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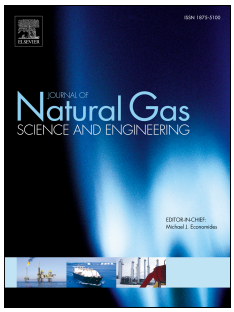

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Numerical modeling of multiple fractures propagation in anisotropic formation

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Abstract

In this study, a fully coupled model is presented for simulating the propagation of multiple hydraulic fractures in anisotropic formation. Rock anisotropy is captured by using anisotropic constitutive relation to describe solid deformation and using modified maximum circumferential stress to determine fracture propagation. Besides, fluid flow in the wellbore is established to partition injection into each fracture for consideration of stress shadowing effect. The extended finite element method is used in the discretization of stress equation, and Newton' iteration is proposed to solve the fully coupled problems. The numerical method is verified against other solutions for one fracture and two fractures propagation problems in the literatures. The effect of rock anisotropy on hydraulic fractures is analyzed in the following aspects: material angle, ratio of Young's modulus and fracture toughness. If material angle is not aligned with fractures initiating direction, fractures would deflect towards the direction of material angle. Ratio of Young's modulus could enhance this effect, but it is in the opposite for ratio of fracture toughness. Results indicate that the simultaneous propagation of multiple hydraulic fractures in anisotropic formation is determined by two competing factors: stress shadowing and rock anisotropy.

Keywords: hydraulic fracturing; multiple fractures; rock anisotropy; stress shadowing; extended finite element method

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