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Technology of Pumping Water to Oil Fields.

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Abstract. The problem of objectivity in assessing the efficiency of waterflooding of an oil field at all stages of development is an urgent task. Ways to solve the problem may be different. The first method is the use of geological models of productive formations that are sufficiently adequate to real conditions and complex hydrodynamic models that describe the mechanism of the filtration process of formation and working fluids injected into the formation.

Keywords. Oil, product, high oil viscosity, carbonate reservoirs, geologic model, waterflooding.

Main part. The problem of objectivity in assessing the efficiency of waterflooding of an oil field at all stages of development is an urgent task. Ways to solve the problem may be different. The first method is the use of geological models of productive formations that are sufficiently adequate to real conditions and complex hydrodynamic models that describe the mechanism of the filtration process of formation and working fluids injected into the formation

However, when flooding fields with hard-to-recover reserves (high oil viscosity, low permeability and large heterogeneity of formations), oil recovery factors decrease to 0.3-0.35 with increasing flushing ratio from 0.8-1 to 5-7, and with viscosity oil more than 25-30 mPa s, waterflooding often becomes ineffective.

Obviously, this method is characterized by a high degree of theoretical justification of the oil recovery mechanism and eliminates error due to the human factor due to the use of software and computing systems. This path, on the one hand, is very labor-intensive, and on the other hand, there is not always reliable information about the properties of productive formations. To eliminate differences between calculated and actual data, a procedure for adapting the created models is initiated, which involves making certain adjustments to individual initial parameters included in the model. In addition, the procedure for adapting the created geological and hydrodynamic models, as is known, to some extent represents a solution to the inverse problem of hydrodynamics, when, based on actual data from the operation of deposits, the initial data (thicknesses, relative phase permeabilities, areal heterogeneity, etc.) are adjusted to achieve an acceptable fit real and actual indicators of development of an operational facility. In terms of labor intensity, this direction is significantly simpler than the first and in modern conditions, from the point of view of the capabilities of computer technology, is already available at the engineering level. The displacement characteristic is understood as an analytical relationship between the main technological indicators and the efficiency of the

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development system - oil recovery of the productive format. To date, about 100 characteristics of displacement are known, proposed by different authors. Moreover, it is characteristic to trace the regionality of the proposed dependencies: some work well in one region, others, on the contrary, in another. This also indicates that the displacement characteristic is an integral dependence of reservoir oil recovery on a large number of initial data, some of which may not only not be taken into account in the technological calculation procedure, but may still not be identified by the science of oil field development. This is especially true for complex carbonate reservoirs.

Assessing the technological effect of waterflooding based on indicators of only a certain stage or stage of operation, as well as any development parameter (reservoir pressure, well flow rate, water cut in well production, etc.) can lead to erroneous conclusions. The application of each method to improve the development system is aimed at increasing the final oil recovery factor. Therefore, to assess the effectiveness of waterflooding, we used the value of the increase (increase) in the final oil recovery factor, defined as the difference in oil recovery factor achieved under the natural regime of reservoir development and with the use of waterflooding:

$$\left(Z_1+\frac{\text{Đ}_1}{\rho g}+\frac{\vartheta_1^2}{2g}\right)-\left(Z_2+\frac{P}{\rho g}+\frac{\vartheta_2^2}{2g}\right)=h_{\text{TP}}+h_{\text{M}}$$

It should be noted that this coefficient is a complex indicator characterizing the properties of reservoirs and formation fluids, the development system and economic criteria, because At the development sites, waterflooding was carried out after a significant period of reservoir development in the natural mode - elastic, followed by a transition to the dissolved gas mode; from the beginning, based on the characteristics of oil displacement by water, recoverable oil reserves were determined for the development periods before and after the use of waterflooding. In accordance with the methodological guidelines for calculating the coefficients of oil extraction from the subsoil based on the characteristics of oil displacement by water, constructed according to the objects of study, the final straight segments were identified to determine the initial recoverable oil reserves for the selected periods of oil deposit development. As an example, the characteristics of oil displacement by water for an oil reservoir in the Andijan field are given.

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