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IMPROVING THE EFFICIENCY OF OPERATION OF COMPLICATED OIL AND GAS WELLS

ALMATOVA B.G[1], BALGYNOVA A.M[2], SARKULOVA ZH.S[2], TUREZHAN A.T.[2*]

Almatova Bayan Gazizovna[1] — Candidate of Technical Sciences, Associate Professor, Leeds University Business School, England
E-mail: baian.73@mail.ru, https://orcid.org/0000-0002-1680-4682;
Balgynova Akzharkyn Merekeevna[2]— Candidate of Technical Sciences, Associate Professor (ARU), K. Zhubanov Aktobe Regional University, Aktobe, Kazakhstan.
E-mail: moldir_merei66@mail.ru, https://orcid.org/0000-0001-5688-996X;
Sarkulova Zhadyrasyn Seidullaevna[2] — PhD doctor, Associate Professor, K. Zhubanov Aktobe Regional University, Aktobe, Kazakhstan.
E-mail: zhadi_0691@mail.ru, https://orcid.org/0000-0001-8539-1802;
[*]Turezhan Ainur Turezhankyzy[2] — Master's student of the ARU named after to K. Zhubanova, K. Zhubanov Aktobe Regional University, Aktobe, Kazakhstan.
E-mail: ainura.turezhan02@gmail.com, https://orcid.org/0009-0006-1281-0176;

Abstract. "Improving the efficiency of operation of complicated oil and gas wells" is relevant in the context of the modern oil and gas industry, where there is a growing need to optimize the processes of production and operation of wells to ensure sustainable and efficient production of hydrocarbons.The research is aimed at identifying innovative approaches and technologies that can improve the efficiency of oil and gas wells, especially those characterized by complicated geological conditions, high fluid viscosity, the presence of aggressive components and other difficulties.The study includes an analysis of existing technologies, methods and tools used in oil and gas production in order to identify their shortcomings and opportunities for optimization. Particular attention is paid to the development of integrated management and monitoring systems capable of providing well operators with up-to-date information for quick decision-making.

In the course of the research, it is also expected to develop new technological solutions aimed at reducing costs and increasing the efficiency of hydrocarbon production. This may include the creation of new materials for casing pipes, the use of advanced methods of geological structure research, as well as the optimization of production intensification methods.

The results of this study can be used not only in the oil and gas production industry, but also in the development of energy policy aimed at sustainable and efficient use of energy resources.

Key words: drilling of wells, development of wells, inflow call, high-viscosity oil, hydrodynamic influence.

Introduction. The opening of the reservoir and calling the flow of oil is the most important stage in the construction of Wells. The further fate of the wells, as well as the flow rate and service life of each particular well, depend on the correct call of the flow. Previously, this factor was not taken into account, and a huge number of wells for which millions of dollars were spent were destroyed during the period of their development. Recently, this direction is the most promising and is a priority in the construction of Wells.

Complications during Well development are caused by geological (low permeability, high oil viscosity) and technological (contamination of the productive layer during primary opening with components of drilling mud, solid phase and filtrate, cementing the casing; during secondary opening (perforation)).

The permeability of an array of rocks is determined by its ability to filter the liquid phase from the reservoir fluid. The consequences of the filtration process are deposits of solid particles in the walls of porous channels and cracks and changes in the properties of liquids in porous space at a certain distance from the wellbore. The existing practice of opening productive layers is through the use of clay layers and mortars. Deep capillary impregnation of the pit area with clay mortar and hardening cement ring filtrates occurs. The layers are covered with clay to a considerable depth. In the presence of high permeability of the layers and good contact with oil fields, they can be cleaned on their own. The gaps of the low-permeable layers practically do not participate in self-cleaning and remain disconnected from production . In addition, asphalt tarparafine deposits in the porous channels of the formation during the oil production process further reduce the consumption of the well.

The coloration of the near-well area (NWA) of the well can occur at different stages of the life of the well, starting from the initial opening. Not only the filters of the solutions used in the process of initial opening and subsequent cementing, but also particles of the dispersed phase of clay and cement solutions enter the NWA, which fall into the filter channels, reducing their permeability.

At the initial opening in repression, a breakdown of the cementing agent of the terrigenic collector in the NWA and colmatization of filtration channels may occur. In the process of operation of the extractive well, there may be colmatization due to obliteration, subsidence of asphalt-paraffin components of oil, salt, etc.

The process of NWA colmatation (decolmatation) and its causes are well studied, various technologies are proposed that reduce the negative impact of this phenomenon on the filtration characteristics of the system.

If traditional methods of calling the flow, based on the principle of reducing the pressure in the well by reducing the density of the liquid or its level, do not provide the necessary depression, then in complex cases, the following methods of developing wells are used for the flow of the reservoir fluid.

Research materials and methods. Acid treatment. Acid treatments are widely used to clean wells and near-Well areas of the formation from clay, mechanical particles and drilling fluid filtrate.

The main acid used in layer acidification is hydrochloric acid (HCl). It has an effective effect on calcium or magnesium carbonate, forming soluble and easily detachable chlorides. Hydrochloric acid is cheap and scarce. Acetic, formic and other acids are also used. Various additives are introduced into acidic solutions: corrosion inhibitors, complexing agents, additives reduce surface tension, slow reaction, dispersion, etc.

Disadvantages of this method:

- the technique can only be used in carbonate collectors, terrigenic collectors are not suitable for processing, since quartz sand with acid does not react;
- working with a large amount of aggressive liquid is harmful to health, negatively affects the environment, contributes to the corrosive destruction of pipes, equipment and Transport for its transportation;
- lack of reliable method of producing reaction products after each cycle, when washing, reaction products are pressed into the layer;
- insufficient contact of hydrochloric acid with Rock due to the deposition of organic deposits, such as Asphalt, resin and paraffin deposits on the surface of the pore space during the operation of the well.

Swabbing. Swabbing is a method of oil production by means of a piston suspended on a cable or cargo rod and equipped with a check valve and sealing cuffs. Swabtau is used to call and intensify the flow of fluids during the development of new extractive wells and wells that are excluded from conservation or disposal, as well as when increasing the flow rate of existing wells.

This method has its drawbacks:

* work when the well mouth is open;
* the need for a lifting mechanism;
* use of expensive equipment;
* ability to break the cable;
* rapid wear of sealing cuffs.

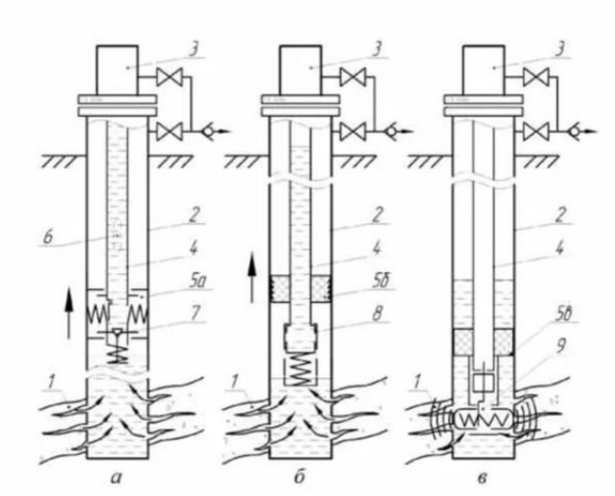

Figure-1.Swabbing scheme in the operation of wells with difficulty.
a - swabbing with a swab-packer in the pump-compressor pipe(PCP) column, b-multi-pulse filling of the PCP column; c-decolmating with a vibroacoustic generator before swabbing; 1st Layer, 2-operational column; 3-Head Equipment; 4-pipe column, 5A-swab-packer; 5B, B-cuff, slotted or basket swab; 6-Switch; 7-Valve, 8-coil; 9-hydroacoustic generator .

Layer hydraulic fracturing. Hydraulic fracturing is one of the methods of intensifying the use of oil and gas wells and increasing the pumping capacity of injection wells. The method consists in creating a high conductivity fracture in the target layer to ensure that the produced liquid (gas, water, condensate, oil or a mixture of them) flows to the bottom of the well. In hydraulic fracturing technology, the main thing is to pump blasting fluid (gel, in some cases water or acid in acid blasting) into the well through powerful pumping stations at a pressure higher than the blasting pressure of the oil reservoir. To keep the fracture open, propant is used in terrigenic reservoirs, acid is used that corrodes the walls of the fracture formed in carbonate collectors.

Disadvantages of this method:

• from 80 to 300 tons of chemicals are used for each layer hydraulic fracturing(LHF) operation;

* LHF leads to the formation of many impurities in well water that are harmful to humans, including benzene, toluene, ethylbenzene, and dimethylbenzene;
* use of expensive equipment;
* high cost and duration of work.

Torpedoing. Well torpedoing-the production of explosions in wells to increase oil flow-is used in layers represented by hard rocks: limestones, Dolomites, strong sandstones, as well as sometimes during corrective or removal work. Torpedoing is carried out by the explosion of an explosive charge in the well. During the explosion, the lower well Area of the well is partially destroyed, forming a cavern, and cracks form in the adjacent layer, which facilitates the flow of oil into the well. It is used both in the development of injection wells and in some other cases (for loosening fixed drill pipes, cutting casing pipes, etc.).

Disadvantages of this method:

* all work on torpedoing цells is carried out by Special Field parties;
* harmful effects on the human body;
* the need to lower special equipment into the well;
* high cost.

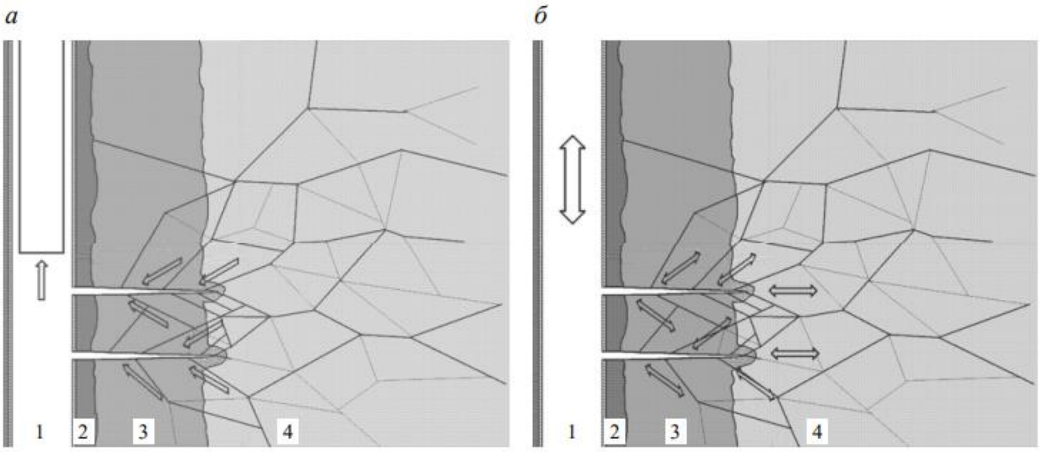

Fig.1. Hydrodynamic methods of processing the WPP from the wellhead: a - hydrosubbing (pressure 3-6 MPa; power 3 kW; duration of liquid discharge ~ 1 min); b - hydrodynamic effect (pressure up to 10 MPa; power up to 600 kW; pulse duration ~ 2 s)
1 - column; 2 - cement ring; 3 - colmation zone; 4 - "clean layer"

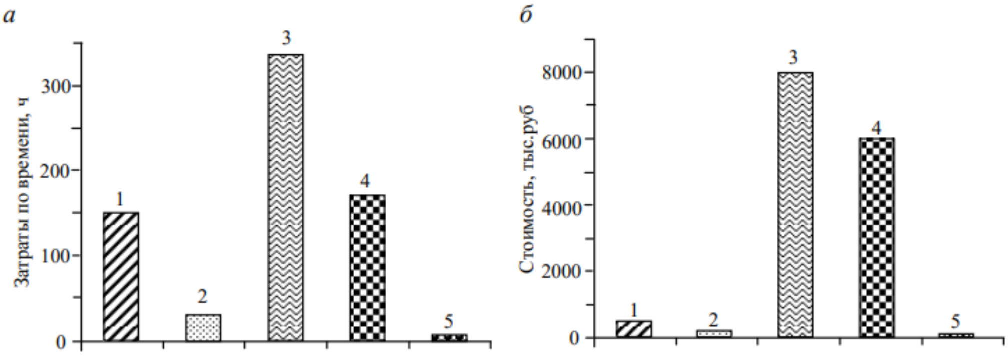

Fig.2. Comparison of well development methods: a - by the time spent; b - by the economic factor
1 - acid treatment; 2 - swabbing; 3 - hydraulic fracturing; 4 - torpedoing of the formation; 5 - hydraulic impact

The method of cyclic hydrodynamic action on the formation. A new method of well development in complicated conditions based on cyclic hydrodynamic effects on the formation is proposed. The essence of the method is as follows.

To cause an influx, there must be periodic pressure drops in order to create fluid flows in the bottomhole zone. Moreover, the gradient of pressure drops should not be dangerous for a holisticcasing and cement stone,

and the speed of liquid movement should facilitate the erosion of viscous hydrocarbons, mechanical impurities, emulsions and their removal into the well for subsequent spillage.

During cyclic injection of liquid into the reservoir and subsequent unloading, channels and cracks are washed out. The colmatants are washed out of the areas of the formation adjacent to the perforations, then at

When they are cleaned, a system of highly permeable channels is formed from more distant ones.

A technology has been developed for transmitting high pressure drops along the well column. The proposed method is economical, environmentally friendly, does not require the involvement of a well repair team, the use of heavy pumping units. The pressure of the impact is regulated to 1015

MPa, the power for the downhole zone of the formation depends on the depth of the well and reaches 600 kW.

By now, the dependence of the rheological properties of highly paraffinic oils on the influence of vibration has been studied in sufficient depth. It is known that by varying the intensity of external mechanical influences, it is possible to in the range to control the rheological properties of structured systems.

Thus, pulse-wave action can contribute to the destruction of the solid spatial structure of high-viscosity oil. The effective viscosity after processing is reduced by an average of 30% compared to the initial one.

Since the displacement of non-Newtonian oils is more effective at high speeds, it is advisable to create periodic pressure drops in the bottomhole zone and along the strike of the formation. This method of hydrodynamic action it can be used in conjunction with thermal mining methods.

The mechanism of destruction of the formation array is as follows. The increased pressure expands the existing cracks of the collector and contributes to the formation of new ones, the pressure drop is accompanied by their closure.

The strength of rocks depends on the type of deformation. The resistance to rupture, stretching, bending is significantly lower than the compression resistance, therefore, the technology of fracture of the formation rock includes the following parameters: pressure, stretching, bending, shear, changing the direction of application of forces leading to loosening, breaking and separation of low-permeability fragments of the formation. Repeated deformation contributes to the fatigue destruction of the rock and the discoloration of its fragments. The impact of periodic shock load reduces the strength of the formation rock by an average of 30%.

Increased pressure alternates with depression during the period of oscillation of the borehole fluid, the fluid does not have time to filter over long distances, therefore large cracks do not form, the formation zone adjacent to the face is destroyed and washed [2]. The detached solid particles in the jet of the injected and poured liquid are an abrasive, and also act as a propane.

The grains of the formation skeleton, which have received displacement or reversal under the action of a pressure pulse, loosely close with the grains of the opposite side of the crack. Thus, in the area of the crack where the grains of the formation skeleton are repackaged under the action of a liquid pressure pulse, the crack walls do not completely close. The smallest cavities remain interconnected, commensurate with the pores between the grains of propane. A layer composed of sandy-clay with weakly cemented rocks, it should be possible to periodically unload for the removal of small particles.

Fluctuations of the borehole fluid due to its mass and inertia also cause the movement of the reservoir fluid, which contributes to the erosion of the channels of the PZP. The creation of repeated pressure pulses increases the extent, branching and opening of cracks. In a deep well, the effect is higher because the downhole fluid is driven with significant mass and inertia. The energy of a moving multi-ton mass of liquid affects both the bottomhole zone and the formation array. Vertical fluctuations in the mass of downhole fluid with a frequency of less than 1 Hz have a low attenuation, therefore, periodic changes in downhole pressure are transmitted as low-frequency waves along the strata and contribute to the redistribution of stresses in the array, which positively affects oil recovery.

In case of longitudinal resonances, the oscillation frequency of the liquid column in the well is determined mainly by the distance between the reflecting surfaces of the well. For the lower reflective surface, usually

The zumpf is taken as the upper one - the contact of liquid and gas near the wellhead. With a large distance between these boundaries, the resonant oscillation frequency can reach 1 Hz or less. Nevertheless, the effective use of longitudinal resonances at low frequencies is associated with certain difficulties. To create resonant vibrations of the entire column of liquid in the well, it is necessary to know exactly the level of liquid in the well, as well as the phase velocity of wave propagation. In most technological operations in wells, it is almost impossible to maintain a constant liquid level. If we consider the reflective properties of the lower zumpf boundary, they are clearly small, since the wave resistances of cement and the surrounding reservoir differ slightly from the wave resistance of the liquid.

Thus, it is necessary to expend energy to maintain the reciprocating motion of the liquid (Fig.1, 2). The moments of application of forces to maintain fluctuations are determined by changes in pressure at the wellhead. In the simplest case, having no information about the liquid level and the wave propagation velocity, the application of pressure pulses is synchronized with the readings of the pressure gauge at the wellhead.

Results and discussions. The research revealed that the solvents «Ranras-6001» and «Ranras-6003» have a higher solvent capacity due to the content of aromatic hydrocarbons (benzene, toluene, xylene).

To improve the solvent and washing ability of the Ranras solvent, it is recommended to add surfactants (surfactants) to its composition.

To influence the BFZ, the use of an oil-soluble surfactant "Rauan-100" is recommended. According to the results of laboratory studies, it was found that the concentration of surfactants in the solution should be 0.1 – 0.2%.

The technical characteristics of the proposed reagents are given in Table 1.

Table 1 – Technical specifications for the solvent of asphalt-resin and paraffin deposits of the Ranras-6001 brand

Name of indicators	Standard	Actually
Appearance	Transparent liquid, colorless or yellow to brown in color with possible opalescence	Brown liquid
Density at 20 ° C, g/cm3, not less	0,65	0,811
Boiling point, ° C, not lower	30	38
Solidification temperature, °C, not higher	minus 45	minus 45

When choosing wells, the factor of increasing the water content of well products over time was taken into account. Given the high viscosity of oil, the phase permeability in water exceeds the phase permeability in oil, and therefore watering occurs.

For all selected wells, the volume of the solvent composition was calculated, providing a radius of the treated formation zone of at least 50 cm. The initial geological and physical characteristics of operational facilities were used in the calculations.

The calculation of the required amount of surfactants for addition to the solvent composition and the sales liquid is carried out based on the condition of obtaining a 2% concentration.

To carry out processing for each well, a lan for processing the bottom-hole zone of the well was compiled, including:

• Well data;
• the current state of the well;
• previously performed work on the well;
• data from hydrodynamic studies of wells and geophysical studies of wells before processing the bottomhole formation zone;
• Preparatory work;
• the sequence of operations;
• Security measures.

The geological and technical characteristics of the well should contain the following information:

• method of operation;
• distance from the rotor table to the upper flange of the column head;
• operating head;
• fountain fittings;
• operational horizon;
• perforation interval;
• the artificial face has been repulsed;
• the design of the elevator (attached diagram).

The treatment plan should list all previous work and research carried out at the well, namely:
• a list of hydrodynamic studies carried out and their result;
• a list of conducted geophysical surveys with conclusions;
• carried out underground, capital, routine and preventive work.

The plan should reflect the current state of the well by the start of work:
• reservoir pressure;
• current face;
• flow rate of liquid;
• water content of products;
• productivity coefficient

The BFZ was processed without removing the underground equipment of the well (tubing columns with a pump). This is especially true where all wells operate in a mechanized manner. The composition is pumped through the annulus of the well.

Conclusions

1. The hydrodynamic effect on the formation allows to cause an influx from the most permeable channels of the formation, in which solid particles of colmatants are not fixed due to mechanical and molecular surface reasons.

2. During cyclic injection of liquid into the reservoir and subsequent unloading, channels and cracks are washed out. The colmatants are washed out of the areas of the formation adjacent to the perforations, then, when they are cleaned, a system of highly permeable channels is formed from more distant ones.

3. The oscillation of the liquid column causes the destruction of the spatial lattice of viscous oil due to its regular deformation, a change in its rheological properties with a gradual decrease in viscosity. The effective viscosity after processing is reduced by an average of 30% compared to the initial one.

4. When pumping a multi-ton mass of borehole fluid, significant energy can be obtained in the bottom-hole zone of a periodic pressure drop, at which an effect similar to hydraulic rupture is likely, but with the creation of an extensive network of short cracks.

5. To create pressure drops in the bottomhole zone, it is advisable to use the energy of the moving mass of the borehole fluid.

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ҚИЫНДАТЫЛҒАН МҰНАЙ ЖӘНЕ ГАЗ ҰҢҒЫМАЛАРЫНЫҢ ПАЙДАЛАНУ ТИІМДІЛІГІН АРТТЫРУ

АЛМАТОВА Б.Г.[1], БАЛГЫНОВА А.М.[2], САРКУЛОВА Ж.С.[2*], ТУРЕЖАНКЫЗЫ А.Т.[2]

Алматова Баян Газизовна[1] — Техника ғылымдарының кандидаты, доцент, Лидс университетінің Бизнес Мектебі, Англия.
E-mail: baian.73@mail.ru, https://orcid.org/0000-0002-1680-4682;
Балгынова Акжаркын Мерекеевна[2] — Техника ғылымдарының кандидаты, доцент (АӨУ), Қ. Жұбанов атындағы Ақтөбе өңірлік университеті, Ақтөбе қ., Қазақстан.
E-mail: moldir_merei66@mail.ru, https://orcid.org/0000-0001-5688-996X;
Саркулова Жадырасын Сейдуллаевна[2] — PhD, доцент, Қ. Жұбанов атындағы Ақтөбе өңірлік университеті, Ақтөбе қ., Қазақстан.
E-mail: zhadi_0691@mail.ru, https://orcid.org/0000-0001-8539-1802;
[*]Турежан Айнур Турежанкызы[2] — Магистрант, Қ. Жұбанов атындағы Ақтөбе өңірлік университеті, Ақтөбе, Қазақстан.
E-mail: ainura.turezhan02@gmail.com, https://orcid.org/0009-0006-1281-0176;

Аңдатпа. «Қиындатылған мұнай және газ ұңғымаларының пайдалану тиімділігін арттыру» көмірсутектерді тұрақты және тиімді өндіруді қамтамасыз ету үшін ұңғымаларды өндіру және пайдалану процестерін оңтайландыру қажеттілігі артып келе жатқан қазіргі мұнай-газ өнеркәсібі контекстінде өзекті болып табылады.

Зерттеу мұнай және газ ұңғымаларын, әсіресе күрделі геологиялық жағдайлармен, сұйықтықтардың жоғары тұтқырлығымен, агрессивті компоненттердің болуымен және басқа да қиындықтармен сипатталатын ұңғымаларды пайдалану тиімділігін арттыруға қабілетті инновациялық тәсілдер мен технологияларды анықтауға бағытталған.

Зерттеу мұнай мен газды өндіруде қолданылатын қолданыстағы технологияларды, әдістер мен құралдарды олардың кемшіліктері мен оңтайландыру мүмкіндіктерін анықтау үшін талдауды қамтиды. Ұңғыма операторларына жылдам шешім қабылдау үшін өзекті ақпаратты бере алатын интеграцияланған басқару және мониторинг жүйелерін әзірлеуге ерекше назар аударылады.

Зерттеу барысында шығындарды азайтуға және көмірсутектерді өндірудің тиімділігін арттыруға бағытталған жаңа технологиялық шешімдерді әзірлеу көзделеді. Бұған корпус үшін жаңа материалдар жасау, геологиялық құрылымды зерттеудің озық әдістерін қолдану, сондай-ақ өндірісті қарқындату әдістерін оңтайландыру кіруі мүмкін.

Осы зерттеудің нәтижелері мұнай және газ өндіру өнеркәсібінде ғана емес, сонымен қатар энергетика ресурстарын тұрақты және тиімді пайдалануға бағытталған энергетика саласындағы саясатты әзірлеу саласында да пайдаланылуы мүмкін.

Кілт сөздер: ұңғымаларды бұрғылау, ұңғымаларды игеру, ағынды шақыру, тұтқырлығы жоғары мұнай, гидродинамикалық әсер.

ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ЭКСПЛУАТАЦИИ УСЛОЖНЕННЫХ НЕФТЯНЫХ И ГАЗОВЫХ СКВАЖИН

АЛМАТОВА Б.Г.[1], БАЛГЫНОВА А.М.[2], САРКУЛОВА Ж.С.[2*], ТУРЕЖАНКЫЗЫ А.Т.[2*]

Алматова Баян Газизовна[1] — Кандидат технических наук, доцент, Бизнес-школа Университета Лидса, Англия
E-mail: baian.73@mail.ru, https://orcid.org/0000-0002-1680-4682;
Балгынова Акжаркын Мерекеевна[2] — Кандидат технических наук, доцент (АРУ), Актюбинский региональный университет им. К.Жубанова, Актобе, Казахстан.
E-mail: moldir_merei66@mail.ru, https://orcid.org/0000-0001-5688-996X;
Саркулова Жадырасын Сейдуллаевна[2] — PhD, доцент, Актюбинский региональный университет им. К.Жубанова, Актобе, Казахстан.
E-mail: zhadi_0691@mail.ru, https://orcid.org/0000-0001-8539-1802;
[*]Турежан Айнур Турежанкызы[2] — Магистрант, Актюбинский региональный университет им. К.Жубанова, Актобе, Казахстан.
E-mail: ainura.turezhan02@gmail.com, https://orcid.org/0009-0006-1281-0176;

Аннотация. «Повышение эффективности эксплуатации усложненных нефтяных и газовых скважин» актуальна в контексте современной нефтегазовой промышленности, где присутствует растущая потребность в оптимизации процессов добычи и эксплуатации скважин для обеспечения устойчивого и эффективного производства углеводородов.

Исследование направлено на выявление инновационных подходов и технологий, способных повысить эффективность эксплуатации нефтяных и газовых скважин, особенно тех, которые характеризуются усложненными геологическими условиями, высокой вязкостью флюидов, присутствием агрессивных компонентов и другими сложностями.

Исследование включает в себя анализ существующих технологий, методов и инструментов, применяемых в добыче нефти и газа, с целью выявления их недостатков и возможностей для оптимизации. Особое внимание уделяется разработке интегрированных систем управления и мониторинга, способных предоставлять операторам скважин актуальную информацию для быстрого принятия решений.

В процессе исследования предполагается также разработка новых технологических решений, направленных на снижение затрат и повышение эффективности добычи углеводородов. Это может включать в себя создание новых материалов для обсадных труб, применение передовых методов исследования геологического строения, а также оптимизацию методов интенсификации добычи.

Результаты данного исследования могут быть использованы не только в промышленности добычи нефти и газа, но и в области разработки политики в сфере энергетики, направленной на устойчивое и эффективное использование энергетических ресурсов.

Ключевые слова: бурение скважин, освоение скважин, вызов притока, высоковязкая нефть, гидродинамическое воздействие.