Application of Dilation-Recompaction Model in Hydraulic Fracturing Simulation

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Abstract

Production of unconventional oil and gas resources has played a significant role on the global energy supply, of which tight oil and gas reservoirs are drawing greater focus. The key enabler behind tight oil and gas production has been multi-stage hydraulic fracturing along extended reach horizontal wells. Hydraulic fracturing, dramatically increases reservoir permeability in the near wellbore region and enlarges the connectivity between the production wellbore and formation. Despite many advances in multistage fracturing, it still remains unclear how to model the hydraulic fracturing process to provide the basis to optimize and predict the layout and geometry of fracture networks and associated enhancement of fluid production. This is especially difficult since it is not possible to directly image the fracture network since the length scales of the network can be relatively small. Although transient analysis can provide estimates of fracture width, half-length, conductivity, and closure time, it does not provide measures of the fracture network connectivity and complexity. In typical reservoir simulation practice, the conventional way to represent the hydraulic fracture is to place transverse plane around the horizontal well – this means that the simulator has prescribed the orientation and length scale of the fracture before the simulation has started. In the research documented here, we explore a dynamic fracturing approach that uses a dilation-recompaction model in a reservoir simulator to model hydraulic fracturing. The key strength of the approach is that the geometry and length scale of the fracture is not prescribed a priori. We also investigate the impact of reservoir heterogeneity on multistage hydraulic fracturing along a horizontal well.