STT07-08   Room:421   Time:April 29 11:15-11:30

Distinct element method for solid-fluid coupled interaction in the application of hydraulic fracturing

NAGASO, Masaya[1]* ; MIKADA, Hitoshi[1] ; GOTO, Tada-nori[1] ; TAKEKAWA, Junichi[1]

[1]Graduate School of Engineering, Kyoto University

The hydraulic fracturing is of great interest in many scientific and engineering fields in hydraulic fracturing, such as the hot dry rock geothermal power(HDR). However, the natural fractures have significant influence on the nucleation and growth of fractures created in hydraulic fracturing. In addition, the viscosity of fluid used in hydraulic fracturing also influences the geometry of hydraulically created fractures. Although the influence of both natural fracture and fluid viscosity has been intensively investigated on the distribution of hydraulic fractures, none of the studies has dealt with natural fractures and fluid viscosity at the same time and the interaction between them has not been revealed yet. We, therefore, performed a series of numerical simulations for hydraulic fracturing in naturally fractured rock using a 2D flow-coupled DEM code to examine the influence of the fluid viscosity on the interaction between hydraulic and natural fractures. In this study, a low viscosity fluid of 0.1 m^2/s and a high viscosity fluid of 100.0 m^2/s are used. Our model is a square block with a borehole at the center under a stress field whose maximum and minimum stresses are 10 and 5 MPa, respectively. We apply the hydraulic pressure to the borehole wall, and observe how induced hydraulic fracture would propagate in the presence of a single natural fracture located adjacent to the borehole. The viscosity of fluid and the angle between the maximum stress direction and fracture orientation are the parameters of the numerical simulation. The results show that the lower the oblique intersection angle is, the less linearly the induced fracture crosses the pre-existing fracture. However, when a high viscosity fluid is used, the interruption of natural fractures decreases and the induced fracture tends to go straight along the direction of maximum compression. Our numerical example implies that high viscosity fluid could be used in hydraulic fracturing to reduce the influence of a natural fracture when the hydraulic fracture intersects the pre-existing fracture with certain angles .

Keywords: hydraulic fractureing, viscosity, natural fracture, discrete element method