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Biotechnologic Methods in the Oil and Gas Industry


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Abstract—According to forecasts, the practical application of a biotechnological method of increase of oil recovery allows to increase stocks involved in working out by 5-7%, in 1.5-2 times to raise efficiency of chinks, and current oil recovery for 15-25% that is equal to opening of new oil fields. Against a background of constant rise of prices for energy carriers, the expenses from introduction of biotechnological methods of increase of oil recovery pay off very quickly and they are very effective economically. Oil recovery increase in developed oilfields is equal to new oilfields opening; therefore the given problem is relevant for all oil-producing countries of the world and especially for Kazakhstan. Considering the above-stated, working out of biotechnological methods of oil recovery increase is very relevant. In the article it is discussed the prospects use of the biotechnological methods for oil recovery augmentation for oilfields of Kazakhstan.

Keywords: Microbial enhanced oil recovery (MEOR); oil production; biotechnology of oil recovery.

INTRODUCTION

At the present time in connection with huge requirements for energy carriers the extraction and oil refining volumes increase. Use of modern biotechnological methods is perspective and economically low-expensive for search and effective development of new oil deposits and also for increase of oil recovery of existing oil deposits. Effective and perspective biotechnological methods in petroleum industry can be used in following basic directions [1-7]:

• Borehole exploring and oil production;
• Increase of oil recovery of layers;
• Purification of soil and water from oil pollution;
• Purification (inhibition) of downhole equipment;
• Purification (inhibition) of adjournment of soils in downhole equipment and pipelines.

Below in greater detail we will consider the most important for Kazakhstan directions of biotechnology which can be used in petroleum industry.

INVESTIGATION AND OIL PRODUCTION

The base of the given method is the existence of the so-called bacterial filter over oil and gas deposits. It is caused by century-old migration of hydrocarbon gases out of oil and gas deposits into earth blankets. Gases are absorbed by hydrocarbon oxidizing microorganisms as carbon and energy sources for their vital functions. Consequence of it is the released quantity and activity of hydrocarbon containing microflora in samples of soil, in-situ rocks and natural waters over oil and gas deposits. The most reliable indicators of oil and gas deposits are bacteria oxidizing propane, butane and some other heavier hydrocarbon gases.

The technology of the first method, the investigation of oil and gas deposits, consists of selection of natural samples at the big territories and definition number and activity of display microflora in them. Samples of soil are undertaken from the depth of 2 m.

As a result the data is charted then the sampling point with the highest number of indicator microorganisms is connected with them – this area should correspond to an arrangement of oil or gas deposits. This method is tested many times and used independently and in a complex with other methods of oil and gas search.

The role of microflora researches in a complex of search works of oil and gas is come to show whether it is necessary in given area to carry out investigation of oil and gas deposits by expensive physical methods and drilling.

Economic benefit of a microbiological method is reached at the expense of reduction of volume of geophysical investigation and drilling in the unprofitable platforms. According to some information in Kazakhstan more than 350 million dollars were spent for search of new oil deposits which was not crowned with success.

For the further perfection of biotechnological methods at investigation and oil exploring it is necessary to improve equipment for gathering of natural samples, it is necessary to carry out detailed studying of physiology, biochemistry and ecology of indicator microorganisms, working out of express methods of an estimation of their activity, adaptation and use of computer programs for processing of the received data and creation of mobile laboratories for working in field conditions.

INCREASE OF RESERVOIRS' RECOVERY

Now at use of traditional ways about half of geological oil stocks is taken from deposits. Use of biotechnological methods allows increasing the reservoirs recovery. It can be reached by various ways. Gasfiller microorganisms form gases (hydrogen, methane, nitrogen, carbonic acid) due to this gas pressure in formation liquid can increase for several atmospheres. Microorganisms capable to form the surface-active substances and capable to reduce surface tension in border between oil and water displacing it also can be used. This approach also results to extension of oil recovery.
Creation of biotechnology of oil viscosity reduction and also improvement of oil and mineral oil properties can be the following steps in the research directed to increase of oil recovery. With use of biotechnological ways it is possible to carry out oil dewaxing. Biotechnological methods also allow developing methods of removal from crude oil of sulfur compounds that litter environment with toxic substances. We have developed the basic circuit of laboratory installation for modeling and optimization of biotechnology of oil recovery increase (Figure 1).

![Diagram](image)

Figure 1 - Basic circuit of laboratory installation for modeling and optimization of biotechnology of oil recovery increase
1 - vessel for nutrient mediums; 2 - vessel for aerated water; 3 - bioreactor for microorganism culture; 4 - chamber for modeling and optimization of biotechnology of oil recovery increase; 5 - vessel for oil gathering.

Biotechnological methods of increase of oil recovery are safe for the environment as the microflora developing in the oil pool does not contain in its structure pathogenic and/or toxic microorganisms. And for carrying out of technological actions permission of the sanitary oversight agency is not required.

Thus, secondary oil recovery can be increased due to allocation of acids by bacteria (particular in carboxic acids) which increase the interstices of calcareous collectors due to formation of gases. Gases being dissolved in oil, increase its mobility, therefore bacteria take active participation in oxidation and transformation of oil and gas deposits.

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Increase of oil recovery at the developed deposits equivalent to opening of new deposits, therefore the given problem is actual for all oil-producing countries of the world and especially for Kazakhstan.

**PURIFICATION OF SOIL AND WATER FROM OIL POLLUTION**

Rational use of natural resources and preservation of the environment from pollution are the most important problems of the modern society, their decision stipulates health and people prosperity. Now for liquidation of oil minerals and oil spillage various methods and approaches are used. Large oil companies working in Kazakhstan annually carry out reclaiming of hundreds hectares of the ground for liquidation of oil spillage and oil refining products. But in our opinion more perspective for soil purification from oil spillage and oil refining products is use of biotechnological methods. A great number of preparations produced by well-known biotechnological companies and scientific laboratories from the near and far abroad which are used for purification of soils from oil spillage and oil refining products.

However, if to take into account natural features and sharply continental climate of Kazakhstan it is obvious, that many import biological products will not work effectively in Kazakhstan conditions. Therefore development of new biological products made of the native microflora for each region of Kazakhstan where extraction and oil refining are carried and where oil spillage and oil refining take place is required.

In Kazakhstan a number of laboratory work above creation of biological products for purification and bioremediation of soils from oil spillage and products of oil refining. But taking into account great number of territories polluted with oil plums and products of oil refining it is necessary to continue researches in this direction.

Development of biotechnology of increase of oil recovery with use of native microorganisms that will considerably allow increasing efficiency of oil wells and volume of oil extraction is very urgent especially for Kazakhstan.

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