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INTRODUCTION OF INNOVATIVE COMPOSITE SYSTEMS IN THE FIGHT AGAINST THE FORMATION OF SALT DEPOSITS IN WELLS

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Abstract. The article deals with the formation of salt deposits in operational facilities during oil production. Using the example of the analysis of this problem for a number of fields in Russia, Azerbaijan and Kazakhstan, it is shown that this problem is especially pronounced in long-term developed fields. At the same time, it is noted that wells operated by the ESP belong to the high-risk group. It is noted that microbiological processes further complicate the problem due to the formation of deposits of complex composition. The main reasons for the process of salt deposition in the bottom-hole zone and the failure of a number of geological and technical measures to rehabilitate the filtration and reservoir properties of the formation in the bottom-hole zone are given. In order to increase the efficiency of the geological and technical measures carried out, a technology for processing the bottom-hole zone based on the use of ammonium chloride (NH_4Cl) in combination with surfactants is proposed.

This research paper is devoted to the problem of eliminating salt deposits in wells using the latest composite systems. Salt deposits in wells pose a serious problem for the oil and gas industry, as they can lead to a decrease in well productivity and an increase in operating costs.The paper discusses various methods and technologies aimed at preventing and removing salt deposits. Special attention is paid to innovative compositional systems that can effectively combat this problem. The work includes a review of existing methods, an analysis of their advantages and disadvantages, as well as the study of new approaches to solving this problem.The study provides important recommendations for oil and gas companies and well drilling specialists, helping them choose the most effective solutions to combat salt deposits and ensure more reliable and productive well operation.

Key words: salt deposition, flooding, CCD-bottomhole zone of wells, operation of wells with ESP, deposits with complex composition, inhibitors, ammonium chloride.

Introduction.The deterioration of the structure of hydrocarbon reserves in recent decades objectively leads to a complication of the conditions for the operation of extractive Wells. This leads to a decrease in the coefficient of well use, an increase in the cost of carrying out forced geological and technical measures, the implementation of new technical and technological solutions to achieve the planned volume of hydrocarbon production.

The deterioration of the structure of hydrocarbon reserves over the past decades objectively leads to a complication of the conditions for the operation of extractive Wells. This leads to a decrease in the well utilization rate, an increase in the cost of carrying out forced geological and technical measures, and the implementation of new technical and technological solutions to achieve the planned volume of hydrocarbon production.

An analysis of factors complicating the operation of extractive oil wells on deposits in Azerbaijan, Russia and Kazakhstan shows that the main complications during the operation of wells are associated with mechanized reserves, although Wells used by the fountain method are no exception.

In about 75 percent of cases, there is a joint manifestation of various complications associated with salt formation, water visibility, sand formation, corrosion, changes in the filtration capacity properties of the near-root zone, etc. For example: processes of well deposition and irrigation, flows (inter-layer, columnar) and salt deposits, heavy hydrocarbon deposition and sediment formation, irrigation and mechanical suffocation,deterioration of the near-Well area of the well for various reasons and sedimentation, as well as other complications associated with changes in the thermobaric and gas-dynamic features of the manufactured product.

Materials and research methods. The formation of salt deposits leads to a decrease in well flow, premature failure of expensive equipment and additional well repairs, as a result of which the technical and economic indicators of oil and gas producing enterprises deteriorate.

The formation of salt deposits in the working bodies of the OES and the wear and tear caused by them is the main cause of both premature failure of installations and accidents associated with the collapse of wells into the pit [1].

Work in the direction of combating salt deposits can be conditionally divided into two categories - preventive measures related to the Prevention of a possible sedimentation process and "removal" of formed solid deposits.

The development of timely and appropriate preventive measures is possible at the stage of studying the mineralized composition of reservoir waters on the cross-section of deposits. Although this approach is necessary, at the same time it is not enough to solve the problem associated with the constantly changing gas-hydrodynamic situation and geochemical changes in the complex layer system.

Currently, the solution to the problems of preventing salt formation is becoming more complicated due to the formation in wells of salts of a complex composition containing iron sulfide. The composition of the deposits is dominated by Gypsum, calcite, barite. In the form of impurities in the sediments, yutsya meet iron sulfide, solid hydrocarbon compounds of oil, particles of quartz and clay rocks, well liquid impregnation [2]. The formation of such deposits is a consequence of not only complex geochemical changes in the layers and associated extracted waters, but also microbiological processes in the lower layer of the formation and in Wells. Microbiological processes further complicate the operation of Wells due to the formation of hydrogen sulfide, which leads to increased corrosion of equipment and an increase in the share of iron sulfide in precipitation. The relevance of the problem of combating salt deposits of complex composition is increasing, since the reserves of Wells, the operation of which is complicated by salt deposits, are constantly increasing.

As a rule, the entire complex of measures for the prevention and control of salt deposits can be divided into 3 categories : technical-technological, physical and chemical. Activities of a technical and technological nature primarily involve the implementation of technologies for limiting water flows, isolation of wetted Proplastics within layered-heterogeneous collectors, elimination of possible flows, careful planning of measures for the effect of water C, taking into account the features of layered waters and the properties of pumped water, as well as various technical solutions for regulating the dynamic characteristics

Among the physical methods, it is worth noting the use of magnetic and electric fields. This can include nanotechnology based on the use of ionized systems produced triboelectrically [3].

Chemical methods provide for the implementation of sediment prevention technologies based on the inhibition of well products, as well as measures to remove sulfate and carbonate deposits formed using chemistry. reagents and various technological fluids [4].

One of the reasons that reduce the efficiency of well production wells is the deposition of salts directly in the bottom zone of the formation, and there is no alternative to chemical methods for their removal. However, in some cases, the effectiveness of these activities is very low and sometimes ineffective, so these operations are classified as unsuccessful. The problem is especially acute in multi-layer and long-term deposits.

Inter-layer flows occurring at some sites, legal flows, breakthrough of water pumped into the wells of wells produced by heavily drained sites, the appearance of sulfate-reducing bacteria in the water, a sharp change in the thermobaric situation in the bottom area of the well-this is not a complete list of reasons for the formation of complex salt deposits in the near-bottom area of the Wells. Two groups of sediments are usually found: carbonate and sulfate. These are usually carbonates, bicarbonates, sulfates of alkaline and alkaline earth metals (usually calcium, magnesium, barium, strontium) and other complex inorganic compounds of sulfates or carbonates, as well as complex mineral compounds of reservoir waters. To combat such complications, various compositions are presented that allow you to eliminate complex mineral formations in the lower area of the Wells. However, in some cases, their efficiency is somewhat lower, since adsorption films of hydrocarbons are often formed on the surface of these sediments, which impairs the contact of the pumped process fluid with the sedimentary product. The latter is due to changes in the phase permeability of water in the area of compressed sites and the rearrangement of flows in the water-saturated areas of the oil and field zone [5,6].

Results and discussions. In order to increase the effectiveness of geological and technical measures to improve the filtration and capacitive properties of rock collectors of the bottom zone of the formation, we proposed a technology for processing the bottom zone (refineries) based on the use of ammonium chloride (NH4Cl) in combination with opz. The technology involves preliminary washing from the surface of deposits of heavy hydrocarbon compounds, and then distillation of the solvent. When ammonium chloride reacts with carbonate compounds of sediments, the following reactions occur:

$$CaHCO_3 + 2NH_4(HCO_3)+CaCl_2 \quad [1]$$

$$2NH_3+2CO_2+2H_2O \quad [2]$$

$$CaCO_3 +2NH_4Cl = (NH_4)_2CO_3 +CaCl_2 \quad [3]$$

$$2NH_3 +2CO_2+2H_2O \quad [4]$$

The sediment formed as a result of these reactions is well soluble in water and discharged to the surface in a stream.

In order to study the effect of the oil film on the efficiency of the process of penetration of chemreagent on the surface of deposition and dissolution, preliminary studies were carried out to select the optimal concentration of reagents and the possibility of implementing the technology of treatment of the bottom zone of the formation based on the preliminary washing of adsorption hydrocarbon films from the surface of sediments with subsequent pumping of ammonium chloride was studied.

The research was carried out in the following order. Initially, models of carbonate deposits were created on the surface of plates of the same size under the same conditions. Further, plates with artificially created carbonate deposits were placed in oil and thus a hydrocarbon film was formed on their surface. To study the oil washing ability of BZ solutions in different temperature and dynamic modes, model samples were placed in prepared solutions of sulfanol of different concentrations. The effectiveness of washing was assessed by the mass of the sample before and after the process.

Figure 1 shows the isotherms of the dependence of the efficiency of the oil film washing process on the concentration of sulfanol. As a result of this series of experiments, it was found that the optimal concentration for 50^{o}C temperature conditions is 0.05%. At 25^{o}C, the optimal concentration is 0.07%.

Further research looked at estimating the optimal ammonium chloride concentration range by the parameter of the residual value of the adsorbed sediment.

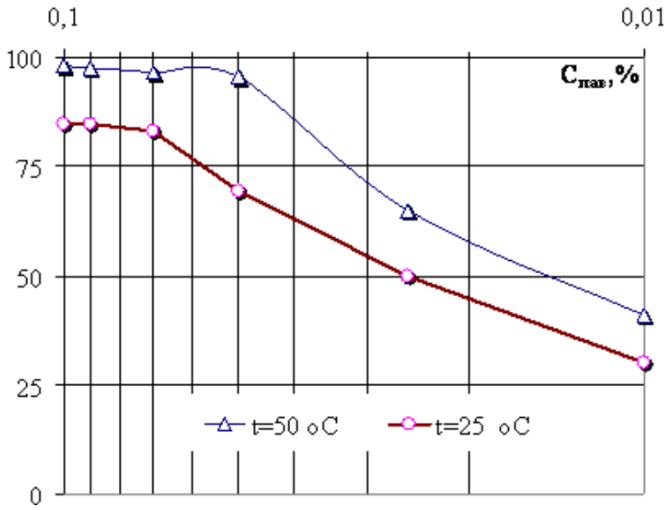

Figure 1. Dependence of oil washing capacity on surfactants concentration

The results of these studies (figure 2) indicate that a solution of ammonium chloride with a volume content of 4% of the main substance is most suitable.In this case, the sediment is completely removed within 8 hours (figure 3).

Analysis of the kinetics of the dissolution process shows that the most intense dissolution occurs within the first two hours.

To quantify the kinetics of the dissolution process, parameter E was introduced, which characterizes the rate of loss of sediment mass over each discrete period of time (fig.4):

$$E = Mt / \Delta T, \quad [5]$$

here,

$$Mt\ i = Mi - Mi\text{-}1 \quad [6]$$

Mi-The total mass of dissolved sediments by Time t as a percentage of the total mass of sediments determined by the results of graviometric measurements

Mi-1 is the total mass of dissolved sediments over time (T-1) as a percentage of the total mass of sediments determined by the results of graviometric measurements.

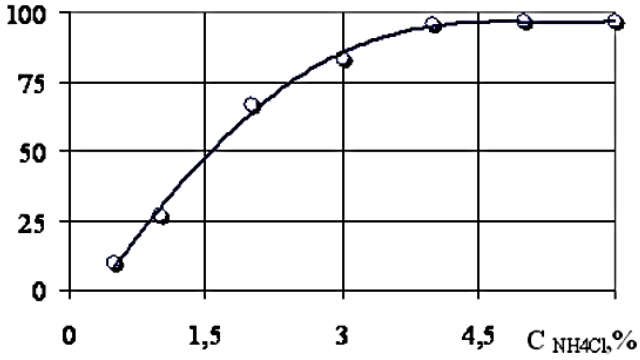

Figure 2. The effect of ammonium chloride concentration on the efficiency of the Salt sediment removal process

As can be seen from Figure 3, after 2 hours of intensive reaction, the dissolution rate stabilizes and the subsequent removal of sediments is characterized by the stability of the rate at which solid sediments pass into the solution. The process ends with a relatively slow melting rate of solid sediments.

In order to study the features of changes in the filtration - capacitive XA characteristics of collectors in the process of implementing the proposed technology, experimental studies were carried out on models of various porous CP.

The research was carried out on linear models of porous media in which the modeling conditions were preserved.

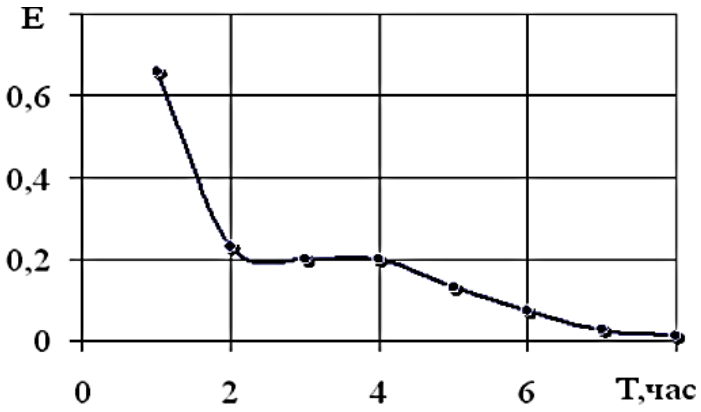

Figure 3. Kinetics of the process of dissolving salt deposits

The length and diameter of each column was 1.7 and 4.4 10-2 M, respectively, the dimensions of the column were: length - 1.7 m, diameter - 4.4 10-2 m. the porous medium consisted of quartz sand with the same fraction of layers of mineral salts prepared from natural deposition products on the surface of pump-compressor pipes. The volume of pore space and the permeability of layer models through air and oil were predetermined. The determination of the permeability of porous media over oil preceded the process of their saturation with hydrocarbon liquid. After that, oil replacement operations were carried out with the proposed formulations. For this purpose, the first column was given a solution of 4% ammonium chloride, and the second sequentially: a rim of 0.05% sulfanol solution and a solution of 4% ammonium chloride in an equal ratio. The volume of pumped technological fluids was 10, 50, 100, 150 and 200% of the volume of the porous space of the layer model. Studies have shown that the best results are achieved by pumping the proposed technological system in an amount of 100-150% of the pore volume.

The result of the study.Based on the results of experimental studies, the effectiveness of the use of the proposed compositions was evaluated. As an efficiency criterion, the parameter of the relative change in the permeability of the same porous media (E) after pumping a 4% Solution of ammonium chloride and the same solution with a 0.05% sulfanol solution was used. This parameter characterizes the actual technological effect (fig. 4). As can be seen from the figure, the best results are achieved by using a 0.05% solution of sulfanol and a 4% Solution of ammonium chloride in the process of their distillation from a percentage of 50%, each from the pore volume.

Conclusion. As a result of cleaning the near - bottom area of wells by the recommended method for more than 4 months, the flow rate of wells increased by 20-25%. During the specified period , the refusal to operate underground equipment was completely excluded, and preventive measures to curb the flow for 3 months were suspended at MGPO Wells, where measures to dose the produced product with an organophosphorus reagent are traditionally used.

The introduction of innovative composite systems in the fight against the formation of salt deposits in Wells is an important and promising direction for the oil and gas industry. These systems can significantly improve the use of Wells and reduce the cost of their maintenance.The use of new technologies and materials makes it possible to prevent and eliminate salt deposits, which helps to maintain high productivity of Wells.Innovative composite systems offer long-term and sustainable solutions compared to traditional methods of dealing with salt deposits.The results of the study show that the implementation of innovative composite systems is not only economically

justified, it also confirms that it contributes to reducing the negative impact on the environment.It is important to continue the research and development of new technologies in this area in order to achieve even more effective solutions and ensure the sustainable development of the oil and gas industry.

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ҰҢҒЫМАЛАРДА ТҰЗ ШӨГІНДІЛЕРІНІҢ ПАЙДА БОЛУЫМЕН КҮРЕСТЕ ИННОВАЦИЯЛЫҚ КОМПОЗИЦИЯЛЫҚ ЖҮЙЕЛЕРДІ ЕНГІЗУ

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Аңдатпа. Мақалада мұнай өндіру процесінде пайдалану объектілерінде тұз шөгінділерінің пайда болу мәселелері қарастырылған. Ресей, Әзірбайжан және Қазақстанның бірқатар кен орындары бойынша осы проблеманы талдау мысалында бұл мәселе әсіресе ұзақ уақыт бойы игеріліп жатқан кен орындарында қатты байқалатыны көрсетілген. Бұл ретте жоғары тәуекел тобына ОТЭСҚ пайдаланатын ұңғымалар жататыны атап өтіледі. Микробиологиялық процестер күрделі құрамдағы шөгінділердің пайда болуына байланысты мәселені одан әрі қиындатады. Түп маңы аймағында тұздардың түзілу процесінің негізгі себептері және қабаттың сүзу-сыйымдылық қасиеттерін оңалту бойынша бірқатар геологиялық-техникалық шаралардың сәтсіздігі келтірілген. Жүргізілетін геологиялық-техникалық іс-шаралардың тиімділігін арттыру мақсатында аммоний хлоридін (NH_4Cl) беттік әрекеттік заттармен біріктіріп пайдалану негізінде кенжар маңы аймағын өңдеу технологиясы ұсынылады.

Бұл зерттеу жұмысы ең жаңа композициялық жүйелерді қолдана отырып, ұңғымалардағы тұз шөгінділерін жою мәселесіне арналған. Ұңғымалардағы тұзды шөгінділер мұнай-газ өнеркәсібі үшін үлкен проблема болып табылады, өйткені олар ұңғымалардың өнімділігінің төмендеуіне және пайдалану шығындарының жоғарылауына әкелуі мүмкін.Жұмыста тұз шөгінділерінің алдын алуға және жоюға бағытталған әртүрлі әдістер мен технологиялар қарастырылады. Бұл проблемамен тиімді күресуге мүмкіндік беретін инновациялық композициялық жүйелерге ерекше назар аударылады. Жұмыс қолданыстағы әдістерге шолу жасауды, олардың артықшылықтары мен кемшіліктерін талдауды және осы мәселені шешудің жаңа тәсілдерін зерттеуді қамтиды.Зерттеу мұнай-газ компаниялары мен ұңғымаларды бұрғылау саласындағы мамандарға тұзды шөгінділермен күресудің ең тиімді шешімдерін таңдауға және ұңғымаларды сенімді және өнімді пайдалануды қамтамасыз етуге көмектесетін маңызды ұсыныстар береді.

Кілт сөздер: тұз тұндыру, суландыру, ұңғымалардың түп аймағы, ОТЭСҚ бар ұңғымаларды пайдалану, күрделі құрамы бар шөгінділер, ингибиторлар, аммоний хлориді

ВНЕДРЕНИЕ ИННОВАЦИОННЫХ КОМПОЗИЦИОННЫХ СИСТЕМ В БОРЬБЕ С ОБРАЗОВАНИЕМ СОЛЕВЫХ ОТЛОЖЕНИЙ В СКВАЖИНАХ

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Аннотация.В статье рассмотрены вопросы образования отложений солей в эксплуатационных объектах в процессе добычи нефти. На примере анализа данной проблемы по ряду месторождений России, Азербайджана и Казахстана показано, что данная проблема особенно сильно проявляется на длительно разрабатываемых месторождениях. При этом отмечается, что к группе повышенного риска относятся скважины, эксплуатируемые УЭЦН. Отмечается, что микробиологические процессы дополнительно осложняют проблему ввиду образования отложений сложного состава. Приведены основные причины процесса выпадения солей в призабойной зоне и безуспешности ряда геолого-технических мероприятий по реабилитации фильтрационно-емкостных свойств пласта в призабойной зоне. С целью повышения эффективности проводимых геолого-технических мероприятий предлагается технология обработки призабойной зоны на основе использования хлорида аммония (NH_4Cl) в комбинации с ПАВ.

Данная исследовательская работа посвящена проблеме устранения солевых отложений в скважинах с использованием новейших композиционных систем. Солевые отложения в скважинах представляют серьезную проблему для нефтегазовой промышленности, так как они могут привести к снижению производительности скважин и повышению эксплуатационных расходов. В работе рассматриваются различные методы и технологии, направленные на предотвращение и удаление солевых отложений. Особое внимание уделяется инновационным композиционным системам, которые позволяют эффективно бороться с этой проблемой. Работа включает в себя обзор существующих методов, анализ их преимуществ и недостатков, а также исследование новых подходов к решению данной проблемы. Исследование предоставляет важные рекомендации для нефтегазовых компаний и специалистов в области бурения скважин, помогая им выбирать наиболее эффективные решения для борьбы с солевыми отложениями и обеспечивать более надежную и продуктивную эксплуатацию скважин.

Ключевые слова: солеотложения, обводнение, ПЗС-призабойная зона скважин, эксплуатация скважин с УЭЦН, отложения со сложным составом, ингибиторы, хлорид аммония.