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Abstract

Acidizing and chemical solutions may change mechanical properties of rocks and facilitate rock fracturing in different mining operation and enhanced oil recovery projects in oil fields. Characterization of rock properties shows an inhomogeneous and completely anisotropic behavior while some rocks exhibit orthotropic behavior. Chemo-mechanical processes result in the development and intensification of inhomogeneity and orthotropy in rock properties which should be characterized for numerical modeling of fracture initiation and propagation in engineering rock works. An extended finite element code which is a powerful numerical tool, compared to the other numerical methods, is developed to model fracturing graded brittle rocks by chemical corrosion. The code uses enriched functions in an anisotropic and inhomogeneous environment to reproduce singularity. A numbers of rock specimens were exposed to various degrees of acidity in different time periods in the laboratory and developed numerical code is verified by laboratory results. Crack propagation is investigated by considering different corrosive solutions under various mechanical loading in three-point and four-point bending tests both numerically and experimentally. The results show that XFEM could model rock fracturing process of the eroded materials by chemical compounds very accurately. Results also show that deformability and asymmetry in the stress distribution is increased as a strong function of chemical concentration. With decreasing *pH*, rock fracture toughness is also decreased and crack propagation paths is more violated compared to the non-eroded rocks. It is also shown that crack orientation in respect to the main axes of orthotropy can have a decisive role on failure load.

Keywords: Numerical modeling; Extended finite element; Acidizing; Inhomogeneous materials; Enrichment functions; Crack propagation.