GEOSEMINAR

Hydraulic Fracture in Particulate Media

by

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Abstract

Hydraulic fracturing has been the subject of investigation over the past decades. In brittle materials, the phenomenon is relatively well understood. Fracturing (of brittle materials) in general is related to the creation of new surfaces due to large tensile stresses developed at the crack tip. These tensile stresses propagate the fracture by breaking some form of bonds. In fine-grained particulate materials, new surfaces are not necessarily created, however bonds due to chemical, electrical and or capillary forces can be contributing factors in fracture propagation. However, these chemical and electrical forces in fine-grained soils are much less prevalent in course-grained materials. Question arises then on weather hydraulic fracturing occurs in course-grained materials where capillarity forces are absent. Resent work by Chang (2004) demonstrated that in dry particulate materials, hydraulic fractures appear if leak-off is limited (thus limiting capillary forces). In this presentation we intend to show that in the laboratory setting hydraulic fractures initiate and propagate in saturated sands even with significant leak-off present. Furthermore, leak-off may play an important role in fracture propagation. An experimental series has been conducted by varying such controlling parameters as the properties of fracturing fluids, boundary conditions, initial stress states, injection volumes, and rates. Results from the experiments and scaling relationships provide insight into the fundamental mechanisms of hydraulic fracturing in particulate materials.

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