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Results of Forecasting the Oil Recovery Factor of the North Urtabulak Field at Different Reservoir Operation Modes

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Abstract
Due to satellite oil gases, global warming, acid residues, climate change and the strengthening of the greenhouse effect are taking place.
The world pays special attention to increasing the oil recovery factor, because... Currently, the main technology for developing oil deposits is associated with the displacement of oil by water while the process is continuous. Development with continuous water displacement of oil, according to scientists, provides an average oil recovery factor of 0.38-0.41, i.e. more than 60% of geological oil reserves remain in reservoirs.
Therefore, research aimed at increasing the oil recovery factor, in particular the efficiency of the waterflooding systems used, is an urgent scientific and practical problem in oil production.

Keywords:

Introduction

The Northern Urtabulak oil field is located in the central part of the Dengizkul uplift, where a number of gas condensate fields (Kultak, Zevardy, Alan, Dengizkul) and gas condensate fields with oil rims are located. The industrial gas-oil bearing deposits on them are carbonate sediments of Callovian-Oxfordian age. The reef deposit in the North Urtabulak area is a rounded hill-like protrusion. The size of the reef is 3.1x2.5 km, height 200m. The commercial oil content of the Northern Urtabulak field was established in 1973. The dimensions of the massive deposit are 2.8x2.2 km with a height of 114 m. The depth of the strata in the roof of the deposit is 2420-2450 m [1].

In the section of the Upper Jurassic carbonate formation, two main productive horizons, XV-P and XV-HP, are distinguished. Productive horizons are represented by limestones. The open porosity of reservoir rocks averages 12.3%, and the average permeability in the oil-bearing contour is 121.8 ppm.

The viscosity of reservoir oil is 1.3 cP, density -0.78 g/cm3, saturation pressure of oil with gas - 92.7 kgf/cm2, gas factor 64.2 m3/t. The oil of the field belongs to the highly resinous category, the paraffin content (in%) is 1.5-13.9; resins - 5.8-22.9; asphaltenes – 0.29-2.3.

The Northern Urtabulak field was put into development in 1974. The field development process can be divided into three stages [2]:

-the first stage includes the period from 1974 to 1987. During this period, due to the drilling of the field, an annual increase in oil production is observed. In 1987, maximum oil production was achieved in the amount of 301 thousand tons;

-the second stage includes 1988-1995. At this stage, due to the drilling of infill wells and intensification of waterflooding, the decline in oil production was stopped and further its growth was noted to 300.3 thousand in 1994;

-from 1996 to the present, there has been a steady decline in oil production, which is typical for the third stage of field development. During this period, there has been a steady increase in the production output of wells. As a result of assessing the energy characteristics of the field based on an analysis of the dynamics of fluid extraction, reservoir and bottomhole pressures, it was established that the field is being developed in a closed-elastic mode. This is confirmed by a rapid drop in reservoir pressure and a decrease in well flow rates. At the beginning of waterflooding, the reservoir pressure dropped from the initial 29 MPa to 19.9 MPa, i.e. by 43% with 7.2% oil withdrawal from initial recoverable reserves.

A distinctive feature of the waterflooding system is that, in order to prevent premature breakthrough of injected water to production wells, injection is carried out not into the productive part of the formation, but under the water-oil contact, although by this time there was information that this waterflooding system at similar facilities in Bashkiria turned out to be ineffective . There was no consensus on the results of waterflooding at the Northern Urtabulak field. A sufficient amount of geological and field data has now been accumulated to assess the effectiveness of the method used. One technique is to compare the actual state of an object when exposed to the expected state without it. Thus, the task comes down to determining predictive indicators in both cases [3].

The forecast of oil recovery index indicators showed that in a closed-elastic mode the field would have operated for 10 years, during which 9.2% of the initial balance reserves would have been extracted. During the subsequent period of development in the dissolved gas mode, another 16.1% of the initial geological oil reserves would have been extracted from the field. Thus, provided that the Northern Urtabulak field is developed in a natural mode (closed-elastic + dissolved gas mode), an oil recovery factor of 25.21% would be achieved. The forecast of recoverable oil reserves under the conditions of development of the Northern Urtabulak field with waterflooding was carried out based on the characteristics of oil displacement by water. As a result, the value of recoverable oil reserves was obtained - 8278.2 thousand tons, which corresponds to an oil recovery factor of 0.4561.

Thus, waterflooding at the Northern Urtabulak field made it possible to increase the oil recovery factor by 0.2041.

The results obtained indicate the high efficiency of the waterflooding system used and the possibility of its successful implementation at sites with similar geological and physical conditions.

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