SOME ASPECTS OF APPLICATION OF INNOVATIVE TECHNOLOGY TO INCREASE OIL RECOVERY

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Abstract

In the article, the study of the factors affecting the reduction of the oil yield of the oil fields located in the dry areas of Azerbaijan and in the final stage of development and the presence of large amounts of residual oil reserves in those fields are explained. At the same time, the problems of solving probes based on the application of modern innovative technologies and "smart" reagents for increasing oil production from those fields were explained with scientific and practical approaches.

Keywords: field, formation, development, oil recovery, flow rate, reagent, innovative technology

I. Introduction

Many fields of the Republic of Azerbaijan, exploited both onshore and offshore, have entered the final stage of development. The fields at the final stage are characterized by low oil flow rates - 0.8 t/day, high water cut - 85...98%, low reservoir pressure and temperature, formation of sand plugs in wells, high efficiency of "surface tension" of oil flow from the formation to the bottom of the well. Surfactants that affect the flushing and extraction of residual "dead oil" in fields are ineffective, and the high viscosity of reservoir oils has created difficulties in the application of progressive methods.

Despite the fact that 150-160 years have passed since oil was extracted from the onshore fields of Azerbaijan, the oil reserves that can be extracted from hydrocarbon fields that are still at the final stage of development are quite large. According to the latest estimate by specialists from the company De Golyer and MacNaughton, the potential of oil reserves on the Absheron Peninsula is 2 billion barrels (Fig. 1).

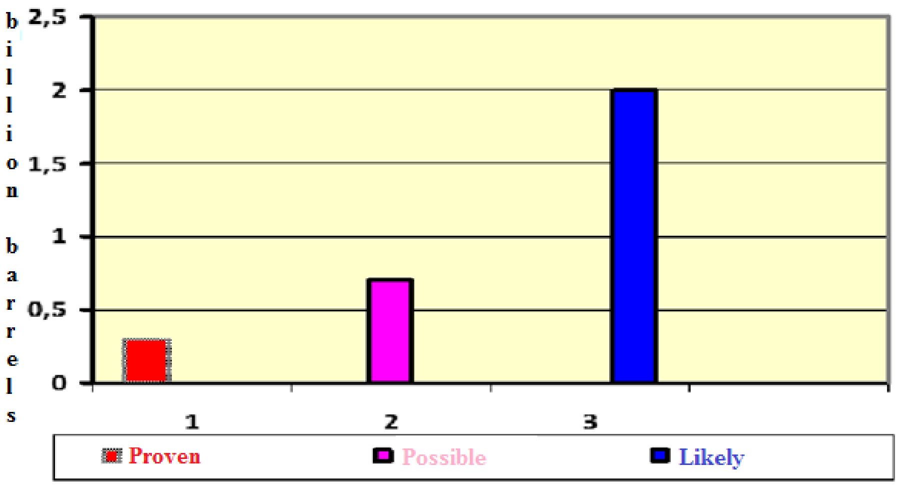

Figure 1: *Proven, possible and probable total onshore oil reserves*

Extracting oil from old fields is a complex production process involving many complex steps. To extract residual "dead oil", and their high prices have created difficulties in the application of advanced extraction methods [1].

Azerbaijan does not produce enough surfactants to extract residual “dead oil”, and their high prices have created difficulties in the application of advanced extraction methods/

In addition, in fields at a late stage of development, alkalis, acids and other reagents are used to increase oil production.

The use of polymers, polymer-dispersed systems and colloid-dispersed systems in oil production worsens the flow of fluid to the bottom of the well in oil-saturated reservoirs and water-flooded zones of the formation, creating conditions for increasing fluid resistance in the formation.

It is necessary to resolve issues that are associated with such features of the oil fields of Azerbaijan, such as the presence of various types of deposits and regimes, weak cementation of reservoirs of the productive strata, and development duration.

For these reasons, most oil reservoirs located on land are exploited with little oil production.

Proper execution and sequence of technological operations at each stage of oil production ensures maximum effect from the entire process, which is expressed in obtaining high-quality oil and maintaining the required production volumes. The maximum effect can be achieved only with high-quality compliance with all technological requirements put forward for this process. Intensification of oil production requires, first of all, a new scientific approach to justify attracting investments into fields and increasing the efficiency of technical and economic processes [2].

II. Methods

I. Enhanced oil recovery (EOR) methods used in the fields of Azerbaijan and abroad

The basis for creating EOR oil-displacing compositions are surfactants of various classes (mainly anionic or nonionic type) in combination with various components (electrolytes, alcohols, hydrocarbons, acids, etc.). For example, a composition for enhancing oil recovery is known, including an anionic surfactant (AS) and a nonionic surfactant (NSAS), where petroleum or synthetic sulfonates with an equivalent weight of 330 to 580 are used as surfactants, and oxyethylated alkylphenols are used as nonionic surfactants. with a degree of oxyethylation from 8 to 16 and additionally - a solvent with the following ratio of components, wt.%: petroleum or synthetic sulfonates with an equivalent weight from 330 to 580...590, ethoxylated alkylphenols with a degree of oxyethylation from 8 to 16...590, the rest - solvent. The disadvantages of this technical solution are the need to use a hydrocarbon solvent and a high concentration of surfactants, which increases the cost of the reagent.

In addition, the composition used in the implementation of the method for developing high-viscosity oil deposits under thermal influence on the formation is known, containing a complex surfactant neftenol VVD (1.0...5.0% wt.) or a mixture of nonionic surfactant (1.0...2.0% wt.) and anionic surfactant (0.5...1.0% wt.), ammonium nitrate (8.0...20.0% wt.), urea (15.0...40.0% wt.), ammonium thiocyanate (0.1...0.5% wt.) and water. In the reservoir, at high reservoir temperatures or thermal effects, urea is hydrolyzed to form an ammonia buffer system [3].

In world oil practice, a composition is used to enhance oil recovery, containing nonionic surfactants and nonionic surfactants, boric acid, glycerin and water. As specified surfactants, the composition contains a complex surfactant, neftenol VVD, or a mixture of nonionic surfactants AF912, or NP40, or NP50 and surfactants volgonate or sulfonal, or NPS6.

Often, gel-forming composites are treated with a water-repellent composition based on cationic surfactants when developing the bottomhole zone of water heating wells (in order to maintain stable reservoir pressure in injection wells and increase the ability to absorb water into the formation). As a result of treatment, the surface of the collector is covered with a monolayer of surfactant molecules, the charged part of the molecules is directed to the surface of the collector, and the hydrophobic part goes into the pore space. Due to the selective orientation of polar surfactant molecules, hydrophobization of the pore space occurs, which prevents intensive coordination interaction of the reagents of gel-forming compounds with the rock surface.

In addition, the disadvantages of the known methods are that an aqueous solution of urea is introduced into a layer with hydrochloric acid to produce an endothermic reaction with the release of heat. A large volume of air is injected into the well, followed by a mixture of steam so that a heat-generating reaction occurs. In this case, the reaction efficiency is not so high. Performing this operation requires a large amount of funds, the resulting result ends with little effect. For these reasons, these methods have not received widespread practical use in the fields.

II. The proposed innovative technology for increasing oil recovery using a "smart" composition

Allows to improve the rheological properties of formation rocks and increase the flow of residual oil to the bottom of the well by reducing its viscosity, changing wetting and surface tension between phases. To achieve this goal, in the first stage, the composition containing methyl alcohol, surfactant (SAM) and water is injected into the layer, which allows to achieve thermochemical effects in the layer. In the second stage, a composition containing a mixture of starch, glue (PVA) and water is injected to form an adsorption layer, create a buffer zone and conduct a thermochemical reaction in the buffer zone. In the third stage, a composition containing a mixture of magnesium, catalyst (Al2O3) and water is injected to carry out the thermochemical reaction in the buffer zone.

The novelty of the proposed innovative technology consists in the implementation of a thermochemical process using the proposed compositions for the creation of an adsorption layer and a buffer zone in the well bottom zone and formation based on a three-stage technology (Fig. 2).

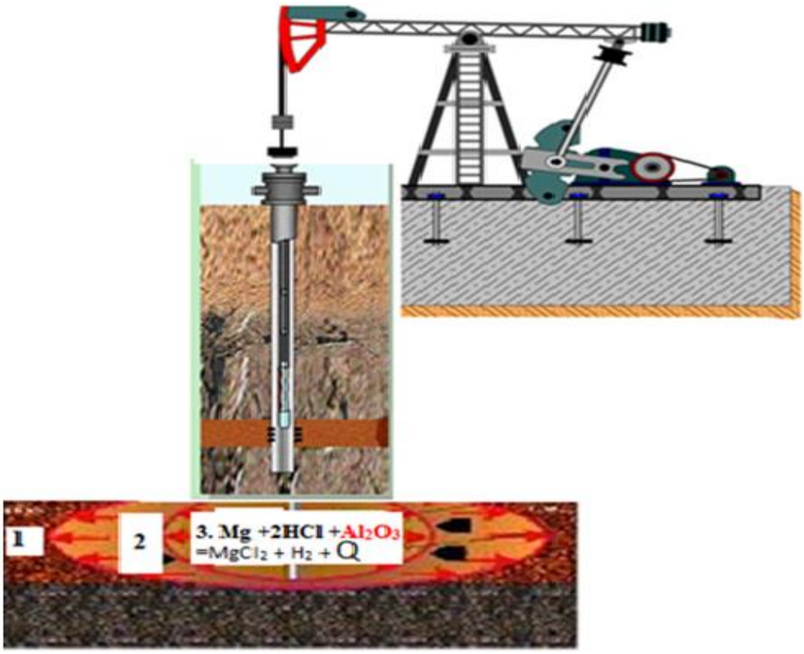

Figure 2: *The scheme of injecting "smart" composition into the well*

Methyl alcohol + SAM + water prepared and injected into the well in the first stage squeezes small particles of sand grains from the bottom zone of the well and washes the oil stuck to the sand rocks. As a result, the viscosity of the oil drops sharply, the flow of oil into the well is improved due to the decrease in surface tension. The fact that oil has a low specific gravity relative to water allows oil to accumulate in the upper part of the formation, and water to enter the lower part of the formation.

The starch + glue + water produced in the second stage creates a buffer zone in the well bottom zone and formation, preventing absorption of magnesium + Al2O3 + water mixture and hydrochloric acid.

In the third stage, a thermal reaction occurs as a result of the encounter of magnesium + Al2O3 + water mixture with hydrochloric acid in the bottom zone of the well.

As a result of the encounter of magnesium + Al2O3 + water mixture with hydrochloric acid in the bottom zone of the well, a thermal reaction occurs. A separate sequential supply of reagents for the implementation of a thermochemical reaction allows to prevent the reaction at the wellhead and inside the well by injecting a surfactant between them [4].

As a result of the reaction, high heat and gaseous hydrogen (H2) compress the methyl alcohol + SAM + water and starch + glue + water counterparts into the formation, enabling the fluid to flow to the bottom of the well. The following thermal reaction takes place in the buffer zone:

$$Mg + 2\,HCI + Al_2O_3 = MgCl_2 + H_2 + Q \tag{1}$$

Here, Q is the heat obtained as a result of the reaction (18.9 Megajoule of heat is obtained as a result of the reaction of 1 kg of magnesium with hydrochloric acid).

The prepared compositions were tested in 6 small production wells of the proposed technology "Bibiheybat" NGCI. The obtained results are shown in Table 1.

As can be seen from the table, the proposed method allows to increase the oil extraction coefficient. Conducting a thermochemical reaction in the well based on innovative technology reduces formation permeability, washes residual oil from formation rocks, separates oil from formation waters, lowers the viscosity of oil inside the formation, eliminates surface resistance, etc. allows to increase the amount of extracted oil due to its improvement.

Table 1: *Results of application of innovative technology*

Indicators	Number of wells			
	3115	3655	3646	3677
	Before the introduction of innovative technology			
Daily oil production, tons	0,5	1,7	0,5	1.2
	After the introduction of innovative technology			
Daily oil production, tons	2,0	3,1	2,0	4,0
Increase in daily oil production, tons	1,5	1,4	1,5	2,8

III. Results

1. On the basis of the proposed innovative technology, based on the works carried out in 3 stages in small oil-producing wells, increasing the permeability of formations in oil wells in operation, a sharp decrease in the viscosity of residual oils in the formation, cleaning the pores from contamination, washing oil stuck to the rock, separating oil from formation water, and the resulting high reaction temperature on the basis of reduction of surface tension, etc. creates an opportunity to increase oil production.

2. To increase the oil recovery of layers, the "smart" innovative composition has high wetting properties. oil-bearing pores.

3. Compared to the reagents in use, PAV has a simple preparation technology and is recommended for use in the oil industry. The price of production of the proposed composition is almost 2 times lower than other reagents produced.

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