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О НОВОМ МЕТОДЕ МИКРОБИОЛОГИЧЕСКОЙ ОЧИСТКИ

ABOUT NEW MICROBIOLOGICAL TREATMENT METHOD

Мусаева Шафа Фархад
кандидат технических наук,
старший инженер-исследователь,
Научно-исследовательский институт
«Геотехнологические проблемы нефти, газа и химии»
shafamusayeva@mail.ru

Аннотация. В статье рассказывается о методе микробиологической обработки, применяемом для ассимиляции остаточной нефти из длительно обводненных, энергетически истощенных пластов. Показано, что с учетом сложности получения стимуляторов (молочной сыворотки и патоки), добавляемых в активный ил, был разработан новый состав, который в результате проведенных исследований показал высокий эффект.

Ключевые слова: микробиологический эффект, активный ил, молочная сыворотка, меласса, выход масла.

Musayeva Shafa Farkhad
PhD in Engineering,
Senior Research Engineer,
Scientific Research Institute
«Geotechnological Problems of Oil,
Gas and Chemistry»
shafamusayeva@mail.ru

Annotation. The article talks about the method of microbiological treatment applied for the assimilation of residual oil from long-term, watered, energy-depleted formations. It is shown that, taking into account the difficulty of obtaining stimulants (milk whey and molasses) added to the activated sludge, a new composition was developed and it was proven to have a high effect as a result of conducted research.

Keywords: microbiological effect, activated sludge, whey, molasses, oil yield.

In recent years, the effectiveness of the method of microbiological effect on layers has been widely written. The results of the conducted studies have shown that this method is selected from other impact methods due to its low cost of implementation, environmental friendliness and high technological effectiveness. Biosynthesis products of bacteria in formation conditions reduce oil viscosity and surface tension at the phase boundary, increase its mobility, and as a result, oil separation from the rock surface becomes easier. At the same time, organic and hydrocarbon acids released by microorganisms affect the change in the volume-filtration property of oil reservoirs.

Analyzing the indicators of scientific and applied work carried out by many foreign [1–5] and Azerbaijani [6–9] researchers, it can be concluded that the microbiological effect method has positive effect on hard-to-recover deposits and while ensuring the increase of oil yield of watered layers, it also affects the reduction of the water produced with the oil. In addition to being a scientifically based method, it leads to a 5–7% increase in the operational reserve, a 1.5–2 times increase in the well productivity and a 15–25% increase in the current oil extraction.

For the first time, in 1946, C.E.Zobellcame up with the idea of increasing reservoir oil yield by microbiological influence. Despite being patented by Zobell [10], this method was not used for a long time. Currently, this idea has been confirmed by many researchers.The essence of the method is based on the displacement of oil from the porous medium and expansion of the displacementbarrier due to gases and metabolic products formed in the formation as a result of the intensification of the life activity of microorganisms when bioreagents – activated sludge (AS), milk whey (MW) and molasses (M) are injected into the formations as working agents.

Activated sludge (AS) is the sludge obtained from industrial and domestic water treatment at the air station facility in Hovsan, Baku. It contains 1012 cells/ml of microorganisms.

Milk whey (MW) is a by-product of the Baku curd factory.

Molasses (M) is a by-product of the Imishli Sugar Factory, and the amount of microorganisms in it is 1–5 million per 1 g/liter.

The chemical formula of molasses is $C_6H_{12}O_6$, and it breaks down during fermentation to form CO_2 and ethyl alcohol.

The main agents that are formed during biotechnological action in the oil layer and affect the compression of oil are the following:

– acids, alcohols, ethers, etc. combinations;
– solvents;
– gases: CO_2, CH_4, nitrogen, etc.;
– biosurfactants, biopolymers, etc.

One of the most important mechanisms involved in oil displacement is the generation of acids, alcohols, solvents, and gases.

Acids and alcohols increase the porosity and permeability of the rock by dissolving carbonate rocks, preventing salt precipitation.

Solvents released by microorganisms dissolve heavy components of oil (tar, asphaltene, paraffin) and increase its mobility in the formation.

Gases, dissolving in oil, reduce its viscosity, and dissolving in water, increase the viscosity of water.

Biosurfactants cause a decrease in surface tension at the interface with the active agent.

Biopolymers and biocomposites secreted by microorganisms change the permeability of the porous medium, block the highly diluted formations, flatten the oil displacement front, and prevent the flow of water into the production wells.

The application of the microbiological method aims to intensify the current oil extraction and increase their ultimate oil yield in the layers whose energy has been depleted due to long-term development and production is highly decrease.In order to apply the method of microbiological influence to specific oil formations, their geological characteristics (porosity, permeability), physical and chemical properties of formation fluids (viscosity, density, formation water content, etc.) should be studied and application criteria should be used.

The microbiological treatment is a universal method; it includes all types of physical and chemical action methods: polymer flooding, acid treatment, surfactant injection, injection of hydrocarbon, carbon and nitrogen gases, etc.

During the impact, activated sludge, rich in microbes, is injected into the layer first. As a result of the conducted researches, it was found that activated sludge cannot provide the necessary nutrients to the biocenosis (microorganisms), it forms due to its specific biochemical activity, and therefore it is necessary to add additional nutrients – stimulators to it. During research conducted for this purpose, after active sludge is injected into the layer, whey or molasses is additionally injected.

Since 1994, the use of molasses in the Volkov field has started to apply the method of microbiological influence, and a positive result has been obtained. The method was applied in the Arlan, Tuymazi, Sayzbash, Rayet, Surgut, and Mancharovsk fields of Kyrgyzstan, as well as in the Vareghan and Samotlor fields of Western Siberia, and more than 500 thousand tons of additional oil was obtained [2].

The method of microbiological influence was applied in the Khorasani area of the onshore Balakhani-Sabunchu-Ramana field of Azerbaijan, in the Binagadi, Surakhani, and Tagiyev fields, in the VII-VIIa horizon of the Guskhanaarea of the Lokbatan-Puta-Gushkhana field and in the Ateshgah field, in the X horizon of the Bibiheybatneft field, in two areas of the Pirallahi field and in addition more than 100 thousand tons of oil were produced [7–9].

Recently, the limitation of whey to be applied to the layer through the active sludge aid applied during the microbiological effect and the increase in the selling price of molasses have made it difficult to use these stimulants. In this regard, it is necessary to find a new, more profitable product. As a result of researches conducted in this field, a new product was developed and proved to have a high effect [11].

For this purpose, oil and water samples were taken from the wells of a number of objects, and research work was carried out in the laboratory. By adding various bioreagents to formation fluids, biocompositions were prepared based on them, and the fermentation process in the created biosystems was studied. As a result, the volume of the gas formed in different systems was determined, and the cultural liquids designated for the bioimpact objects were selected (Table 1).

Table 1

Indications	Biocompositions			
Take out products	activated sludge 300 sm^3	activated sludge 300 sm^3 milk whey60 sm^3	activated sludge 300 sm^3 Molasses 60 sm^3	activated sludge 300 sm^3 new product 60 sm^3
The amount of carbon dioxide taken,%	8.7	10.3	25.7	33.5

Note: during the experiments, 300 g of sand, 150 cm^3 of oil and 200 cm^3 of reservoir water are poured into the Zongen apparatus each time, and then the extracted product is added and mixed.

Conclusion

The results obtained from the conducted studies showed that the amount of carbon dioxide (Table 1) in the gases formed by adding activated sludge molasses or newly processed solution was high.

This suggests that the acid, solvent, gas and bio-surfactants obtained by activating the activity of microorganisms formed by the active sludge to be injected into the reservoir through the new waste product will increase the oil yield of the reservoir and reduce the volume of producedwater.

The obtained results indicate that a positive result will be obtained from the application of the microbiological treatment method in offshore oil fields.

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