

Numerical study on hydraulic fracture penetrating interface in shale oil reservoir simulation

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Abstract: Shale oil is an important type of unconventional oil and gas. However, due to its extremely low porosity and thermal conductivity, it is necessary to form a complex fracture network in oil shale reservoirs by hydraulic fracturing to improve oil recovery. We propose a shale model based on local CFEM considering the friction sliding effect of NFs to predict the interaction between HF and NFs. When the interface is activated, the relative sliding generated by the two interfaces is controlled by a simple friction law, which reflects the physical behavior that the friction affects the shear deformation of the fracture wall to affect the opening of the fracture along the vertical wall. It can well simulate the complex elastoplastic behavior and fracture process of rock materials. Besides, the local CFEM method is used to insert interface elements only in areas with NFs distribution according to geological data, which reduce the degree of stiffness reduction. The results showed the vertical in-situ stress difference, cohesion and internal friction angle of NFs are positively correlated with the HF penetration ability. When the intersection angle is large (greater than 20 degrees), the intersection angle is positively correlated with the HF penetration ability while the intersection angle is very small (less than 20 degrees), due to the interaction of the local stress field between the NFs and the HF, the HF will penetrate the NFs. In terms of construction parameters, the viscosity and flow rate of fracturing fluid are positively correlated with the penetration ability of HF, while the distance of injection point is negatively correlated with the penetration ability of HF. The results of this study can provide a deeper understanding of the law of HF propagation in laminated shale and the influence of NFs on HF propagation.

Keywords: Hydraulic fracture; Interface; Friction sliding effect; Shale; Penetrating