Alina Akhtyamova

Poroelastoplastic geomechanic model for unconventional reservoirs: construction, core based initialization and practical application

One of the understudied problems of hydraulic fracturing is mechanisms of cracks propagation in the Geomedia. Importance of this problem related to development of unconventional reservoirs, which may contain significant amount of clays and kerogen. Apparently, under specific conditions such formations manifest plastic properties and failure mechanism is of viscous nature and are attended by plastic deformations. Thus, the question about crack propagation pattern in the layered formations with great contrast in strength and elastoplastic properties is arised.

The goal of this research is investigation of specific of cracks propagation in the media, containing plastic layers and layers with contrast strength properties. The study was carried out by using numerical simulation of deformation and failure process of medium with initial crack of a given length. Calculations were performed having used software package where system of equations of continuum mechanics including equations of motion and consistency and constitutive relations of material behavior were solved numerically. Material behavior is defined in terms of modified Drucker-Prager model with unassociated flaw law.

The emphasis is on the investigation of crack propagation character in the medium with various properties and revealing the conditions under which branching of cracks may occur. As leading factors affecting the cracks propagation character, strength and elastoplastic properties, thickness and relative position of layers and initial stress distribution are considered. Further significant factor defining character of cracks propagation is rate of load application in terms of rate of pressure increasing and its changing on the tip of the crack, which as a result determine distribution of pressure in the growing crack.