SRSTI 70.25.01 https://doi.org/10.52081/tst.2025.v03.i11.061

THE USE OF PUMPING AND EJECTOR INSTALLATIONS FOR ENHANCED OIL RECOVERY OF ORE FORMATIONS IN DIFFICULT CONDITIONS

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Annotation. When developing fields with water pumping, one of the conditions that complicate development is the deposition of solid deposits in wells, pumps, prefabricated and harvesting plants. During oil production and well operation, methods of combating subsidence of asphaltene, resin and paraffin in the well have been studied, indicating factors that negatively affect installations and equipment. Methods of combating them and ways to improve the reliability of aggregates, when salts enter the well and methods of combating them, pipeline protection measures have been studied. The paper considers methods of influencing the reservoir in order to increase oil production and options for its implementation using various technologies. Of these, the method of water-gas exposure using a pumping-ejector system was chosen as the most universal and reliable method.As a result of the calculations, the technologies necessary for the pumping and ejector system of water and gas impact on the reservoir in order to increase oil recovery and utilization of associated petroleum gas are presented.

Keywords: borehole, sediments, pumping and compressor pipes,water and gas pumping, pumping and ejector system.

Introduction. Most of the deposits in the Republic of Kazakhstan are developed by mechanical mining methods, characterized by great depth, a high gas factor, paraffin precipitation, sand in the produced product, and a number of other complex factors. These conditions are taken into account during field development, defining the difficulties encountered in the operation of production and injection wells. The causes of the various complex factors in production well operation are listed below:

* properties and composition of formation fluids (high mineralization of formation water promotes the formation of salt deposits, a high content of heavy oil fractions leads to asphaltene-resin-paraffin deposits) (ASPAP) formation;

*properties of the productive layer (if the reservoir is poorly cemented and represented by friable rocks, the probability of mechanical mixtures increases);

* thermobaric characteristics of the deposits (thermobaric conditions of extraction affect the formation of ASHPC and salt deposits;

*well productivity (high well flow rates, due to increased filtration rate, cause disruption of the reservoir);

*characteristics of the operating mode of the well and the equipment used (The flow rate, discharge, and flow characteristics vary depending on the well's operating mode and the equipment used, which can lead to the disruption of the reservoir formation and, consequently, the formation of mechanical mixtures).

The frequency and intensity of these complex factors vary at different deposits and are related to the aforementioned issues. Based on their solubility properties, sediments can be classified as soluble and insoluble (Figure 1).

One of the main problems in mechanized oil production is the formation of various deposits in pump components, pump-compressor tubing (PCT), and other components. Insoluble mechanical impurities are substances that do not dissolve in gasoline and whose particle size does not exceed 100 µm. Mechanical impurities mainly consist of sand, clay, fine iron particles, mineral salts, corrosion products, and other substances.

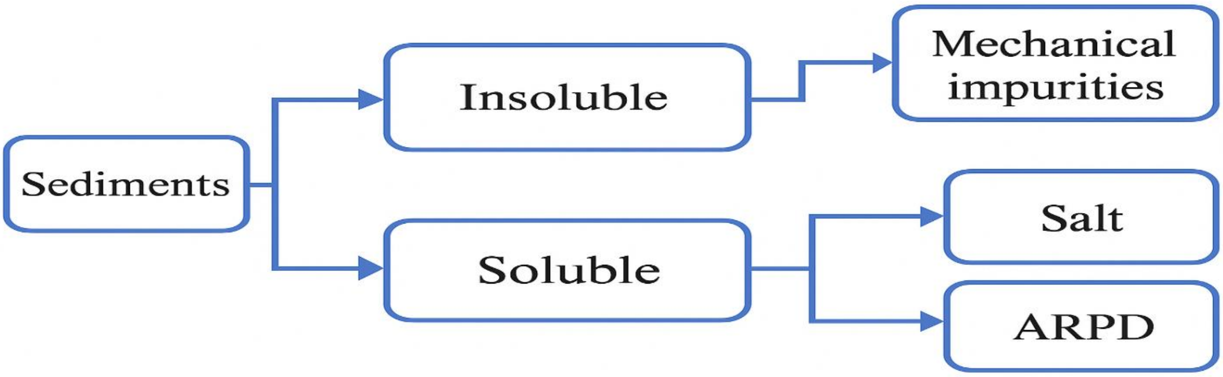


Figure 1 – Main types of deposits

Soluble deposits include ACP and salts. The internal surfaces of oilfield equipment are affected by the heavy components of the precipitated oil. Salt deposits in the Kumkol fields are primarily represented by calcium carbonate and barium sulfate. Several main prerequisites that hinder the oil production process during well operation can be distinguished:

1. Frequent repairs during continuous operation;
2. Low equipment efficiency;
3. High water cut in the produced oil;
4. Decrease in formation pressure;
5. Lack of high-performance, efficient, and reliable pumps;
6. Low profitability of continuous-operation production;
7. Complex operating conditions, which include the following issues:

a) deposition of salts on the pump's working parts;
b) deposition of paraffinic and asphalt-resinous components of the oil;
c) clogging of the pump's working parts with mechanical impurities. Also, a number of geological criteria can be distinguished: The presence of a productive formation at great depth, a poorly cemented, friable rock matrix, low permeability and heterogeneity of the reservoir, high mineralization of the formation water, and others.

Research materials and methods. Most of the current methods for operating under low reservoir pressure are inefficient and often lead to shortened intervals between overhauls or even loss of mine production. For example, using rod-type well pumps (RWP) to produce oil from low-rate wells does not allow for sufficient deepening, and their maximum performance does not match the wells' flow rates. Such problems also arise when using low-rate wells with electric centrifugal pump installations, as this is constantly accompanied by supply interruptions and frequent shutdowns, which leads to significant losses. The use of electric centrifugal pumps (ECP), which always operate in an optimal mode, allows for the resolution of the aforementioned issues, as well as a telemetry unit for wells where well performance monitoring is carried out. (TMU) installation, enabling faster and higher-quality deployment without risk, while also allowing for the minimization of formation pressure and the increase of depression.

During well operation, this promotes additional flow of the fluid. Thus, in the pulsed mode where the driving and depression pulses alternate, the downhole zone is effectively treated. To eliminate these consequences, low-frequency discharge methods are employed in the operating mode, sludge traps are installed, and scale-deposition inhibitors are used. Wells are periodically acidized and washed, but this does not yield the desired results.

Therefore, to address the current situation, the following solution options were considered:

1. Application of downhole rod pumps (DROPs);
2. Application of screw-type deep-well pump systems;
3. Switching to low-performance EOTS analogs from other manufacturers.

Not all of these operations yield the correct results, because the use of submersible and screw pumps is limited by the pump's draft depth, Additionally, using ROVs requires the creation of deep depressions, which forces subsea equipment to be deployed to depths below 2500 m, making the use of domestic ROV installations impossible. Switching to other manufacturers' EOTS analogs is also not a solution, as the problem is related to the similarity in the design of this type of SUU and, consequently, the similarity of the problems encountered when utilizing low-yield reservoirs. Figure 2 shows the dynamics of the well inventory at the field. It can also be seen in the figure that the growth rate of the inventory share is higher than the growth of the drilled wells.

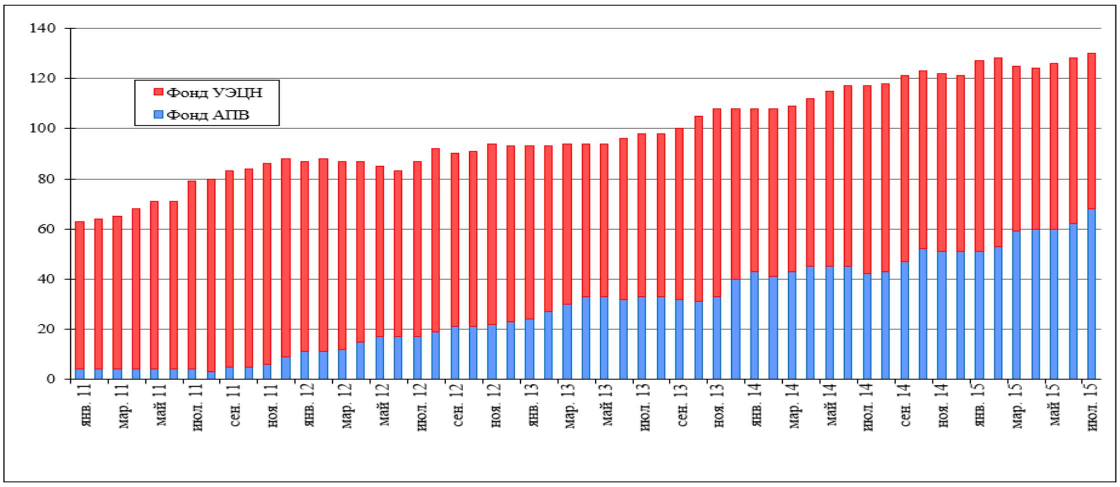


Figure 2 – Dynamics of the well inventory of the Kumkol field

The late stages of oil field development are characterized by a high level of water production, which necessitates measures to increase well flow rates in order to maintain oil production levels. As the well's flow rate increases, the release of mechanical impurities from poorly cemented formations increases due to the formation of micro-cracks, which leads to an increase in the velocity of filtration in the walls of channels and fissures and the destruction of the reservoir skeleton. The nature of the particles in the pumping equipment is varied.

According to the accepted classification, the presence of mechanical mixtures in wells is due to several reasons:

* introduction of mechanical mixtures into the near-wellbore zone of the formation during current and capital repairs of wells (C&R), fracturing (F), as well as during the drilling process;

* Injection of unqualified completion fluids (dirty solutions) into the well;

* Geological causes: productive formations composed of weak, fracture-prone rocks during development, resulting in sand production from the well. Among the main sources of mechanical contaminants entering the suction unit, four main groups can be distinguished according to their nature of origin.

The reservoir, production well, downhole equipment, as well as the process fluids injected into the reservoir (Figure 3) [1-3]. Based on the conditions for the formation of mechanical mixtures, three main groups of causes for reservoir damage and sand formation can be distinguished: geological, technical, and technological. They are shown in the diagram in Figure 4.

The following geological causes of reservoir impairment can be distinguished: the reservoir's formation depth; reservoir pressure; the nature of the produced fluid and its phase state; the degree of cementation of the reservoir, its permeability; injection of formation water into the deposit and dissolving the cementing material; characteristics of the formation sand (angularity, clay content), and a number of other factors.

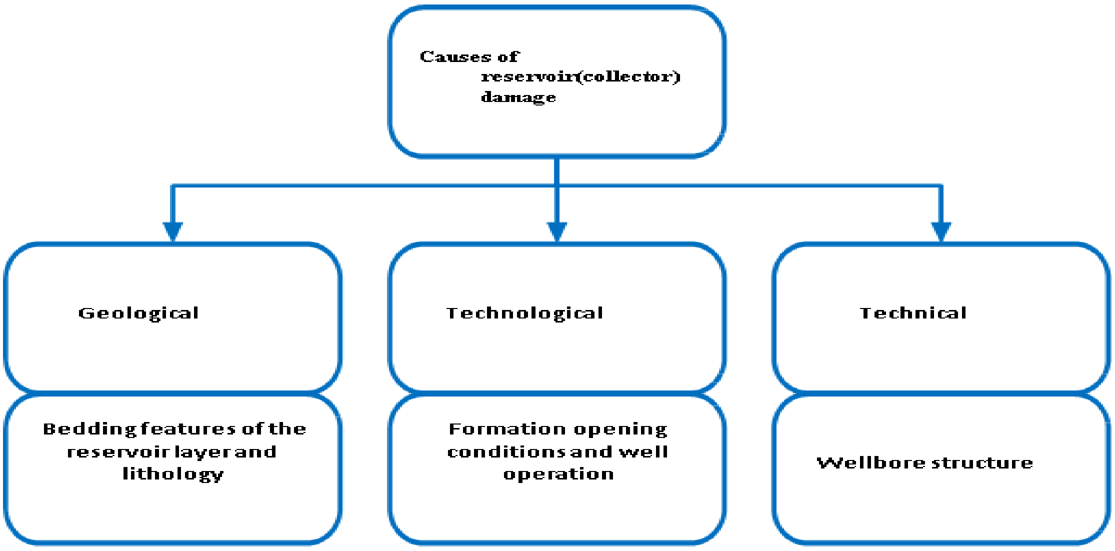


Figure 3 – Main causes of reservoir damage

Technological causes are related to the following properties: wellbore yield, formation drawdown, sand loads, etc. Technical reasons include factors such as: wellbore design, formation spacing, perforation string openness, etc.

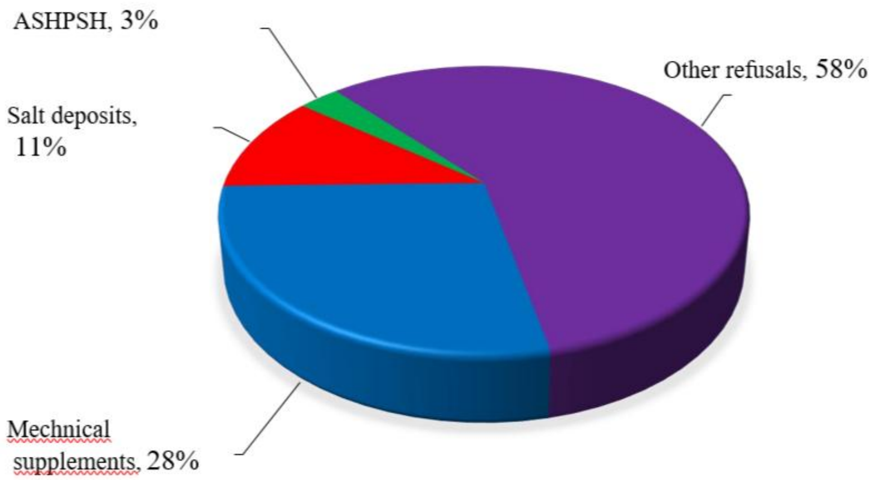


Figure 4 – Causes of failure of electric centrifugal pump installations

The remaining failures are mainly due to the quality of EOTS manufacturing and operation, specifically cable damage, mismatch between EOTS parameters and well or formation parameters, and a number of other causes. The presented statistics allow us to conclude that the most pressing issue in mechanized oil production is the prevention and control of deposits of salts, asphaltenes and paraffins, as well as mechanical inclusions. Mechanical impurities are one of the main causes of failure in deep pump equipment.

For most oil fields in the Kumkol field, pump equipment failure due to the effects of mechanical contaminants is 35-50% accounts for mechanical contamination failures, and in some cases this share can reach 80%; the share of defects due to corrosion is 20–25%, and for salt deposits it is 15–20%. For example, According to data from the Kumkol field, equipment failures due to blockages from mechanical impurities account for 33%. Mechanical impurities significantly affect the performance of EOTS. Large particles accumulate inside the pump, causing it to clog, while smaller ones generate vibration and lead to abrasive wear of the pump equipment, as sand is a highly abrasive agent [4-6] .

Additionally, leaks in threaded connections, especially in wetted wells, can occur, causing the threads to "corrode" with mechanical contaminants, which leads to the formation of a fluid leak path, resulting in reduced delivery. In recent decades, due to the deterioration of reservoir structure, there has been an intensive development of research in oil production from small and medium-flow wells, as well as in the field of oil production under complex conditions. The existing methods for combating challenges in complex conditions are diverse and numerous, but no single method can address all the main challenging factors; a combination of methods is required.

In this regard, over the past two decades a trend has emerged in search of a comprehensive solution that enables addressing multiple challenges. This approach not only solves technological issues but also reduces the economic costs of dealing with complex factors.

1. During the course of the work, a literature review of regulatory documents and scientific and technical literature was conducted. Various methods for increasing the oil-producing efficiency of the formations were considered.
The water-gas injection method was selected as the most suitable and relevant for solving the tasks set forth as a result of evaluating the efficiency, application criteria, and utilization potential of associated petroleum gas.

2. As a result of analyzing methods for implementing water-gas treatment, the use of pump-ejector systems was chosen because they are technically and economically reliable and efficient.

3. For the calculations, a technological scheme for implementing the water-gas impact was selected, using a pump-ejector system with the minimum number of process equipment and moving parts, which in turn allows for increased equipment reliability and a reduction in its acquisition cost and operating expenses for repair and maintenance.
For many years, the oil production sector has remained an important link in the entire fuel and energy complex in Kazakhstan and in many other oil-producing countries. A steady increase in global demand for the production of such a valuable resource is being observed. It is estimated that there are 244.6 billion tons of proven oil reserves worldwide. Alongside the development of conventional reserves, the share of those involved in exploiting fields whose development is complicated by certain factors is growing. There is an urgent need to develop new technologies, as well as to increase the reliability and effectiveness of the application of existing methods of influencing oil fields in order to increase oil production [7-8].

A relevant and interesting solution is to implement the water-gas interaction (WGI) using a pump-ejector system (PES) composed of a pump and an ejector. Pump-ejector systems can generate a fine-dispersed water-gas mixture that is injected into the formation through producer wells. The success of implementing the proposed solution depends on the following factors: • geometric parameters of the ejector (length of the mixing chamber, nozzle parameters, distance from the nozzle to the entrance of the mixing chamber); * operating parameters of the system (developing pressure, pressure upstream of the nozzle) • composition of the water-gas mixture phases (mineralization of the working fluid, gas composition, presence of base).

It is worth noting the potential for using associated petroleum gas (APG), since according to official Global Gas Flaring data for 2018–2020, a significant volume is flared in Kazakhstan. The resistance of the water-gas mixture to external factors, i.e., the mixture's degree of resistance to external influences, is one of the main factors affecting the efficiency of the water-gas injection technology. The water-gas injection allows for a greater flow of oil because it promotes increased layer coverage in both the area and thickness of the water-gas mixture. This is due to the good permeability of the mixture compared to the water's permeability in the same rock sample.

To enhance treatment efficiency, it is recommended to conduct filtration tests on granular models to determine the dependence of the gas-injection coefficient on the pore-water mixture under layered conditions. The known methods for increasing the reservoir's oil recovery factor using a driving agent are divided into several types: There is also a classification by the stages of field exploitation. In reality, a single stimulation method is very rarely used, and several methods are typically applied simultaneously—a combined stimulation. This allows for a further increase in the effectiveness of each method [9-10].

For each specific case, the characteristics of the oil and gas reservoir are compared with the application limits of the reservoir's oil production enhancement methods to select the most suitable method for increasing oil production, i.e., a screening is conducted. The main factors in selecting the most effective method for increasing oil production are the depth of the reservoir and the viscosity of the oil; however, there are many other parameters that must be considered at this stage of the work, such as water saturation, gas factor, temperature, and reservoir pressure, etc. etc. The implementation of modern methods to increase the oil-producing efficiency of reservoirs is a complex and expensive process compared to traditional working methods.

Results discussion. New technologies are complex chemical and physical processes and transformations that occur in the bulk and on the surface. According to the action of the gas agent, the water–gas effect is divided into several types [11]. It is possible to use "dry" or enriched hydrocarbon gas containing a large amount of hydrocarbon solvents. Using air as an agent carries the risk of exothermic oxidation reactions between the hydrocarbons in the oil and the oxygen in the air. In this case, the air does not serve as a working agent but rather as a means to achieve the required displacement. Depending on temperature, pressure, and the fluids in the formation, there are several different variants of the oil displacement process. Smokewood gases are used when a thermal effect on oil production is not desired. When using the thermogas method, internal combustion in the formation is initiated at high regional temperatures.

When using water–gas injection technology, the injection methods are divided into several types of formation injection [12]: In the sequential injection method, gas is injected for an extended period, followed by water injection into the formation. Sequential injection means injecting the agents into the formation separately, with the volume of the formation's edges not exceeding 15% of the initial volume. In joint injection, gas and water enter the formation simultaneously to form a mixture. The advantages of the water-gas stimulation technology for enhancing the reservoir's oil recovery factor are considered [13-14]:

* It can be applied immediately to individual producing wells or across the entire field;

* The technology allows it to be used in existing fields as part of the reservoir pressure maintenance system;

* It allows for the reduction of water breakthrough in production wells;

* Increased oil recovery. This is achieved through the presence of water in the gas-liquid mixture, which allows for an increase in the productive formation's sweep efficiency and raises the oil displacement efficiency from the porous medium;

* Allows for the effective resolution of the issue of associated gas utilization in oil production;

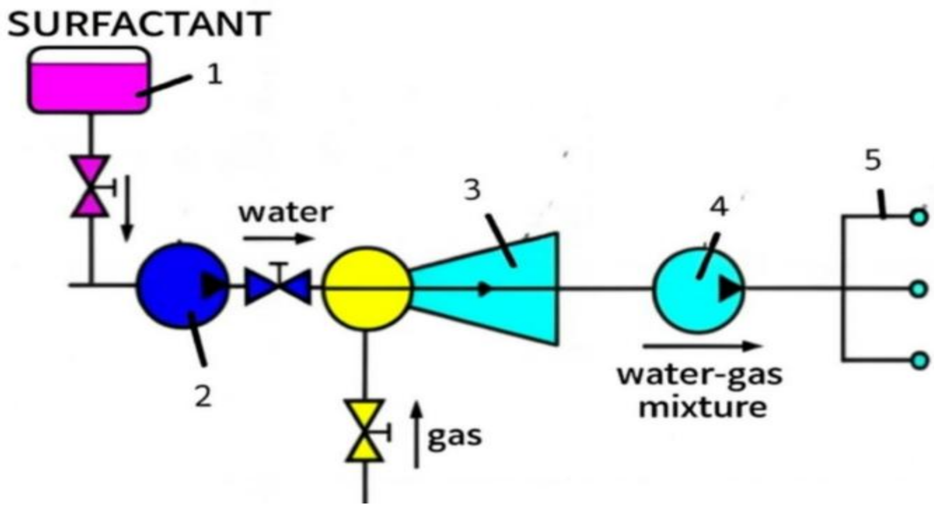
It is also worth noting the disadvantages of this technology:

* It requires high capital expenditures for the construction of a gas pipeline to provide the necessary volume for the water-gas injection system;

* The gas for this technology must be at a high pressure;

* A sufficient gas source is required for effective operation.

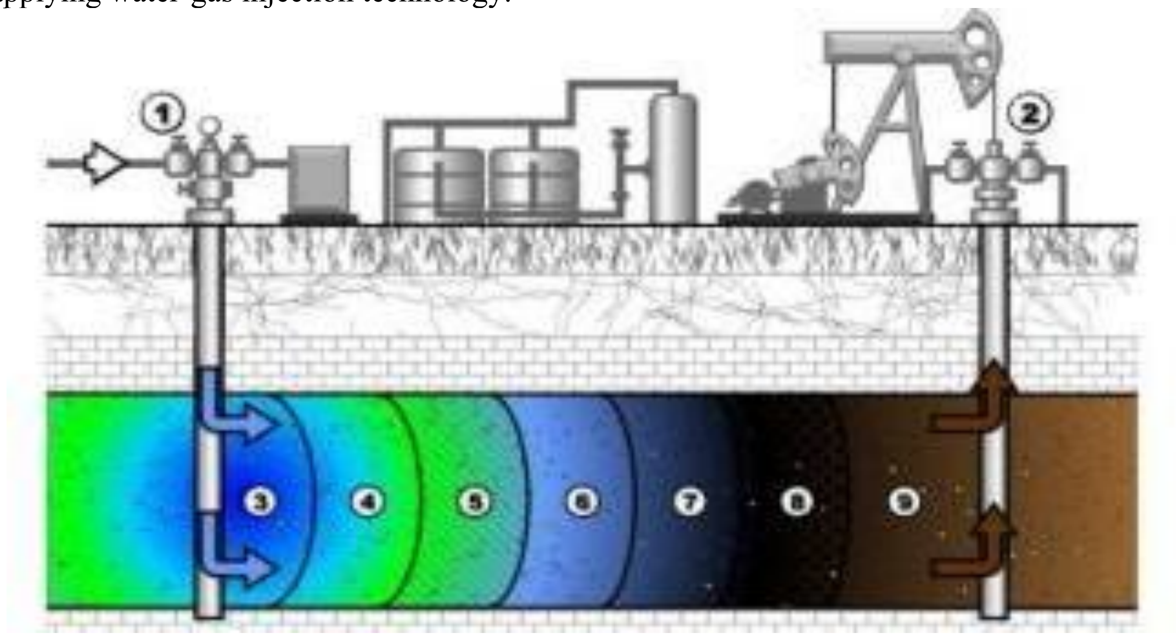
The well design becomes more complex due to the need for greater sealing of the production and pump-compressor tubing columns, and the use of a packer device is also required. The challenges of implementing the water-gas injection technology include the calculation and selection of the process equipment for pumps and compressors, as well as regulating its continuous operation and establishing the required parameters of the technological process. The basic technological scheme for water-gas injection into the formation is shown in Figure 5 [15].



1-page active substances; 2,4-electrocentrifugal pumps; 3-injector, 5-injection wells

Figure 5 – Schematic of the water-gas injection into the formation using a pump-injector system

Figure 6 shows the basic schematic for displacing oil from a productive formation by applying water-gas injection technology.



1 – Drive well; 2 – Production well; 3 – Water-gas zone; 4 – Gas; 5 – Water-gas zone; 6 – Gas; 7 – Mixing zone; 8 – Oil stem; 9 – Initial state reservoir.

Figure 6 – Schematic of water-gas displacement of oil

The accuracy of the selected method of influence on the reservoir determines the efficiency of this field's development. The choice of the displacement method itself is determined by several conditions, including: the geological and physical conditions of the oil field, its composition, structure, and other factors, including the properties and characteristics of the fluids. The method is selected based on this data, which satisfies the screening criteria. For the effect of water and gas, the criteria shown in Table 1 are also included.

Table 1 – Criteria for the use of water and gas

Parameters	Units of measurement	Application criteria
Depth	m	1000-1800
Formation pressure	mPa	15-18 or more
Formation thickness	m	2-20
Porosity	%	10-35
Permeability	mkm ^{2}	0.02-0.8
Formation temperature	$^o C$	>50
Oil viscosity	mPa·s	1-10

The ambiguity of the application criteria is explained by the limited research on some of the processes that occur when using this method. The most common explanation for the mechanisms observed when acting on the layer with gaseous water is a model derived from experimental results, in the work of scientists Yu. M. Ostrovsky and E. I. Liskevich, where large channels are hydrophobic, while small channels are, conversely, hydrophilic. This model was proven and confirmed by foreign scientists through experiments conducted on transparent models of a porous medium. Visual data showing the effect of gas and water on large and small pores was obtained.

In the experimental model, hydrodynamic processes are examined from the flow perspective; therefore, using this method to calculate the effectiveness of reservoir stimulation requires determining the properties of the medium, as well as the properties of the oil and gas that govern the fluid flow regime. Let us evaluate the results of studies on the dependence of the oil displacement coefficient on water–gas injection into the formation under various operating modes of the process equipment: In the studies, the displacement oil was first gas-displaced, then water-displaced, and vice versa – water-displaced, then gas-displaced; when water and gas are injected simultaneously; when the working fluids are injected alternately; and over various durations of such injection cycles.

Data obtained from the conducted studies show a strong impact of the product layer's porous medium on the oil recovery efficiency of the waterflooding process and on increasing the oil-drive coefficient. In terms of capital and operating costs, pump-jet installations offer significant advantages over compressor and booster units thanks to their low-cost, reliable equipment. From the above, it is concluded that this technology has the potential for wide implementation and problem-solving during the water-gas method development of fields, due to its use of available and quality equipment to influence the productive formation. The disadvantages include the need to create a high pressure of the gas-liquid mixture. This requires appropriate technological equipment and the availability of water and gas.

To analyze and address the issues of using pump-jet systems for water-gas injection into a formation, one must first consider what a jet apparatus is. It is divided into two types: the ejector and the injector. An ejector is a flow device designed to draw in liquid or gas. An injector, by contrast, enables pumping. The operation is based on energy exchange and the interaction of fluid streams in the device. The schematic of the flow device is shown in Figure 7. The device's operation begins when a high-pressure stream of liquid enters the nozzle inlet, where the pressure decreases while the velocity, conversely, increases. Then the flow enters the mixing chamber, which is already filled with a propellant whose velocity and pressure have been significantly reduced.

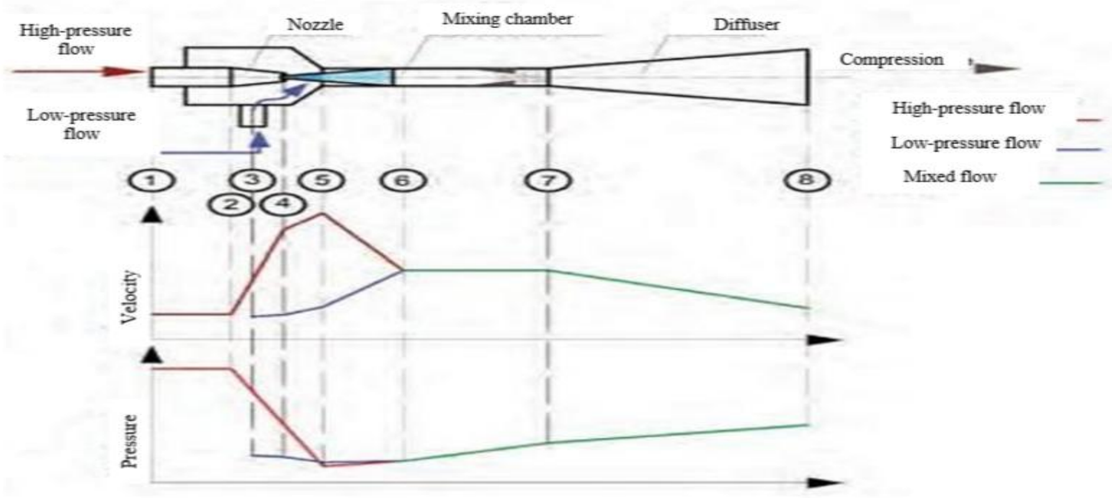


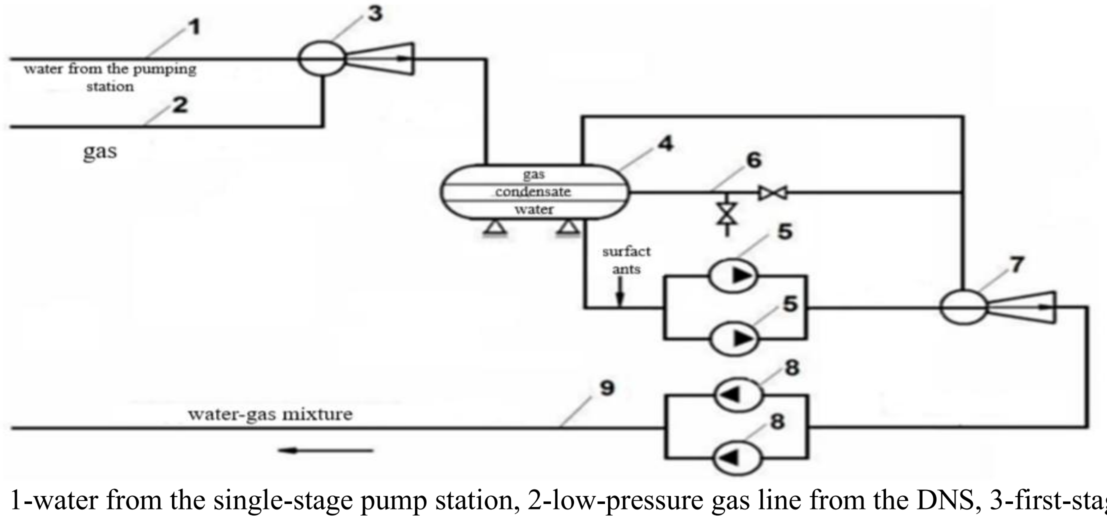
Figure 7 – Schematic of the flow device's operation

After passing through the nozzle, the flow breaks up and the media mix with each other. At this point, the kinetic energy of the working agent is converted into the pressure of the mixture. Then the mixture passes through the apparatus's expanding section—the diffuser—where the pressure increases and the velocity decreases. Furthermore, it is necessary to understand the reasons for the limited scope of using jet apparatus to increase and maintain the pressure of a liquid or gas compared to conventional pump and compressor units. This is primarily due to the following issues:

* the efficiency of flow devices is significantly lower compared to volumetric and dynamically acting machines—by approximately 30-40%, although the upper limit has not yet been precisely determined;
* the insufficient study of the operation of these devices in variable modes;
* inadequate research into issues of regulating the operation of flow devices.

Despite the drawbacks mainly due to the limited research on the devices, they have a number of practical advantages, for example:

* Low equipment cost;
* Short payback periods; To perform the calculations, the process schematic shown in Figure 8 was selected.



1-water from the single-stage pump station, 2-low-pressure gas line from the DNS, 3-first-stage compression ejector, 4-separator, 5, 8 – multistage pumps, 6 – condensate return line, 7 – second-stage compression ejector, 9 – water line to injection wells.

Figure 8 – Process diagram of the water-gas injection pump-ejector system

Data for the calculation are presented in Table 2: Calculation of the hydrostatic pressure in the well:

$$P_{guide} = \rho_{water} \cdot g \cdot H_{well} \quad (1)$$

$$P_{guide} = 1007 – 9,81 - 1339 = 13,23 \text{ MPa}$$

Calculation of water velocity:

$$v_{water} = Q / S = Q_{water} \cdot 4 / t \cdot \pi \cdot d_{pqu} \quad (2)$$

$$v = 978 \times 4 / 86400 \times 3,14 \times 0,1142 = 1.11 \text{ m/s}$$

Reynolds number calculation:

$$Re = v_{water} \cdot d_{pqu} \cdot \rho_{water} / \mu \quad (3)$$

$$Re = 1,11 \cdot 0,114 \cdot 1007 / 1 \cdot 10^3 = 12740$$

The obtained value $Re > 2320$ corresponds to the turbulent regime. Calculation of the region boundaries:

$$\text{Lower boundary} = 10\, d_{pqu} / \Delta = 10 \cdot 114/0,1 = 11400 \quad (4)$$

$$\text{Upper boundary} = 500\, d_{pqu} / \Delta = 500 \cdot 114/0,1 = 570000 \quad (5)$$

Table 2 – Initial Data

Name	Symbol	Value
Gas volume fraction in the mixture under the layer condition	α	30%
Density of water at standard conditions	ρ_{water}	1007 kg/m^3
Gas density at standard conditions	ρ_{gas}	1,228 kg/m^3
Pressure at the gas injection wellhead during injection	P_{cag}	12 MPa
Injected water volume	Q_{water}	978 m^3/day
Well depth	H_{well}	1339 m
Internal diameter of the wellbore	$d_{wellbore}$	114 mm
Gas flow rate under standard conditions	Q_{gas}	35000 m^3/day
Gas pressure at intake	P_{intake}	0,4 MPa

Calculation of the hydraulic resistance coefficient for Region 2 of the turbulent regime:

$$\lambda = 0,11 \cdot (68/Re + \Delta / d_{pqu})^{0.25} \quad (6)$$

$$\lambda = 0,11 \times (68 / 12740 + \Delta / 114)^{0.25} = 0.021$$

Calculation of friction pressure losses:

$$h_{friction} = \lambda \cdot (Q/d_{pqu}) \cdot v2 / 2g \quad (7)$$

$$h_{friction} = 0.021 \cdot (1339/0,114) \cdot (1.112/2 \cdot 9,81) = 15.71 \text{ m}$$

Calculation of the pressure loss due to friction:

$$P_{friction} = \rho_{water} \cdot g \cdot h_{friction} \quad (8)$$

$$P_{friction} = 1007 \cdot 9,81 \cdot 15,71 = 1,55 \cdot 105 \text{ Pa}$$

Calculation of total wellbore pressure:

$$P_{кенjar} = P_{gid} + P_{friction} + P_{sage} \quad (9)$$

$$P_{kenjar} = (132,3 + 1,55 + 120) \times 10^5 = 25,38 \times 10^6 \text{ Pa}$$

Conclusions. The work examines methods of reservoir stimulation and their implementation through various technologies to increase oil production. Among them, the water-gas injection method using a pump-jet system was chosen as the most versatile and reliable method. Based on the calculations performed, the necessary process equipment for the water-gas injection system was selected to increase the reservoir's oil production and to utilize the associated natural gas.

The liquid flow is 978 m^3 per day, and under standard conditions the gas flow is 35,000 m^3 per day. The pressure at the wellhead is 14.31 MPa. The total power consumed by the pumps is 531.6 kW. The calculated budget for the scientific and technical research, taking into account the purchase of technological equipment, is 104923308 tenge. As shown by the technical-economic evaluation, the additional oil production using the pump-jet system amounts to 1460 tons per year. The calculation shows that the net profit from selling the additional oil produced amounts to 389,318,785.30 tenge.

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КҮРДЕЛІ ЖАҒДАЙЛАРДАҒЫ КЕН ҚАБАТТАРЫНЫҢ МҰНАЙ БЕРГІШТІГІН АРТТЫРУ МАҚСАТЫНДА СОРАПТЫ – ЭЖЕКТОРЛЫ ҚОНДЫРҒЫЛАРДЫ ҚОЛДАНУ

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Аңдатпа. Кен орындарын су айдау арқылы игерген кезде, игеруде қиындататын жағдайлардың біріне ұңғымаларда, сораптарда, жинау және дайындау қондырғыларында қатты шөгінділерінің түсуі болып табылады. Мұнай өндіру мен ұңғыманы пайдалану кезінде, қондырғылар мен жабдықтарға кері әсер ететін факторлар мен олармен күресу әдістемелері және агрегаттар сенімділігін арттыру жолдары келтірілген Ұңғымадағы асфальтен, шайыр және парафиннің шөгуіне қарсы күресу шаралары, ұңғымаға тұздардың түсуі және олармен күресу әдістері, жабдықтармен құбырларды тотығудан қорғау шаралары зерттелді. Жұмыста мұнай өндіруді арттыру мақсатында қабатқа әсер ету әдістері және оны әртүрлі технологиялармен жүзеге асыру нұсқалары қарастырылған. Олардың ішінен ең әмбебап және сенімді әдіс ретінде сорапты-эжекторлық жүйені қолдана отырып, су-газды әсер ету әдісі таңдалды. Жүргізілген есептеулер нәтижесінде қабаттың мұнай беруін арттыру және ілеспе мұнай газын кәдеге жарату мақсатында қабатқа су-газ әсерінің сорапты-эжекторлық жүйесі үшін қажетті технологиялар келтірілген.

Тірек сөздер: ұңғыма, шөгінділер,сорапты-компрессорлы құбырлар, су-газ айдау, сорапты-эжекторлық жүйе, мұнай бергіштік,технология, коллектор.

ПРИМЕНЕНИЕ НАСОСНО-ЭЖЕКТОРНЫХ УСТАНОВОК ПРИ ПОВЫШЕНИИ НЕФТЕОТДАЧИ ПЛАСТОВ В СЛОЖНЫХ УСЛОВИЯХ

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Аннотация. При разработке месторождений с перекачкой воды одним из условий, затрудняющих разработку, является отложение твердых отложений в скважинах, насосах, сборных и заготовительных установках. При добыче нефти и эксплуатации скважин изучены методы борьбы с проседанием асфальтена, смолы и парафина в скважине с указанием факторов, негативно влияющих на установки и оборудование. Изучены методики борьбы с ними и путей повышения надежности агрегатов при поступлений солей в скважину и методы борьбы с ними, меры защиты трубопроводов. В работе рассмотрены методы воздействия на пласт с целью увеличения добычи нефти и варианты ее реализации по различным технологиям. Из них в качестве наиболее универсального и надежного метода был выбран метод водно-газового воздействия с использованием насосно-эжекторной системы.В результате проведенных расчетов приведены технологии, необходимые для насосно-эжекторной системы водно-газового воздействия на пласт с целью повышения нефтеотдачи пласта и утилизации попутного нефтяного газа.

Ключевые слова: скважина,отложения, насосно-компрессорные трубы, водогазовая перекачка, насосно-эжекторная система, нефтеотдача, технология, коллектор.