

Experimental study of mechanical and filtration processes in low-permeability reservoir rocks of Verkhnevilyuchanskoye oil and gas condensate field at implementation the method of directional unloading of the reservoir

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Hard-to-recover (HTR) reserves of oil and gas are being actively developed due to the continuous depletion of easy-to-recover reserves. Approximately 2/3 of the world's HTR reserves are located in low-permeability rocks, which are characterized not only by low permeability, but also by low porosity, which significantly hampers the flow of hydrocarbons to the bottomhole [1]. In this regard, it is necessary to adapt new efficient environmentally safe oil and gas production technologies to the conditions of fields with HTR reserves, primarily with low-permeability reservoirs. The most promising among such technologies are those based on the geomechanical approach, which is centered on increasing the permeability of productive formations by creating in them stress states of the required type and value. Separately, it should be noted that for building geomechanical models of oil and gas fields with low-permeability rocks, it is especially important to understand the dependence of rock permeability on the nonuniform external stress field. Such studies are only possible using true triaxial loading facilities.

In order to increase the permeability of the productive formation, an environmentally friendly, effective and economically favorable method of directional unloading of the reservoir (DUR) has been developed at the Ishlinsky Institute for Problems in Mechanics (IPMech) RAS [2]. The idea of this approach is to induce a system of micro- and macro-cracks in the vicinity of the borehole by creating the necessary stress state, which will thereby increase the permeability of reservoir rocks. This stress state can be realized by creating a pressure drawdown in the bottomhole zone and performing a number of technological operations, including creating a system of perforation holes on the wellbore.

In this work presents the results of a series of experiments on physical modeling of mechanical and filtration processes in productive formations of Verkhnevilyuchanskoye oil and gas field, when using the DUR method can lead to an increase of reservoir rock permeability. The tests were carried out on the unique Triaxial Independent Load Test System (TILTS) of the IPMech RAS [2]. The dependence of filtration properties of the studied rock specimens on the type of stress-strain state is presented in the work, and the values of pressure drawdown which can lead to an increase of rocks permeability under a certain bottomhole design are determined. In order to analyze the change in the internal structure of rock specimens after geomechanical testing, complementary studies were performed using a high-resolution X-ray micro-CT scanner ProCon X-Ray CT-MINI [3]. The obtained results indicate that the DUR method can be successfully applied to wells drilled in the Verkhnevilyuchanskoye oil and gas field.

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Reference list

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