Fracture formation in a porous medium and its filling with solid particles

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The use of the hydraulic fracturing method to increase oil and gas recovery from reservoirs leads to the formation of new hydrocarbon recovery surfaces. To preserve the opening of fractures under the action of rock pressure, it is necessary to timely introduce solid particles - proppant into the hydraulic fracturing fluid flow, preventing the closing of newly formed fractures. Fractures filled with large particles (proppant) are characterized by increased permeability compared to host rocks, which makes it possible to significantly increase oil recovery from fracture surfaces.

In the process of filling hydraulic fracturing cracks with proppant, uneven settling of particles along the length of the artificially created channel may occur, associated with the action of gravitational forces and with the filtration of the fluid carrying the particles. Under the action of rock pressure, it is possible to close part of the fracture faces, leading to a decrease in the efficiency of the hydraulic fracturing technique used.

Accordingly, one of the main problems in the rational development of hydrocarbon deposits is the choice of the optimal mode for introducing particles into hydraulic fractures and determining the conditions for their uniform filling, as well as the destruction of the formed proppant plugs.

The effect of liquid filtration into the surrounding space on the transfer and settling of particles is considered not only in the problems of the oil and gas industry. In particular, when analyzing geophysical phenomena associated with colmatation and decolmatization of fractures in permeable rock masses, it is also necessary to take into account the processes of particle transfer and deposition on the fracture walls.

The paper presents pilot experiments on a model installation that study the process of crack development in a poroelastic medium with the introduction of particles into the injected flow. The experiment was carried out on an optically transparent model, which makes it possible to determine the stress-strain state of the poroelastic skeleton and the velocity of particles. The presented problem requires further study.

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