GC2024-SG065

Modelling the influence of acoustic vibrations on the movement of plastic particles through rocks

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The development of oil deposits in clastic reservoirs is accompanied by a deterioration in the permeability of the bottomhole formation zone, which leads to a decrease in production rates, failure to meet design targets and the formation of undeveloped areas in the productive formation. To ensure that reservoir development targets are met, inflow stimulation methods are used that help restore the permeability of the reservoir zone and maintain the mechanical integrity of the reservoir. Vibration methods demonstrate an increase in the influx of formation fluid to the production well. In engineering practice, this phenomenon is usually explained by various effects associated with the mobilization of capillary pinched oil, a decrease in fluid viscosity, and others [1]. Such effects are widely covered and physically substantiated in theoretical works. However, there are very few laboratory studies demonstrating the performance of mathematical models. This is primarily due to the complexity of the experiment, which requires the laboratory stand to meet the conditions for processing a rock sample (model) with elastic vibrations and the presence of liquid filtration. To fulfill these conditions, some foreign researchers use microfluidics approaches [2], demonstrating the effects of vibration on artificial micromodels. However, to confirm the effectiveness of vibration methods, oil companies need to demonstrate the effect using traditional core samples. In this regard, laboratory research into the influence of vibrations is a necessary and relevant direction that can demonstrate an improvement in the permeability of rocks.

A laboratory rig given in [3] is used to demonstrate the effect of paraffin mobilization in pore channels from vibrations of a rock sample. When the piezoelectric elastic vibration emitter (Langevin emitter) is activated, the lid is subjected to high-frequency reciprocating movement of the emitter, which it transmits to the liquid in the chamber, as a result of which the pressure in the chamber changes in accordance with the shape of the specified signal (sinusoidal, rectangular, etc.). The resulting elastic vibrations are transmitted through the bushing to the sample through the matrix and a system of pore channels.

Due to the resulting relative displacement of the rock matrix and paraffin particles, the paraffin accumulations blocking the pores are broken up. The criterion for the effectiveness of treatment is the ratio of permeability at the end of treatment to permeability before the first treatment.

The results of the studies indicate that acoustic vibrations restore the permeability of rocks. A model of the influence of vibrations on plastic paraffin particles inside the flow and rock permeability is developed. The results obtained can be used when influencing the reservoir zone, in which deterioration in reservoir properties is observed due to blocking of the pore space by paraffin particles.

The study was supported by the Russian Science Foundation grant No. 22-19-00447, https://rscf.ru/project/22-19-00447/.

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