A Coupled THC Model for Wormhole Propagation in 3D Fractured Carbonate Rocks

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Abstract Aiming to promoting the oil production in carbonate reservoir, acidizing treatment is employed to dissolve damage and create dominant wormholes with high conductivity by injecting reactive fluid (hydrochloric acid) into the formation. In this study, a three dimensional thermal-hydro-chemical coupled Unified Pipe Network Method (UPM) is applied to simulate the acidizing process in the fractured carbonate rock. The concept of the traditional two-scale continuum model is completed by considering thermal effects and extended by incorporating multiphysical governing equations for fractures which are explicitly represented in the current method. Both matrix and fractures are discretized as equivalent pipes which are assembled to form the fractured porous media in the 3D UPM framework. The accuracy of the thermal-hydro coupled process is verified against commercial software (COMSOL Multiphysics). And the reliability of modeling the acidizing process in different temperature is demonstrated by comparing with previous experimental results. The influences of the existence of fracture network, varying reservoir or inlet acid temperature and formation heterogeneity on the acidizing efficiency are numerically analyzed. The current modeling gives insight understanding of the acidizing optimization process for practical field of fractured carbonate reservoir to achieve favorable acidizing treatment.

Keywords: Thermal-hydro-chemical, Acidizing treatment, Unified Pipe Network Method, Two-scale continuum model, Fractured carbonate rock