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SURFACTANTS FOR THE EXTRACTION OF RESIDIAL OIL

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ABSTRACT

In the article it is offered to use chemical reagents for extraction of residual hard-to-recover oil, existing traditional methods. Such reagents can serve as surface-active substances of nonionic character. The advantage of the latter is their solubilization and lower adsorption value compared to ionogenic analogues.

Keywords: chemicals, oil recovery, surfactants, polymers.

INTRODUCTION

Chemical methods of enhanced oil recovery is a promising direction in the development processes of oil fields, they are intended for oils of low and medium viscosity. All of these methods can be divided according to the nature of reagent the following groups: polymers; surfactants; alkaline flooding; combined methods using complex reagents.

This study established [1] that the quantity of oil remaining in the reservoir after displacement of water depends on lithology and heterogeneities of reservoir, chemical composition and properties of fluids, temperature, etc., resulting from the application of water flooding in the reservoir formed two types of residual oil. The first type of residual oil contained in the water washed zones of the productive formation and has a higher content of heavy components than the original oil. Education the second type of residual oil is linked to the unequal displacement of oil from heterogeneous reservoir, which leads to the formation of the pillars of oil in poorly drained, stagnant zones, lenses and proplastid with poorer reservoir properties. Composition and properties of residual oil of the second type is a little different from the original oil field.

It is also established by the authors [2] that the type of wettability of a reservoir rock largely determines the properties and structure of layers of residual oil of the first type. In the case of hydrophilic rocks, the water wets the surface of the reservoir and displaces the oil in the pores of large or medium size, the effect of capillary forces in this case contributes to a more complete displacement of oil. As the result of flooding in a hydrophilic porous medium remains 20-45 % of the original oil, which is a few drops of oil blocked in the pores of the formation.

In hydrophobic reservoirs wetting fluid is oil, so the water displaces the oil from large and medium-long. In fine then, the oil held by capillary forces, which is the main reason for the low degree of extraction of oil from hydrophobic layers [3]. Thus, hydrophobic reservoirs residual oil is present in the form of a film on the surface and small pores.

Most of the minerals forming the oil reservoirs are hydrophilic. The maximum hydrophilicity have clay gidrologo composition and quartz. Minimum possess hydrophilic properties of limestone, dolomite and feldspars.

Studies [4] found that a significant portion of the reservoirs of oil fields has intermediate wettability, contains hydrophilic and hydrophobic areas. Therefore, in the fields after flooding may contain residual oil in the form of entrapped droplets and oil film, requiring searches the methods of its extraction [5].

On the structure, properties and the amount of residual oil of the first type is influenced by the viscosity of the oil content of high molecular weight components of resin [6], asphaltenes, acids, compounds having surface-active properties. As a result of physical and chemical sorption of oil and water on the collector surface, the formation of boundary layers, a viscosity which is much higher than the viscosity of the fluid in the free volume. The interaction of surface-active components of crude oil [7] with the rock leads to an increase in the degree of hydrophobicity, increasing the share and improving the structural-mechanical properties of the film of residual oil.

Education the second type of residual oil is linked to the unequal displacement of oil from heterogeneous oil reservoir. An increase in the degree of heterogeneity of oil reservoir reduces the reservoir coverage by flooding, leading to breakthrough of the injected water in highly permeable formations and channels, the growth in the number of the residual oil of this type in the formation [8]. The increase in oil viscosity and the presence of a non-Newtonian oil properties also contribute to the uneven displacement of oil from a formation by waterflooding.

Thus, increasing the degree of oil displacement can be achieved by increasing the coverage [9] of heterogeneous formation a flooding; either by reducing the amount of residual oil in the boundary layers on the surface of the collector; and finally, displacing the capillary trapped oil compositions with low interfacial tension.

To increase the coverage of reservoirs by waterflooding technologies are used that regulate the viscosity of the displacing fluid and the permeability of the inhomogeneous layer using the polymer of the effects of viscoelastic particulate compositions, the gel - and sediment-forming technologies. To reduce the amount of oil in boundary layers is possible by the use of reagents that improve the wettability of rocks displacing water [10].

To suppress capillary forces that hold residual oil, possibly with the use of surfactants and compositions on their basis.

RESEARCH METHODOLOGY

The aim of this study was the possibility of increasing the efficiency of development high-viscosity oil deposits with application of surface-active substances. The increase in the recovery factor of heavy oil in conditions of nonuniform permeability layers must be ensured by introducing the technology of injection of surface-active substances (surfactants).

The most widely used in technologies of enhanced oil recovery found neogene surfactants (nonionic surfactants). In this study, for achieving a more complete displacement of oil we recommend the use of aqueous solutions of nonionic surfactants. The advantage of nonionic surfactants is their compatibility with water of high salinity and have a much lower adsorption compared with ionogenic surfactants.

Experimental studies have shown that the use of concentrated solutions of nonionic surfactant in the primary oil displacement models of terrigenous rocks significantly improves the process of oil displacement. The maximum increase of the displacement factor compared to water was 2.2% - 2.7%. A slightly larger value of the growth rate of displacement equal to 3.5 - 4.0 % was obtained in models of low-permeable porous media.

The study found that one of the criteria of applicability of the method is the observation of temperature conditions of the reservoir not more than 70 ^{0}C, the mineralization of formation water should not exceed 200 g/m^3, the thickness of the oil layer should not exceed 15 m. Neblagopryatnye factor in the applicability of the method is the fracturing and the clay content on the layer, which must be not more than 10% in sandy reservoirs with permeability to 1.0 μm^2.

A significant advantage of the reservoir flooding with aqueous solutions of nonionic surfactants is exceptional ease of technology use, transportation, storage, preparation and injection into the reservoir. Nonionic surfactants are not sensitive to salts, applicable in a wide temperature range and highly compatible with other chemical reagents.

The use of nonionic surfactants is economically viable method of enhanced oil recovery, as can be seen in Figure-1, which shows the need of using nonionic surfactant for injection into injection wells and Figure-2 - graph of extraction residual oil using nonionic surfactants.

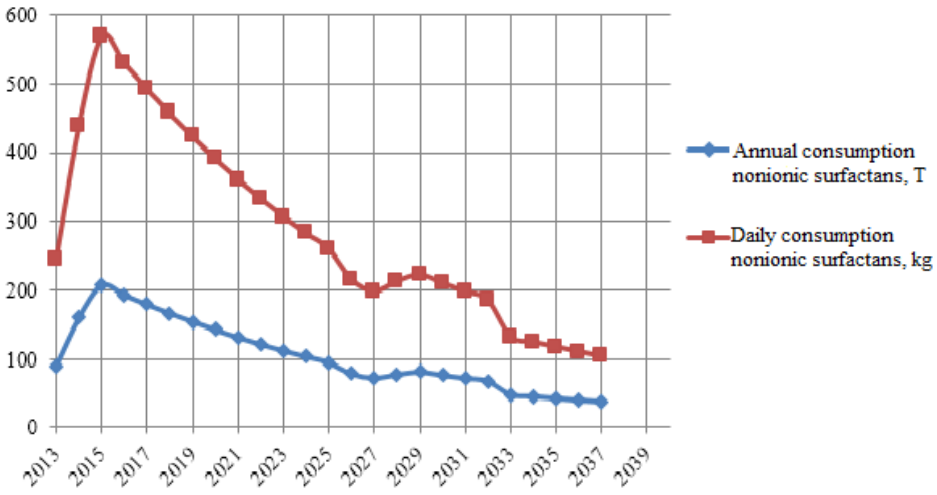

Figure-1. Using nonionic surfactants.

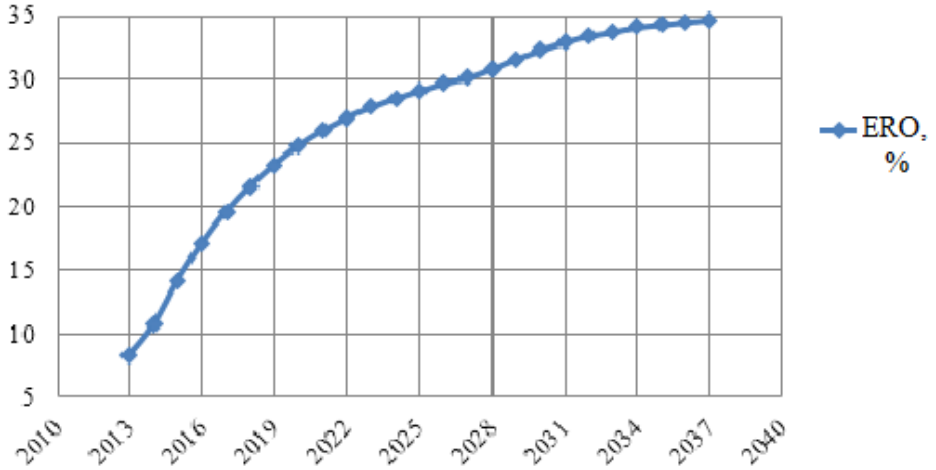

Figure-2. Extraction of residual oil (ERO) using nonionic surfactants.

For the implementation of variants of development of the field can recommend this method of enhanced oil recovery with injection of nonionic surfactants.

To prepare the solution can be used a mixture of formation water established horizons, wastewater, and intended for pumping of water aquifers after the appropriate studies

Before the implementation of a method, in order to prevent complications associated with possible salt precipitation in oil reservoir and intensification of corrosion processes, it is recommended to conduct a comprehensive study on the stability, compatibility, corrosiveness of formation water in the established horizons, wastewater, and intended for pumping of water aquifers.

The recommended concentration of nonionic surfactants in the injected water of 0.05 - 0.1%. As a nonionic surfactant recommended for use: isononylphenol Nonylphenol, oxyethylated alkyl, block copolymers of ethylene oxides and propylene. Nonionic surfactant is added to the injected water through the dosing pump.

CONCLUSIONS

a) Injection of polymer compositions in oil reservoirs can reduce the ratio of the viscosities of the displacing agent of water and oil, and level of heterogeneity of the reservoir properties of the porous medium.

b) The use of surface-active substances allows to increase oil-displacing system properties of water and activate capillary and diffusion processes of displacement by reducing the interfacial tension of oil in contact with the injected water and reducing the contact angle of wetting, thereby washing off the film of oil, gidrofilizatsii rocks, reduction of swelling clay minerals, the acceleration of capillary impregnation, increasing the relative permeability to oil.

c) The use of chemical reagents allows us to achieve additional oil recovery.

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