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NANOSYSTEM FOR SCALE PREVENTION DURING THE EXPLOITATION OF THE OIL FIELDS IN THE FINAL STAGE OF DEVELOPMENT

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The article is dedicated to the testing of nanosystem for scale prevention generated during oil production in flooded oil wells which are in the final stages of development. The impact of nanosystem caused by the surface active substances, polymer and metal nano particles on the basis of "low impact and stimulation" effect on the salt deposits was studied. The field test works of the processed inhibitors carried out at "Siyazanneft" and "Bibiheybatneft" OGD and the high-efficiency has been achieved. According to the results of field tests it was determined that as a result of the application of the multi-functional inhibitors the scale was prevented, oil production and time between overhauls increased and electricity saving was achieved.

Keywords: scale, oil production, time between overhauls, nano particle, nanosystems, surface active substance, inhibitor

Currently, the scale prevention is an important challenge. During the oil production in the most flooded fields, inorganic salt deposits and their accumulation on the surface of the oil-field equipment are observed, in turn, it causes the technological complications preventing the stable operation of the oil field (fig. 1).

The scale is formed during all exploitation methods of the wells, but it increases when the produced water salinity and alkalinity are high in the exploitation process by the compressor, pump depth, as well as electrical submersible pumps.

Formation of salt layer in the well screen zone, in unsmooth parts of casing and production string, weld joints, including inner side of downhole equipment prevents fluid flow. Solving of current problems, besides extra costs leads to loss of time and oil.

Separate horizons of many oil and gas fields in Azerbaijan are characterized by corrosive formation water with a high degree of mineralization and because of it the extent of the problems associated with saline deposit is much broader. So, numerous researches have been carried out for scale prevention in reservoirs and lifting pipes and reasons of it formation and con-

trol methods have been studied. It was found that, the salt deposition occurs during oversaturation of produced water with the presence of oil components, gas phase and mechanical mixtures which have effect on intensity, nature and composition of deposits in the complex hydrothermodynamic conditions [1-3].

Current technology, physical and chemical methods used for scale prevention are less effective and so this problem has not been solved in oil-gas production yet. So, conducting of the researches is necessary for development of new scale inhibitor. It is known that, the effectiveness of new scale inhibitor using for oil production depends on their effect of activity, the component value included into composition, presence of production base, consumption of composition, simplicity of inhibitor preparing and using technology and etc. Taking into account the foregoing, new metal nanoparticle, surfactant and polymer content nanosystem were developed on the basis of "low impact and stimulation" effect [4-6]. The sample taken from scale formed at in-field collector lines, lift pipes of the wells of Azneft PU and produced water were analyzed at the laboratory and due to the results new nanosystem for scale prevention was developed.

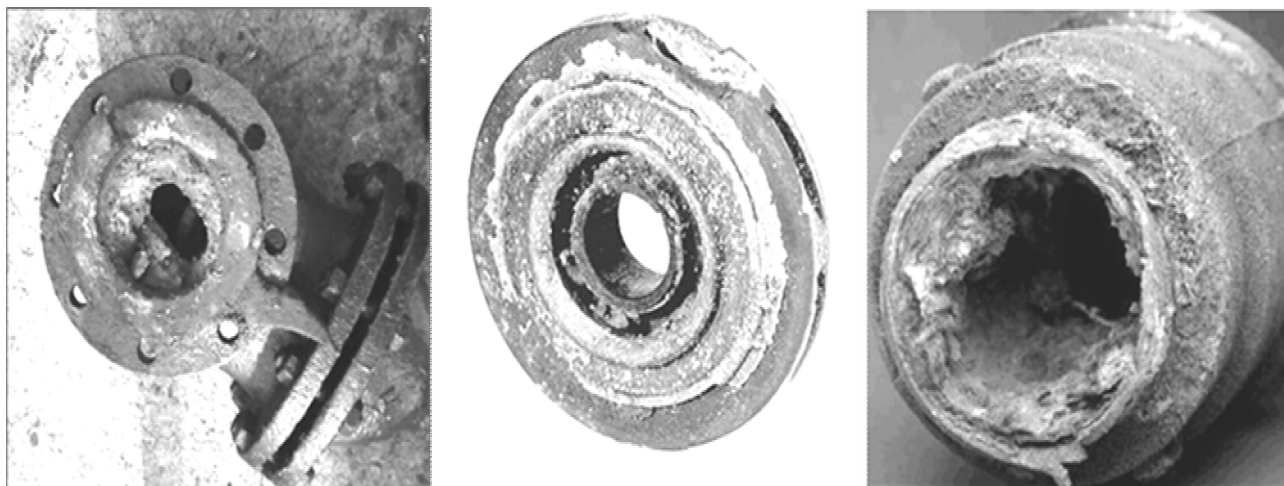


Fig. 1. Scale on the oil field equipment

These nanosystems are water based and consist of water soluble polymer, surfactant, 15 %-chlorous acid for forming hydrogen index into $\text{pH} < 5$ and various metal nanoparticles.

It is known that, obtaining of scale occurs in several stages. The first, nano-size crystals acting as crystal nucleus, then micro particles are formed and in the course of time these particles grow and are deposited at the equipment walls. Phase change of microheterogeneous system depends on some factors, including additives increasing crystallization and physico-chemical parameters of inhibitor reducing scale speed. Nanoparticles added to the system in the content of complex reagent act as numerous crystal nucleuses. The surface of formed crystals isolates with surfactant molecules as a result of surfactant presence in used nanosystem, and prevents crystal growing. Then small sized salt crystals are removed from the system by fluid flow. Field-testing of new nanosystems obtained in the laboratory "Siyazanneft" and "Bibiheybatneft" carried out at OGPД, high efficiency has been achieved.

Nanosystem has been very successfully and problem has been solved in order to prevent the scale of lift pipes in production well № 1547 and 1300 m lengths of mining interior reservoir of in particular, "Siyazanneft" OGPД. The application process continued for 60 days, time between overhauls before the application was 22 days in the well № 1547 operated in Sadan field of "Siyazanoil" OGPU there was no mooring connected with salinization during 1 year 2 months

passing the nanosystem application and the scale is limited in lift pipes. Nanosystems applied and the process lasted 75 days in order to improve the supply of the fluid and prevention of scale in mining internal fluid reservoir of OGPД № 2. The pressure in connection with salinization in reservoir was 1,9 atm until the beginning of the application. Therefore, once in 2 months of beating and 50 m³ cleanup work was carried out by washing with water. As result of the introduction of nanosystem, the hydraulic resistance decreased (0,8 atm), the scale was prevented and transportation of the fluid intensified. Collector pressure remained stable with 0,8 atm since the beginning of the application period of 2 years and there was no mooring connected with salinization.

Application-testing work of the nanosystem was conducted in wells № 2009, 2888, 2946 and 3753 against scaling and positive results were obtained. As a result of the introduction of nanosystem, the scale is prevented, medium and low-flooded oil wells, a significant increase time between overhauls, as well as the required electrical power has been achieved. Thus, the synergistic effect resulting from the application of nanosystem was taken.

Thus, the time between overhauls before the application was 10 days in well № 2009 of "Bibiheybatneft" OGPД, the figure was 41 days after the application of nanosystem (fig.2). Oil production increased by 60 % of less prolific wells in flooded.

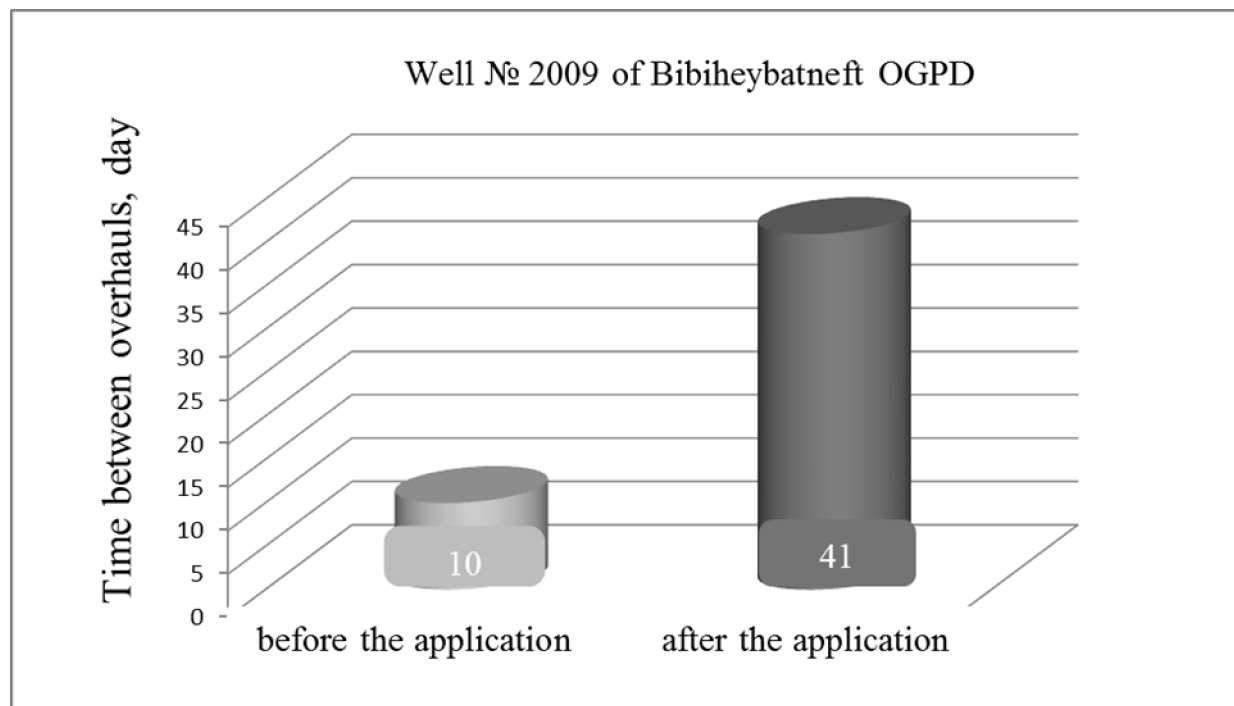


Fig. 2. Changing of time between overhauls before and after application of nanosystem for scale prevention in the well № 2009 Bibiheybatneft OGPD

The time between overhauls before the application was 10 days in the well №3753 “Bibiheybatneft”, the figure was 21 days after the application of nanosystem (fig. 3). Oil production increased by 4% in this well after the introduction of nanosystem.

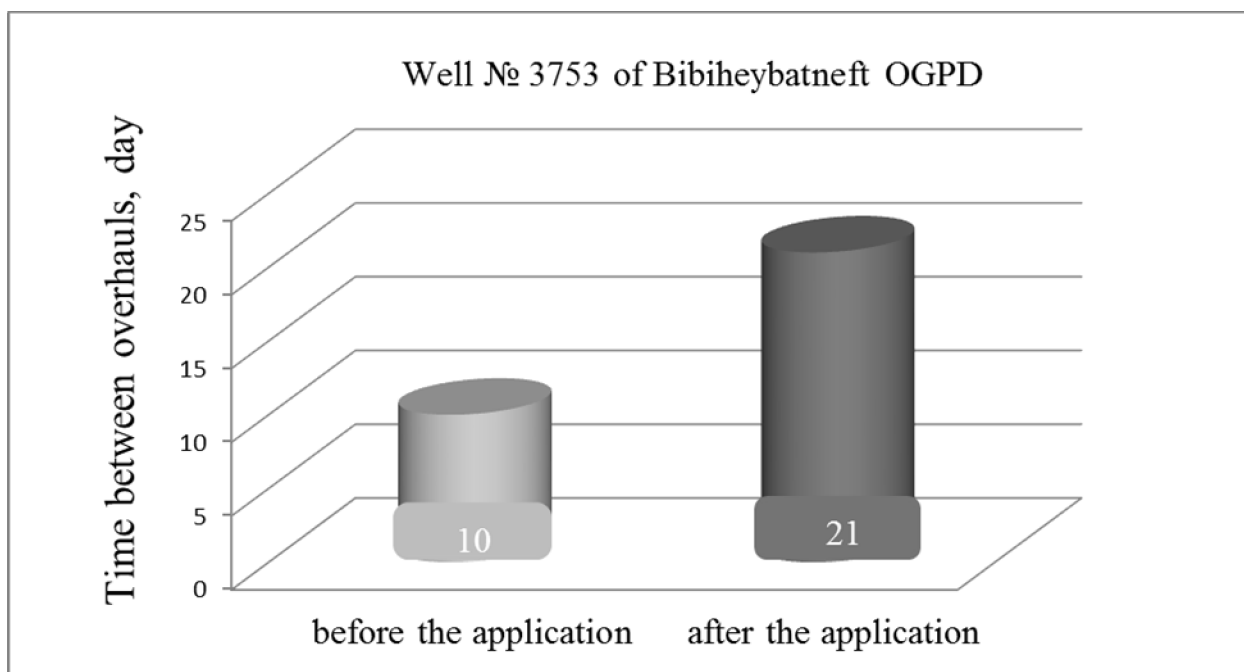


Fig. 3. Changing of time between overhauls before and after application of nanosystem for scale prevention in the well № 2009 Bibiheybatneft OGPD

Besides in wells № 2888 and 2946, OGPU "Bibiheybatneft", application of nanosystem resulted in increased oil production as well as time between overhauls. So, oil production of well № 2888 increased daily from 0,7 to 1,2 ton.

The time between overhauls of the well № 2946 before the application was 21 days and after nanosystem application the well operated without observation of any technological complication within 147 days. In addition, 40 % decrease of the oil viscosity at 20 °C from the reagent influence was observed.

Conclusions

Surface-active substances and various proportions of their compositions, also scale inhibitor were developed with new multifunction nanosystem consisted of polymer and metal nanoparticles. The field-testing works of this inhibitor developed on the basis of "low impact and stimulation" effect were conducted in "Siyazan-neft" and "Bibiheybatneft" OGPU and the synergetic effect obtained.

The time between overhauls before the application was 22 days in the well № 1547 operated in Sadan field of "Siyazan-neft" OGPU, there was no mooring connected with salinization during 1 year 2 months since nanosystem application and the scale is limited in lift pipes. Nanosystem was applied for the improvement of the fluid transportation, scale prevention in infield fluid reservoir of № 2 OGPU and the reservoir pressure remained stable with 0,8 atm during 2 years since the beginning of the application, there was no mooring connected with the scale.

Moreover, scale prevention applied-test works of nanosystem were conducted in wells № 2009, 2888, 2946 and 3753 of "Bibiheybatneft" OGPU and positive results were ob-

tained. So, the scale prevention time between overhauls were 10 days before nanosystem application in for two wells of "Bibiheybatneft" OGPU wells № 3753 and 2009 but after application this parameter was respectively 21 and 41 days. Oil production of this low debit flooded wells respectively increased by 40 and 60 %. Besides in wells № 2888 and 2946 of OGPU "Bibiheybatneft", application of nanosystem resulted in increased oil production as well as time between overhauls. So, oil production of well № 2888 increased daily from 0,7 to 1,2 ton. The time between overhauls of well № 2946 before application was 27 days and after nanosystem application the well was operated during 147 days without observation of the technological complications. Besides oil viscosity decreased by 40,0 % at 20 °C from influence of reagent.

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İŞLƏNMƏNİN SON MƏRHƏLƏSİNDƏ OLAN NEFT YATAQLARININ İSTİSMARI ZAMANI YARANAN DUZ ÇÖKÜNTÜLƏRİNİN QARŞISININ ALINMASI ÜÇÜN NANOSİSTEM

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Məqalə, neft hasilatı zamanı neft-su axınında əmələ gələn duz çöküntülərinin qarşısını alan nanosistemin, işlənmənin son mərhələsində olan sulaşmış neft quyularında sınaqdan keçirilməsinə həsr olunub. “Kiçik təsir və həyəcən” effekti əsasında səthi-aktiv maddələr, polimer və metal nanohissəciyin əmələ gətirdiyi nanosistemin duz çökmələrinə təsiri tədqiq olunmuşdur. İşlənmiş inhibitorun mədən-sınaq işləri “Siyəzənnəft” və “Bibiheybətneft” NQÇİ-lərdə həyata keçirilmiş, yüksək səmərəlilik əldə edilmişdir. Aparılmış mədən sınaqlarının nəticələrinə əsasən müəyyən olunmuşdur ki, bu çoxfunksiyalı nanosistemli inhibitorun tətbiqi nəticəsində duzçökmənin qarşısının alınması ilə yanaşı, quyularda neft hasilatının, təmirlərarası müddətin artırılmasına, həmçinin neftin çıxarılmasına tələb olunan elektrik enerjisinin qənaətinə nail olunmuşdur.

Açar sözlər: duzçökmə, neft hasilatı, təmirlərarası müddət, nanohissəcik, nanosistem, səthi-aktiv maddə, inhibitor

НАНОСИСТЕМА ДЛЯ БОРЬБЫ С СОЛЕОТЛОЖЕНИЕМ НА ПОСЛЕДНЕЙ СТАДИИ РАЗРАБОТКИ НЕФТЯНЫХ МЕСТОРОЖДЕНИЙ

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Статья посвящена проведению испытания на обводнившихся нефтяных скважинах наносистемы, предотвращающей солеотложения, возникающие в результате водонефтяного течения в процессе добычи нефти. На основе эффекта «малого воздействия и возмущения» было исследовано влияние наносистемы, состоящей из ПАВ, полимера и металлических наночастиц. Промыслово-испытательные работы разработанного ингибитора были проведены на НГДУ «Сиязаньнефть» и «Бибизейбатнефть», была получена высокая эффективность. В результате проведенных промысловых испытаний определено, что при применении многофункционального наносистемного ингибитора наряду с предотвращением солеобразования было достигнуто увеличение добычи нефти и межремонтного периода, в то же время удалось добиться экономии электроэнергии.

Ключевые слова: солеотложение, добыча нефти, межремонтный период, наночастица, наносистема, поверхностно-активные вещества, ингибитор