Hydromechanical analysis of a hydraulic fracturing problem

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ABSTRACT

Hydraulic Fracturing is a technique of stimulation of wells which recently has been widely used for shale gas extraction. In the hydraulic fracturing, a fluid is injected into the wellbore under controlled pressure and flow. The differential pressure generated by the injection of fluid initiates cracks that will propagate into the deep-rock formations, so that allows the extraction of hydrocarbons trapped in the rock. The technique is used in conventional and unconventional reservoirs of hydrocarbons. In the first case, in conventional reservoirs, the technique is applied in order to increase the production of the well, while in unconventional reservoirs (shale gas) the technique is used to enable the extraction of the gas due to its very low permeability. Furthermore, the process of fracturing the rock at great depths involves the control over the type of fracture created or reactivated, as this will depend on a number of factors. The study of the technique is important to improve the control over the execution of this procedure and also to avoid possible contingencies and accidents. In this work was implemented a formulation capable of representing discontinuities in a continuous mesh using a finite element code. The Extended Finite Element Method (XFEM) was implemented in a hydromechanical coupled formulation. Additionally, analysis were performed to identify how the permeability of the rock and the permeability of the fracture influence the hydraulic fracturing. As a resut, it was observed that maintaining all of the mechanical properties constant, the hydraulic properties have a great impact on the hydraulic fracturing process. The velocity of propagation of the fracture is affected by the permeability of the rock, and its ratio is inversely proportional.

Key words: Hydraulic Fracturing, Hydromechanical, XFEM