Numerical calculation of temperature and pressure in the fracture during supercritical carbon dioxide ($SC\text{-}CO_2$) fracturing

He Yuting
Southwest Petroleum University, China

Supercritical carbon dioxide fracturing can solve the problem that hydraulic fracturing consumes a lot of water. On the other hand, part of the carbon dioxide after the fracturing enters the pores of the reservoir rock or is adsorbed by the coal, which plays the role of carbon dioxide storage and helps to alleviate the warming caused by the increase of atmospheric carbon dioxide concentration.

In supercritical carbon dioxide fracturing, wellbore, reservoir, temperature, pressure and carbon dioxide physical parameters interact, so in order to study this complex process, a thermal-hydro-mechanical (THM) coupled supercritical carbon dioxide fracturing model needs to be established, which fuses wellbore model and fracture propagation model. The finite difference method is used for the calculation of the wellbore model; the boundary element method is used for the calculation of fracture propagation; the finite volume method is used for the calculation of carbon dioxide flow; the energy conservation criterion is used to calculate the temperature of carbon dioxide. Both the wellbore model and the crack propagation model use implicit solutions, and the coupling process is solved based on Picard successive approximation method. Based on the model, the effects of Young's modulus, leak-off coefficient, in-situ stress of reservoir and reservoir temperature on the fracture morphology and temperature of supercritical carbon dioxide were analyzed.

The results show that the reservoir rock mechanical properties have a significant effect on the heating rate of carbon dioxide in the crack, and the reservoir temperature and pressure have a significant effect on the fracturing effect compared with conventional hydraulic fracturing. And in order to ensure supercritical carbon dioxide fracturing effect and cost savings, a drug that can reduce leak-off needs to be developed.

Biography

He Yuting has expertise in numerical simulation of hydraulic fracturing fracture growth, multi-field and multi-phase coupling, calculation of carbon dioxide phase state and physical and chemical parameters and enhanced geothermal system (EGS) and oil and gas stimulation theory and technology. With his years of experience in research, he has built this supercritical carbon dioxide (SC-CO2) fracturing model coupled thermo-hydro-mechanical Processes (THM) based on the implicit fully coupled solution of boundary element method (BEM) and finite volume method (FVM) The model can accurately calculate the change of physical properties of carbon dioxide during fracturing, which has important guiding significance for SC-CO2 fracturing.

HYT_Frac@126.com