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Propagating cracks in saturated ionized porous media. (English) Zbl 1323.74076

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Summary: Ionized porous media swell or shrink under changing osmotic conditions. Examples of such materials are shales, clays, hydrogel and biological tissues. The presence of the fixed charges causes an osmotic pressure difference between the material and surrounding fluid and concomitantly prestressing of the material. Understanding the mechanisms for fracture and failure of these materials are important for design of oil recovery, medical treatment and materials. The aim has therefore been to study with the Finite Element Method the effect of osmotic conditions on propagating discontinuities. The work uses the partition of unity modeling of a crack in a swelling medium. The modeling of the fluid flow around the crack is essentially different for mode-I compared to mode-II. In mode-I, the pressure is assumed continuous in the crack area, while in mode-II the pressure is assumed discontinuous across the crack. Step-wise crack propagation through the medium is observed both for mode-II as for mode-I. Furthermore, propagation is shown to depend on the osmotic prestressing of the medium. In mode-II the prestressing has an influence on the angle of growth. In mode-I, the prestressing is found to enhance crack propagation or protect against failure depending on the load and material properties.

For the entire collection see [Zbl 1202.74012].

MSC:

74R99 Fracture and damage
74F10 Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
74S05 Finite element methods applied to problems in solid mechanics
76S05 Flows in porous media; filtration; seepage

Keywords:

porous media; crack propagation; partition of unity; cohesive zone; step-wise propagation

Full Text: DOI

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paper as accurately as possible without claiming the completeness or perfect precision of the matching.