

Permeability variations of ultra-low permeable rock in the loading-unloading cycle.

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An important feature of porous rocks and oil shale is the strong dependence of their filtration properties on the stresses. Such rocks may exhibit inelastic behavior under external load, which manifests itself in the form of a significant decrease in their permeabilities with time under constant long load, and the absence of filtration property elastic recovery after the short-term loading. The long-term variations of the filtration properties of porous rock sample under external confining pressure was studied in laboratory experiments. The experimental data on change of the ultra-low-permeable limestone permeability during 29 days of the loading-unloading experiment was obtained. It was found, that the sample permeability decreased by more than one and a half times. There was practically no permeability elastic reaction to the short-term changes in the confining pressure. An experimental study of the flow stabilizing process in the sample was also conducted. It was found that the characteristic time of the flow rate stabilization, both theoretically estimated and measured, is much less than the characteristic time 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 related with its viscous deformation. The phenomenon requires further study, especially in connection with increasing role of the low-permeable reservoirs in the oil production. Such reservoir rocks may be subjected to considerable compaction during development. In most cases, this compaction is irreversible, and therefore cannot be described using traditional linear theory of poroelasticity. 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 recovery intensification methods, such as hydraulic fracturing.