

Conditions for crack initiation at the boundary of a poroelastic medium with an impermeable obstacle

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Rocks that contain liquid or gas according to the genesis of origin are classified as sedimentary. The two main features of sedimentary rocks are porosity and the presence of heterogeneities. When exposed to fluid filtration, the stress-strain state of the porous formation changes, resulting in possible cracks. When initiating a crack, one of the main criteria is the condition when the shear stresses exceed the strength of the rock. A more significant stress-strain state changes at the boundary of an elastic permeable medium and a less permeable obstacle as a result of the interaction of a viscous fluid passing through a porous skeleton. To study the formation and development of a crack in sedimentary rocks, a model of a poroelastic medium containing impenetrable obstacles is considered.

In the presented work, the influence of fluid filtration on the process of crack propagation in an inhomogeneous porous medium was studied by the method of physical modeling. For this, an experimental setup was created, the main part of which consisted of a Hele-Shaw cell filled with a poroelastic medium. The liquid pressure was recorded at the cell inlet. The experiments were carried out for various geometric parameters of inhomogeneities and their location. The picture of the processes occurring during the filtration of a viscous fluid in the skeleton was recorded in real time. An optically transparent model of a porous medium made it possible to estimate the stress-strain state of the skeleton under the action of a viscous fluid. The conditions for the formation of a channel during the destruction of a porous medium as a result of shear stress at the boundary of a porous medium and an impermeable obstacle are revealed. In the course of the experiments, the influence of the location of the inhomogeneity on the propagation of an elastic wave was considered. According to the visualization of the experiments, the speed of the filtration front (filtration wave) was obtained, as a result of which the change in permeability over time was estimated.

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