EGU2020-13011, updated on 28 Oct 2021
https://doi.org/10.5194/egusphere-egu2020-13011
EGU General Assembly 2020

Hydro-mechanical Dependent Hydraulic Conductivity within Alluvial Gravelly Soil: An Experimental Study

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Abstract: Seepage process can be extensively observed in rainfall infiltration, natural waterways, artificial hydraulic constructions and other interactive phenomena between water and soil. Recent investigations targeting the deep water circulation as well as shifts of basin patterns induced by massive projects urge the need to enhance the understanding of seepage characteristics under profound depth (high packing state) and great hydraulic pressure. Alluvial gravelly soil is an ordinary weathering product in mountainous area, either exposed to the ground or embedded as a layer. This research focuses on the hydraulic conductivity of such soil. A novel large-scale triaxial seepage apparatus was designed with the capability of replicating densely packed soil specimen and simulating severe hydraulic conditions. Influences of both the packing state and the hydraulic pressures were experimentally studied. It is revealed while most existing permeability models present the rational description that hydraulic conductivity decreases with higher packing state, these formulas for non-plastic soil overestimate the hydraulic conductivity of gravelly soil more than one order of magnitude. The dependence of hydraulic pressure displays the similar trend, as increasing hydraulic gradient diminishes the hydraulic conductivity. Coupled hydro-mechanical permeability models are therefore introduced based on test results. No observation of obvious seepage failure illustrates that high packing state resulting from mechanical loads are favorable to prevention of soil erosion and corresponding countermeasures.