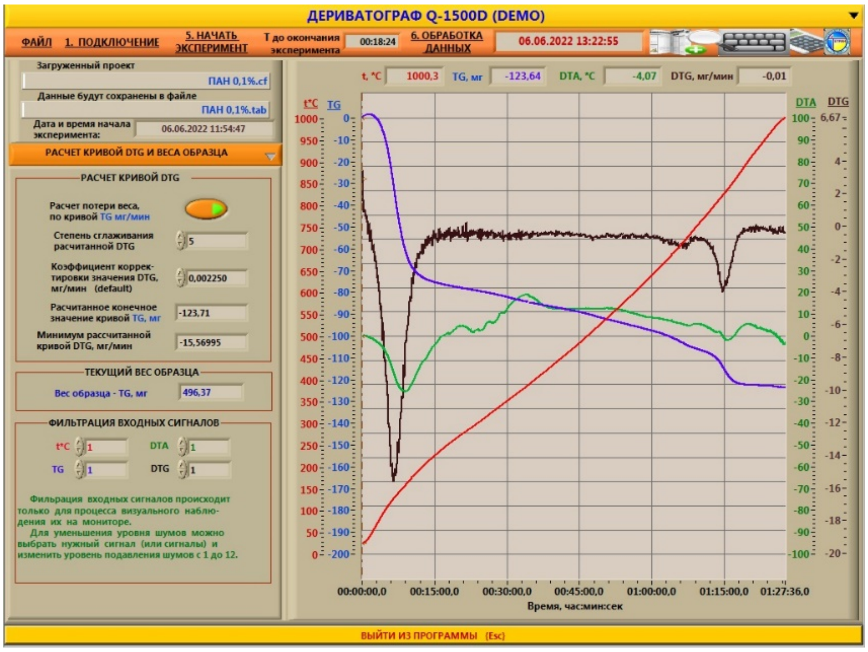

Fig.2. DTG 15% of water dispersions of montmorillonite clays of the Darbaza deposit in the presence of 0.1% synthesized sulfonic acid WSP

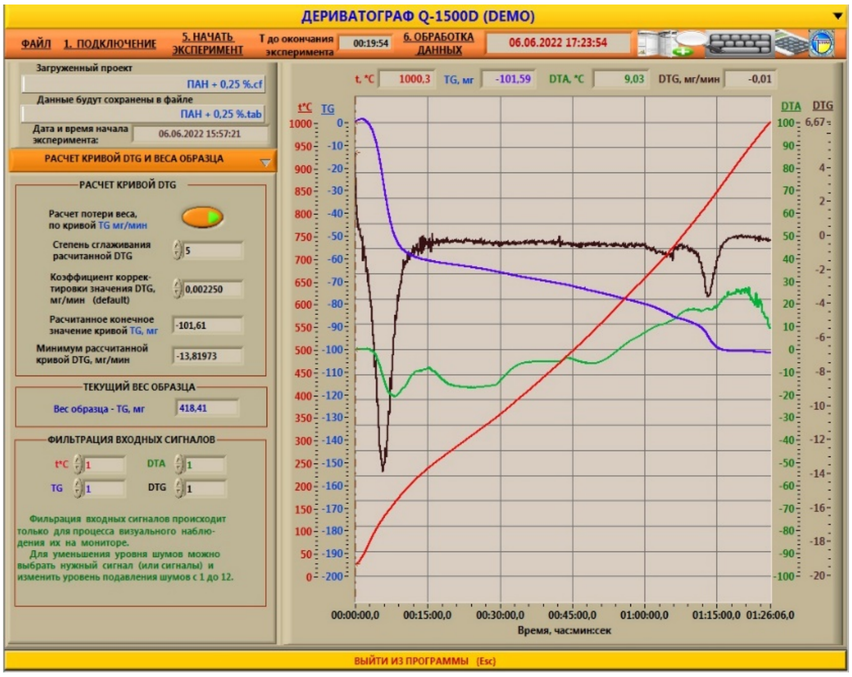

Fig.3. DTG 15% of water dispersions of montmorillonite clays of the Darbaza deposit in the presence of 0.25 % synthesized sulfonic acid WSP

A sample of 15% water dispersions of montmorillonite clays of the Darbaza deposit, in the presence of 0.5% synthesized sulfonic acid WSP (Fig.2) has a pronounced endoeffect, which characterizes the removal of surface and hydrate moisture, which indicates an intense weight loss curve (TG)– 70°C -220°C – 15%. The second endoeffect at 400°C is polymorphic changes in siliceous and aluminosilicate phases. Vague exoeffects in the region of 280-350°C are characteristic of the process of burning out volatile and organic compounds, weight loss (TG)-220 °C- 770 °C – 56%, and at 450°C and above insignificant exoeffects of decomposition of sulfur compounds, weight loss (TG)-770 °C - 860 °C – 12%.

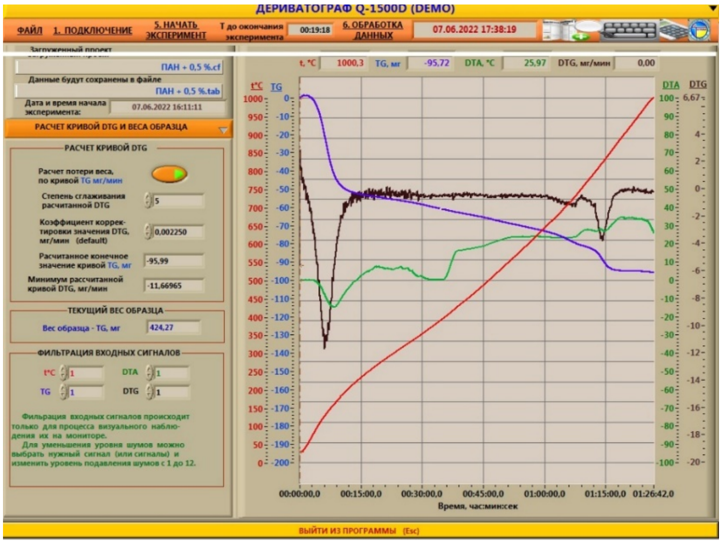

Fig. 4. DTG of 15% aqueous dispersions of montmorillonite clays of the Darbaza deposit in the presence of 0.5 % synthesized sulfonic acid WSP

A sample of 15% aqueous dispersions of montmorillonite clays from the Darbaza deposit, in the presence of 1% synthesized sulfonic acid WSP, is characterized by four vague endoeffects and three non-intense exoeffects. Endoeffects at 130-140, as well as at 830 °C are characterized by a significant weight loss of the analyzed sample. Moreover, the first characterizes the removal of crystallohydrate moisture, weight loss (TG) – 60 °C -220 °C – 13%, and the second decomposition of carbonate compounds, weight loss (TG) – 220 °C- 770 °C – 52%.and a third of weight loss (TG) – 3 – 750 °C - 880°C – 15%.

Intermediate endoeffects at 330 and 560 °C seem to characterize polymorphic transformations of aluminosilicate minerals. Exoeffect at 250°C indicates the burnout of volatile organic compounds exoeffect at 400 – 450^{o}C polymorphic changes of aluminum – silicon containing minerals, and at 720 – 750°C burnout of sulfur-containing components.

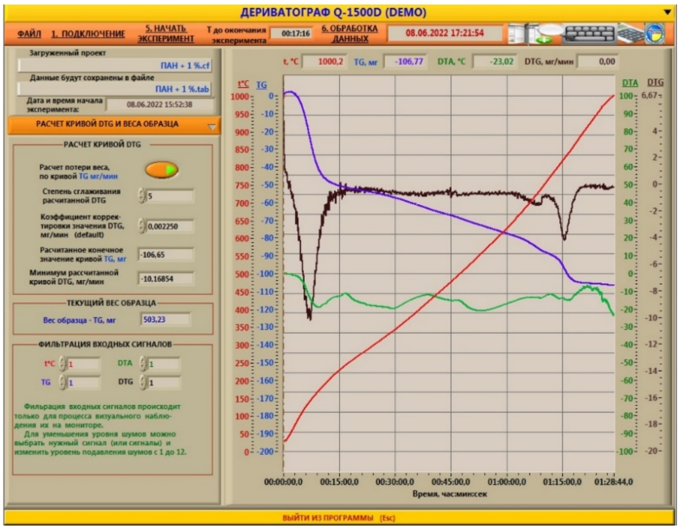

Fig.5. DTG of 15% aqueous dispersions of montmorillonite clays of the Darbaza deposit in the presence of 1.0 % synthesized sulfonic acid WSP

Thus, the study of the thermal stability of the proposed drilling fluids of 15% aqueous dispersions of montmorillonite clays of the Darbaza deposit, depending on the concentration of 0.01 - 1.0% synthesized sulfonic acid WSP, can be attributed to thermostable. At the same time, there is a slight change, i.e. the appearance of endoeffects at different temperatures, which are apparently associated with the formation of a different structure: in the initial composition from 0.01 to 0.25% aggregative formations (Fig. 1-3) and 0.25 to 1% with compaction of the structure of the resulting product (Fig. 4.5) [6,7].

The obtained data on thermal stability by the DTA method are confirmed by the results of hydrothermal treatment of 15% suspensions of hydroslude-montmorillonite clay of the Darbazinsky deposit in the presence of WSP synthesized acrylonitrile and vinisulfonic acid (SANVSA) (C = 0.5%), carried out in a laboratory autoclave at a temperature of 200-220 °C and a pressure of 10-20 atm. for six hours.

The resulting composition, as shown by preliminary data, gives the solution lubricating properties. To determine the comparative effectiveness of the developed SANVSA drilling lubricant additive, the most common dispersed systems of drilling bit lubricants were selected: industrial MS-20 oil; vapor, cylinder oil-52 and nigrol.Their basic physico-chemical characteristics show that, compared to these oils, SANVSA has the highest molecular weight, and also has a sufficiently high limit temperature at which it is used.

When studying the tribotechnical properties of lubricants, their anti-wear and extreme pressure properties were evaluated according to the "sliding" scheme on the friction machine of the American company "Baroid".

The study consisted in determining the coefficient of friction of the wear rate of chisel steel 16KHNMZA in the medium of the studied lubricants at various specific loads. Determination of the dependence of the wear rate of steel on the specific load showed that the synthesized SANVSA has higher anti-wear properties than cylinder oil-52, vapor, MS-20 and nigrol. This may be a consequence of both the presence of polar groups in its composition and compounds. predisposed to chemical modification of tribopolymerization.

Table 1 – Comparative dependence of the coefficient of friction on the specific load in the environment of various lubricants and SANVSA

Lubricant	The value of the coefficient of friction at specific load, MPa		
	20	60	95
Nigrol	0,97	0,068	0,054
Cylinder-52	0,089	0,058	0,048
Vapor	0,087	0,55	0,044
MS-20	0,085	0,53	0,045
SANVSA	0,07	0,51	0,055

The studies carried out also showed that oil and SANVSA do not differ much in their anti-friction properties. The table presents the values of the relative friction coefficients for the studied lubricants.

Under the influence of lubrication, adsorption monomolecular lubricating films are formed on the friction surfaces, which weakens the interaction force of the friction parts. As a result, there is a decrease in the coefficient of friction and, accordingly, the coefficient of friction (K), which is theoretically determined by the ratio of the friction force to the load W (K =F/W) [8].

CONCLUSION

Thus, the study of the temperature resistance of the proposed drilling fluids of 15% aqueous dispersion of montmorillonite clays of the Darbasa deposit can be attributed to thermo-stable solutions due to the concentration of 0.01-1.0% of the synthesized sulfoacid Sep. In this case, there is a slight change, that is, the appearance of endoeffects at different temperatures, which are associated with the appearance of a different structure: from 0.01 to 0.25% in the initial composition with aggregative formations (fig.1-3) and from 0.25 to 1%, with sealing the structure of the resulting product. The results obtained on thermal stability by the DTA method confirm the results of hydrothermal treatment of a 15% suspension of hydrosludisto-montmorillonite clay of the Darbaza field with the participation of the WSP of the SANVSA. The synthesized SANVSA has anti-wear properties and can be recommended for use in drilling wells for liquid and solid minerals in complex geological conditions.

These studies were carried out within the framework of the program AP14972915 "Development of technology for obtaining thermal-salt-resistant composite polymeric stabilizers of drilling fluids for drilling deep wells" of the project "Zhas Galym" with the support of the committee of the Ministry of Science and higher education of the Republic of Kazakhstan.

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DEVELOPMENT OF MATHEMATICAL MODELS OF THE PROCESS OF REMOVING WATER-BASED EMULSIONS

Baibotayeva S.Y.[*], Abdurakhmanov M.Zh., Sadyrbayeva A.S.
M. Auezov South Kazakhstan University, Shymkent, Kazakhstan
[*]Corresponding Author's Email: sbaibotaeva@mail.ru

ABSTRACT

The article describes the process of dewatering during field oil preparation, which is carried out as a result of the destruction of the oil-water emulsion, using thermochemical methods. In this regard, the selection of the most effective demulsifiers in order to improve the processes of dehydration and desalination of oils is an urgent task. The dehydration process includes the stages of droplet formation and settling. The more efficient the droplet formation process has been, the more effective the separation of the emulsion into oil and water will be. Therefore, it is necessary to know how to intensify this process, and the effectiveness of the influence of various technological parameters on the processes of droplet formation. Currently, mathematical modeling is a necessary stage in solving the problems of analysis, optimization and efficiency improvement of existing field oil treatment plants (UPN). Therefore, the purpose of this work is to process and analyze experimental data on the effect of technological parameters on the process of droplet formation during the movement of the emulsion through the pipeline and to study the process using a mathematical model.

Keywords: oil, oil field, surface tension, demulsifier concentration.

INTRODUCTION

The oils of different fields have different physical and chemical characteristics, and therefore an important task is to select a demulsifier for the most efficient mass transfer process and the subsequent coalescence process of water droplets. One of the main parameters characterizing the oil emulsion is the surface tension. There are practically no theoretical dependences of the surface tension on the concentration of the demulsifier, therefore, in order to take into account, the effect of the concentration of the demulsifier on the droplet formation process, we analyzed experimental data on the effect of the concentration of the chemical reagent on the surface tension for various types of demulsifiers. One of the main stages of oil preparation in the field is the process of oil dehydration, which is carried out mainly as a result of the destruction of water-based emulsions using thermochemical methods.

The high degree of wetting of the oil field is due to the depth of location of the extracted oil and the different strength properties of water-based emulsions and causes serious difficulties in the production, collection and preparation of oil. Only demulsifiers can ensure that emulsified water droplets irreversibly destroy the protective layers on the surface. Emulsified water from the produced crude oil can be used after extraction, because the presence of salts in the reservoir water increases the corrosion of equipment, neutralizes catalysts of petrochemical processes and increases the ash content of end products of oil refining. One of the most pressing problems of oil field development is to improve the efficiency of hydrocarbon raw materials in the oil industry.

MATERIALS AND METHODS

The model allows you to calculate the diameter of a drop, the linear velocity required for the formation of a drop, the length of the pipeline, etc. The diameter of the drop in the mathematical model is calculated by the method of V.P. Tronov. [1]:

$$d_{\max} = 43.3 \cdot \frac{\sigma^{1.5} + 0.7 \cdot \mu_w \cdot u^{0.7} \cdot \sigma^{0.8}}{u^{2.4} \cdot \mathrm{Re}^{0.1} \cdot v_{mixture}^{0.1} \cdot \rho_o \cdot \mu_o^{0.5}} \tag{1}$$

where – $d_{\max}$ maximum size of stable drops; σ – surface tension; μ_w, μ_o – dynamic viscosity of water and oil, respectively; u – average linear flow rate; $v_{mixture}$ – kinematic viscosity of the mixture; ρ_o – oil density.

Using a mathematical model, studies of the effect of the concentration of a chemical reagent and the consumption of an emulsion on the indicators of the droplet formation process were carried out (Fig. 1-3)

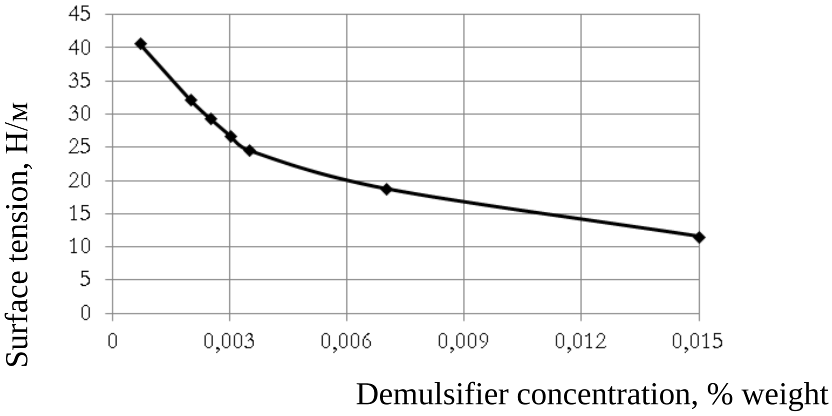

Fig.1.Dependence of the surface tension on the concentration of the demulsifier

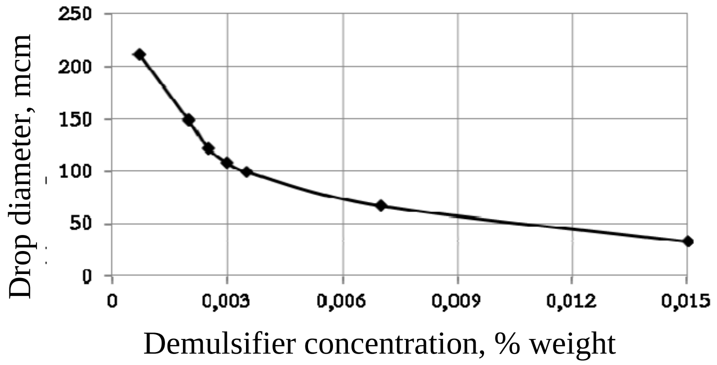

Fig.2. Dependence of the drop diameter on the concentration of the demulsifier

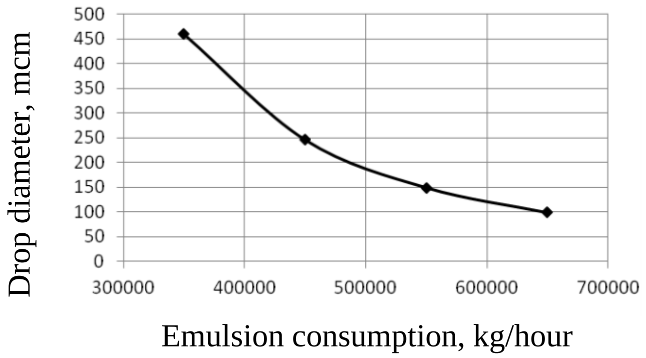

Fig.3. Dependence of the drop diameter on the flow rate of the oil-water emulsion

An equally important parameter in the field preparation of oil is the length of the pipeline in which the coalescence process takes place. The calculation of the length of the coalescing and mass transfer sections of the pipeline will determine the necessary place for the introduction of the demulsifier.

Figure 4 shows the results of a study of the effect of the reagent concentration on the length of the pipeline required for an effective droplet formation process.

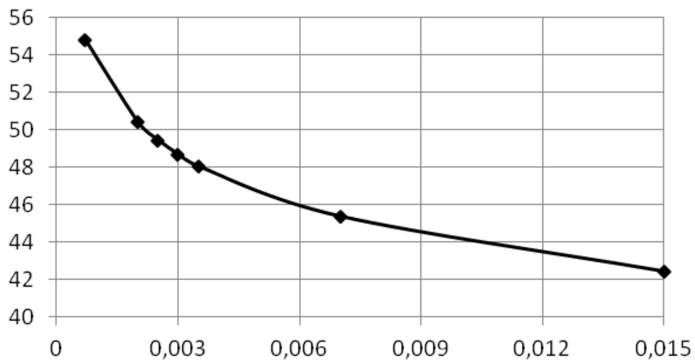

Fig.4. Dependence of the length of the pipeline on the concentration of the demulsifier

Studies performed using a mathematical model have shown that the diameter of the droplets, the surface tension and the length of the pipeline decrease with an increase in the concentration of the demulsifier, all other things being equal. At a reagent concentration from 0,0007 to 0,015% by weight. the diameter of the droplets decreases from 210 to 33 microns, the surface tension decreases from 41 to 11,5 din / cm, and the length of the pipeline varies from 54,8 to 42,4 m. Analysis of the results of the effect of the emulsion flow rate on the drop diameter showed that by increasing the emulsion flow rate from 350000 to 650000 kg/h, the diameter of the droplets decreases from 460 to 98,5 microns. Consequently, the efficiency of the droplet formation process and, in the future, the process of settling water, will decrease.

Thus, taking into account the influence of the demulsifier concentration on the surface tension in the mathematical model will allow us to predict the effect of the reagent on the efficiency of the droplet formation process during field oil treatment and determine the most effective modes of the process of destruction of the oil-water emulsion.

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STUDY OF THE COMPOSITION AND THERMAL CHARACTERISTICS OF SULFUR-, NITROGEN AND PHOSPHORUS-CONTAINING OLIGOMER

Normurodov B.A.*, Turaev Kh.Kh., Toshev M.E.
Termez State University, Termez, Uzbekistan
***Corresponding Author's Email:** normurodovbakhtiyor@gmail.com

ABSTRACT

The main modern global trend in the development of any type of product is the creation on its basis of a wide range of models, types, brands, modifications that ensure the effective development of a rapidly growing modern economy, expanding the areas of application of products, increasing the volume of their output. This trend is fully characteristic of modern, especially thermoplastic polymer materials. Obtaining new synthesized highly filling additives for polymer materials with high heat resistance and fire retardant efficiency, stabilization of polymers, environmentally friendly and economical today is an urgent task.

Keywords: phosphorus-containing oligomer, nitrogen-containing compounds, viscosity, oligomers.

INTRODUCTION

The development of modern technology requires new materials with predetermined properties, but the creation and development of production of new polymers practically does not occur.

The main goal pursued when filling polymers is to reduce the cost of products based on them. In the overwhelming majority of cases, the introduction of fillers leads to an increase in the fragility of the resulting composite material and a catastrophic decrease in its frost resistance, which manifests itself especially significantly at high volume fractions of filler. In this case, the maximum possible degree of filling for polymers processed from the melt is limited by the melt viscosity and, as a rule, does not exceed 40%.

Filling always leads to difficulties when molding products, which is associated with an increase in the viscosity of the melt compared to the melt of an unfilled polymer [1,2].

In general, the complex of properties of filled polymers is determined by the combined action of a number of factors, the most significant of which are: the nature of the thermoplastic and the filler, the shape and size of the filler particles, the relative position of the filler particles and the change in their local density over the volume of the sample, the concentration of the filler [3,4].

The nature of the thermoplastic and filler primarily determines their compatibility when molding a composite material. If the polymer and filler turn out to be incompatible, then the resulting product will have reduced mechanical characteristics, since the application of a load will lead to the destruction of the adhesive bond, resulting in the separation of the matrix from the filler particles. If the work of adhesion achieved upon contact between the polymer and filler is large, then the load applied to the composite material will be distributed more or less evenly without significant stress concentration at the polymer-filler interface. With a high strength of the polymer-filler adhesive bond, it is possible to obtain composites with relatively high mechanical characteristics [4].

METHODS AND MATERIALS

Physicochemical properties were studied: density, melting point, solubility, IR spectroscopy and DSC in a sulfur-, nitrogen- and phosphorus-containing oligomer.

IR spectra of the oligomer were recorded on an Avatarsystem 360 FT-IR spectrometer from Nicolet Justument Corporation (USA)

Thermal analytical studies were carried out on a Netzsch Simultaneous Analyzer STA 409 PG device (Germany), with a K-type thermocouple (Low RG Silver) and aluminum crucibles. All measurements were carried out in an inert nitrogen atmosphere with a nitrogen flow rate of 50 ml/min. The temperature range of measurements was 25-370°C, the heating rate was 5 K/min. The amount of sample per measurement is 5-10 mg. The measuring system was calibrated with a standard set of substances KNO3, In, Bi, Sn, Zn.

RESULTS AND DISCUSSION

This work is devoted to the study of the physicochemical properties of effective fillers based on sulfur-, nitrogen- and phosphorus-containing oligomers for polyethylene.

Therefore, the modification of known polymers, the development of polymer composite materials filled with functional additives, or mixed compositions, is today one of the priority areas in the creation of polymers and composites with predictable properties.

Physicochemical properties were studied: density, melting point, solubility, IR spectroscopy and DSC in sulfur-, nitrogen- and phosphorus-containing oligomers. The physicochemical characteristics of the synthesized highly filling oligomer of the DPS-3 brand (Phosphorus pentasulfide with sulfur-containing organic compounds) are presented in Table 1.

Table 1.Physico-chemical characteristics of a highly filling oligomer

Indicators	High filling oligomer
	DPS-3
Density, g/cm^3 GOST 15139-69	1,40
T_d, °C	130
η_{xv}	0,070
Solubility	Dimethylformamide
Appearance and color	Brown viscous substance

In the IR spectrum of DPS-3, in the regions of 2906-2858 sm^{-1}, there are absorption bands confirming the presence of $-CH_2-$ groups, and absorption bands in the region of 3244 sm^{-1}, corresponding to unreacted free hydroxyl –OH groups. Bending vibrations of all active groups appear in the form of strong narrow bands between the usual bands of bending vibrations –CH_2–CO– in the region of 1400 – 1465 cm^{-1}. Absorption bands in the region of 1712 cm^{-1} confirm the presence of –CO–S- groups. The presence of groups containing phosphorus P=O and P–O–C in the region of 979–1014 sm^{-1} is confirmed by a wide intense band and sulfur-containing compounds in the regions of 400-900 sm^{-1}, 1014-1060 cm^{-1} and 1100-900 cm^{-1}.

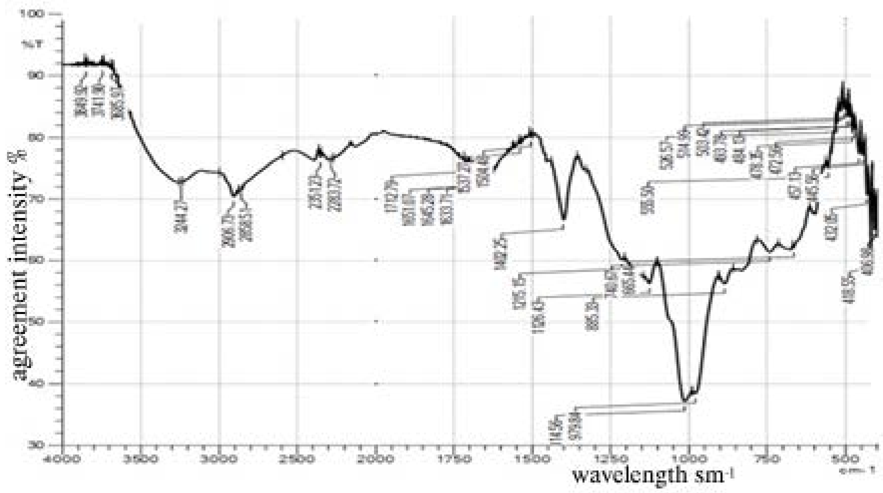

Fig. 1. IR spectrum of sulfur-, nitrogen- and phosphorus-containing oligomer brand DPS-3.

A study was carried out of the influence of oligomers on the DSC process of a sulfur-, nitrogen- and phosphorus-containing oligomer of the DPS-3 brand. The mass of the DPS-3 sample does not change up to 207°C. On the DSC curve in the temperature range 20 -370°C there is one endothermic peak (at 250°C), which corresponds to the melting of the sample. Above a temperature of 207°C, the sample begins to decompose in two stages - up to 265°C at a rate of 6%/min, and above 265°C at a rate of 2.5%/min, with a total mass loss of 57.43%. The decomposition reaction is endothermic, the total decomposition energy is -183.6.7 J/g. (Fig.2.)

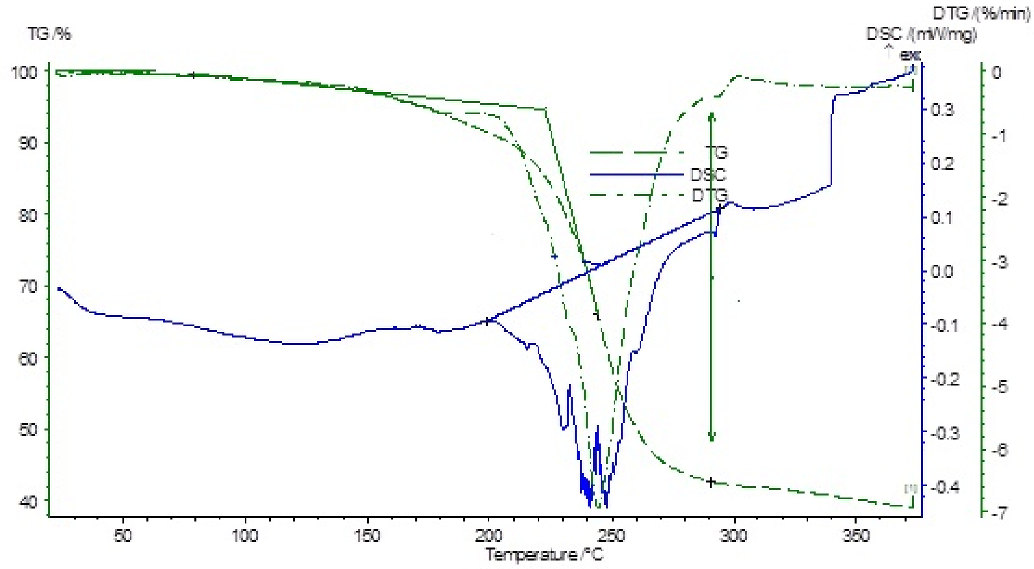

Figure 2. DSC sulfur-, nitrogen- and phosphorus-containing oligomer brand DPS-3.

CONCLUSION

Thus, the characteristic properties of the sulfur-, phosphorus- and nitrogen-containing oligomer were determined by IR spectroscopy and DSC; as a result of laboratory tests, it was proven that the oligomer can be used as highly filling additives for polymer materials.

Physicochemical properties were studied: density, melting point, solubility, IR spectroscopy and DSC in sulfur-, nitrogen- and phosphorus-containing oligomers.

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ANALYSIS OF THE FOAMING PROPERTIES OF FOAMING SOLID SURFACTANTS

Oripova Sh.K.[1*], Adizov B.Z.[2], Akramov B.Sh.[3]
[1]Karshi Engineering and Economic Institute, Karshi, Uzbekistan
[2]Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, Tashkent, Uzbekistan
[3]Russian State University of Oil and Gas (NRU) named after IM Gubkin in Tashkent, Tashkent, Uzbekistan
[*]**Corresponding Author's Email:** oripova sha hlo1991@umail.uz

ABSTRACT

The effectiveness of the oil and gas field exploitation system largely depends on the rational use of wells. Usually, over time, water begins to appear in the product of the wells. Especially in gas wells, the liquid taken together with the gas gradually accumulates in the well body, creating an obstacle to gas flow and even stopping the well from working. Applying wellbore control measures and eliminating accumulated fluid in the gas wellbore provides an opportunity to increase well productivity. Most of the gas and gas condensate fields used in the Republic of Uzbekistan have the problem mentioned above, which is an urgent issue. There are several ways to remove fluids from the bottom of the well, one of them is the method of removing fluids using foaming surfactants. This article describes the compositions of foaming solid surfactants and the related laboratory results are described. Also, the effect of formation water mineralization on the contents of mineralization of formation waters of Alan gas and gas condensate field and the composition of foaming solid surfactants was considered.

Keywords: Gas and gas condensate deposits, well bottom, well bottom fluid, surfactants (SFM), solid surfactants, anionic surfactants, foam, mineralization, calcium and magnesium salts (Ca^{2+} and Mg^{2+}).

INTRODUCTION

At the last stage of the use of gas and gas condensate field wells, as a result of a decrease in formation pressure and flow rate, a decrease in the operating period of the well and a decrease in flow rate are observed due to the accumulation of liquid (water, condensate, etc.) and mechanical impurities at the bottom of the well. The stability of the operation of flooded wells in the final stages of development and the development of wells that are self-blocking are carried out by various physical and physicochemical methods aimed at removing the accumulated fluid. There are many technological methods that allow to solve the problem of removing liquid from the bottom of the well. The method of removing liquids using surfactants is widely used in the world. Surfactants form a foam when injected into a flooded well, and as it rises to the surface with the gas flow, it also removes the downhole fluid.

Shows the requirements for foaming agents. Surfactants must have mechanical stability in a liquid environment, whereas surfactants must maintain their strength properties for a long period of time, several days. It should have high foaming properties in both low-mineralized and high-mineralized waters. It is also necessary to take into account the easy availability and cheapness of reagents.

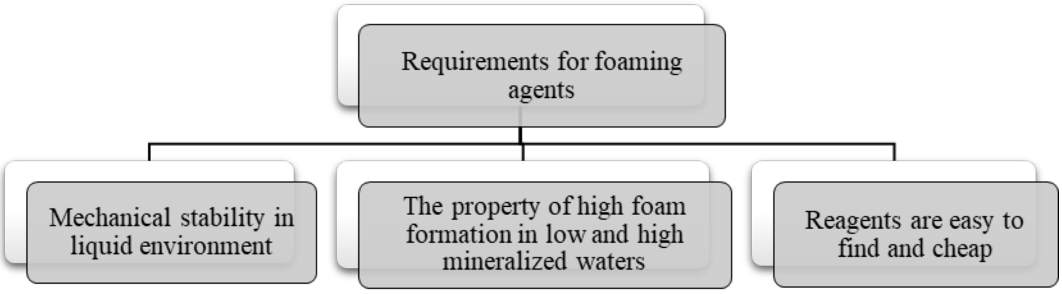

Fig. 1. Requirements for foaming agents

It is known that liquid and solid surfactants are used to remove the water load from the gas well body. The main disadvantage of dewatering with liquid surfactants is that the liquid is not completely removed when they are used. Liquid surfactants must be pumped into the well several times to extract water, which in turn increases the cost of extracting the liquid. This method is very inefficient in the continuous accumulation of formation water. It is desirable to use solid surfactants in removing liquid from the bottom of gas and gas condensate wells.

The use of solid surfactants allows maintaining the stability of their operation until such measures are taken by removing water from the sealed pipe back and the bottom of the well, without changing the design of the wells (except for the need to remove the downhole valves). Unlike other methods of removing water from the bottom of the well, the removal of liquid from the bottom of wells with surfactants allows measurements to be made with depth instruments.

The use of foam to remove accumulated fluid in low-flow gas wells depends on two performance criteria: economic efficiency and the ability of foam surfactants to reduce bottom pressure. The best candidates for the use of foam in low-flow gas wells with a gas-liquid factor between 28,000 and 224,000 m^3.

EXPERIMENTAL METHODS

Different surfactants belonging to four main classes are used to remove the accumulated fluid in the wellbore: anionic surfactants, nonionic surfactants, cationic surfactants and ampholytic surfactants. The range of surfactants used for dewatering well fluids is quite wide, but the most commonly used are anionic and nonionic surfactants.

Nonionic SFMs include polyoxyethylated compounds of alcohols and phenols, among others [1]. They are highly soluble in cold water and we did not use them in our study due to the fact that their solubility decreases with increasing temperature.

Anionic surfactants contain one or more hydrophilic groups in the molecule and dissociate to form a hydrocarbon anion. The following groups of surfactants are often used to remove accumulated liquid: alkyl sulfates (R - OSC>3, where M is a metal cation); alkyl(aryl)sulfonates (R-SO_3 M) - sulfonol, α -olefin sulfonates; laurethsulfonates and others.

Sulfonol (several modifications) is an alkyl aryl sulfonate available both as a powder and as a concentrated solution. Effective in highly mineralized solutions, it forms insoluble salts with cations of polyvalent metals. α -olefin sulfonates (several modifications) are available in the form of powder and aqueous solution, the presence of a double bond in the hydrocarbon chain leads to a critical concentration of micelle formation and an increase in salt resistance [2].

Surfactant molecules have a water-soluble (hydrophilic) and a hydrocarbon-soluble (hydrophobic) part. Thus, the surfactant contains hydrophilic and oleophilic (oil-soluble) components, which cause the molecules to accumulate at the interface between the aqueous and non-aqueous phases. When the surfactant concentration reaches a critical level, the interface is completely covered with surfactant molecules.

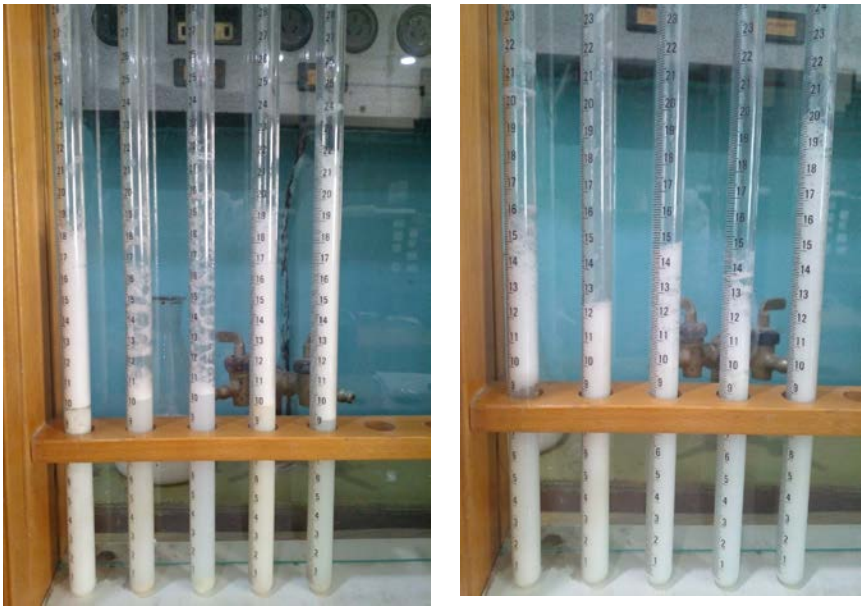

Fig. 2. Foaming properties of solid surfactants

When new parts of surfactants are added, they enter one of the liquid phases. To ensure the optimal concentration of surfactants, it is necessary to take into account their solubility and ability to cover the surface of dispersed bubbles. In addition, ionic forces of attraction act between the surfactant molecules and the liquid, which strengthens the film. The selection of optimal surfactants and suitable conditions for their use are important to ensure efficient dispersion of bubbles and emulsions.

Taking into account the fact that the temperature increases with the depth of gas and gas condensate wells, we used anionic surfactants in our research. In the Alan gas condensate field of the Mubarak Oil and Gas Production Department, where research is being carried out, an experimental device was assembled in order to conduct the foaming properties of *surfactants* at 81-96°C, taking into account the depth of the wells of 2700-3200 meters [3]. Surfactants designed to remove well fluids in laboratory conditions were tested in an experimental device that models well to a certain extent.

The research was conducted in the formation water of the Alan gas condensate field belonging to the Mubarak Oil and Gas Production Department under laboratory conditions based on the samples of foaming solid surfactants. The mineralization composition of aquifer water is very different compared to freshwater with its salts. The foaming properties of various foaming solid surfactants created in the experiments were studied (Figure 2).

RESULTS AND DISCUSSION

Fluid collected in gas and gas condensate wells and at the bottom differs in general mineralization and composition of salts. Calcium and magnesium salts have a significant effect on the foaming process. Based on this, Ca^{2+} and Mg^{2+} in the water of gas and gas condensate deposits according to the composition, it is more convenient to conditionally divide into three types. The first type of water includes water that does not contain Ca^{2+} and Mg^{2+}, or their content in water is so small that it does not significantly affect the foaming ability of surfactants. The total content of Ca^{2+} and Mg^{2+} < 0.1 g/l. The second type of water is most common in the layers of gas and gas condensate deposits. The total amount of Ca^{2+} and Mg^{2+} is from 0.1 to 1 g/l. The third type of water includes water with a total amount of Ca^{2+} and Mg^{2+} more than 1 g/l. Depending on the type of water, a certain type of foaming agent and its concentration are selected to remove liquid from gas wells [4].

The contents of the formation water mineralization of Alan gas condensate field were studied. In the southeastern part of the Chardjou stage, which includes the Alan deposit, the formation waters of the Jurassic aquifer complex are very diverse in terms of composition, with mineralization up to 100-150 g/l, mainly sedimentary metamorphosed saline of the calcium chloride type. represented by waters [5].

The salinity of formation water in the Alan gas and gas condensate field mainly varies from 91 to 109 g/l. Chlorine (53-66 gr/l) and alkalis (30-44 gr/l) prevail in the ionic salt composition, calcium (1.7-9 gr/l) is significantly more than magnesium (0.02-1.3 gr/l) is superior. Sulfates and bicarbonates are low, mostly 0.66-2.0 (5.3-6.6 g/l in individual samples) and 0.12-0.69 g/l. Hydrogen sulfide and nitrogen dioxide were not detected in the waters.

Table 1 shows the properties of various foaming solid surfactants developed, including experimental results of foam height, foam retention times, foam stability, and solubility properties of the solid surfactant at different temperatures.

Table 1 - Laboratory results of generated solid surfactants

No	Sample name	concentration, %	The height of the foam at different temperatures, mm			Foam retention time, min	Foam stability	Solubility of the substance
			20 ^{0}C	70 ^{0}C	90 ^{0}C			
1	TP-1	5	40	98	85	120	not stable	soluble
2	TP-2	5	57	98	112	constant	average	hard
3	TP-3	5	68	105	117	constant	average	hard
4	TP-4	5	55	114	115	120	not stable	soluble
5	TP-5	5	45	90	108	120	not stable	soluble
6	TP-6	5	30	55	85	constant	average	hard
7	TP-7	5	67	90	88	constant	average	soluble
8	TP-8	5	70	65	75	constant	average	soluble
9	TP-9	5	13	65	63	constant	low	hard
10	TP-10	5	43	132	135	constant	high	hard
11	TP-11	5	17	75	129	constant	high	hard
12	TP-12	5	22	58	80	constant	average	soluble
13	TP-13	5	37	60	58	constant	low	soluble
14	TP-14	5	60	67	80	constant	average	soluble
15	TP-15	5	67	130	146	20	not stable	hard
16	TP-16	5	48	119	112	constant	not stable	soluble
17	TP-17	5	72	144	123	15	not stable	soluble
18	TP-18	5	76	157	185	10	not stable	soluble
19	TP-19	5	47	122	128	constant	not stable	soluble
20	TP-20	5	64	167	180	25	not stable	hard

Anionic surface-active substances nonionic was not surface active to substances than more many times ability have and wide temperature in the interval efficient will be, but their apply scope issued of water to salinity and especially gas condensate to existence high sensitivity because of limited. Using surfactant foam is a very simple and inexpensive method for shallow wells. The cost of reagents is directly proportional to the flow rate of the liquid. Well equipment is not required, but for small wells where liquid sluices are formed, a capillary injection system can be very useful. This method is suitable for wells with low gas flow, where the gas velocity in the operating column is 0.5-5 m/s, and the critical velocity in wells in the presence of foam is about 5 m/s.

CONCLUSION

The use of solid surfactants is a simple and effective way to deal with fluid accumulation in gas wells. In the near future, as more and more fields move into the middle and late stages of development, wells will become choked. For this, it is advisable to use solid surfactants. The effect of minerality, formation water hardness, and, mainly, hydrocarbons in its content on foaming of surfactants is also very high. It is desirable to create a substance containing *surfactants*, stabilizers, plasticizers, and thickeners, which has high foaming properties in mineralized waters and high mechanical stability in well conditions.

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