

Change in Permeability of an Ultra-Low Permeable Porous Media under The Influence of Confining Pressure

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The objective of this research was to study long-term response of filtration properties of a porous rock sample to external confining pressure. An experimental dependence of the permeability of an ultra-low-permeable limestone sample on time during the loading-unloading cycle with a duration of 29 days was obtained. An experimental study of flow stabilizing process in the sample was also conducted. It is shown that the characteristic time of stabilization, both obtained from theoretical estimates, and measured much less than the characteristic times at which the permeability change occurred during the main loading experiment. This allows us to conclude that the observed change in the permeability of the sample is due to its viscous deformation. Previously, we carried out a series of experiments on the short-term loading of more permeable limestone samples [1]. Experiments have shown a relatively weak permeability response to external stress. During the stepped loading-unloading cycle lasting about two hours the permeability of the samples irreversibly decreased by the amount of 3-5% from the initial one. As a result of the long-term loading experiment we found that the change in permeability under the same loads over longer times can be much more significant: during the month, the permeability of the sample under study decreased by more than one and a half time. At the same time, there was practically no visible elastic response of the sample to a abrupt increase in load, and the entire change in permeability occurred in the way of viscous deformation. This phenomenon requires further study, especially in connection with the increasing role of low-permeable reservoirs in the oil production. Such reservoir rocks may be subject to considerable compaction during development. In most cases, this compaction is irreversible, and therefore cannot be described using the traditional theory of poroelasticity. This can lead to incorrect estimates of changes in the filtration properties of reservoirs during the development process. Understanding the mechanics of deformation is important for estimating the volume of recoverable hydrocarbon reserves, in development of hydrodynamic models of oilfields and oil production intensifying methods, in particular, hydraulic fracturing.

1. Arkhipov Ya.D., Baryshnikov N.A., Zenchenko E.V., Turuntaev S.B. Changes in the filtration properties of low-permeable porous media under external load. *Dynamic processes in geospheres*. 2017. No. 9. P. 68-75. (in Russian)