Determining Hydraulic Fracturing Methods For Wells In Naturally Fractured Reservoirs

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Abstract

Objectives/Scope: Hydraulic fracturing has been necessary to stimulate deep and tight gas reservoirs for boosting production although the reservoirs are naturally fractured. Two fracturing methods related to cased-hole perforation hydraulic fracturing and open hole multistage stimulation fracturing are generally used. In practice, how to select the right fracturing method for a well seated in naturally fractured reservoir has been rarely discussed, which is the objective of this paper.

Methods, Procedures, Process: In this paper, a novel geomechanics workflow is presented, along with some criteria that can be used to select the right fracturing method for wells landed in naturally fractured reservoirs. Several key components of the novel geomechanics workflow will be briefly introduced, such as natural fracture prediction, 3D mechanics model for perforation breakdown pressure, 3D geomechanics model, 3D hydraulic fracture-natural fracture modeling, and fully coupled analysis for open hole multistage fluid injection. The interaction between discrete natural fractures (NF) and propagating hydraulic fractures (HF) will be investigated through some modeling studies.

Results, Observations, Conclusions: Different interaction scenarios between hydraulic fractures and natural fractures and the occurring conditions are qualitatively explored and discussed. Several hydraulic fracturing modeling case studies considering natural fractures are provided to exhibit the possible roles of natural fractures on hydraulic fracture propagation. Both advantages and disadvantages of the natural fractures’ roles can be objectively visualized based on the resulted fracture network. The sensitivity of key parameters on the HF-NF interaction can be easily verified through the numerical example studies, which are fracture interface mechanical properties and natural fracture orientations. Some guidelines on hydraulic fracture treatment in naturally fractured reservoirs for both open hole and cased hole will be given. Issues on placing proppants in complex hydraulic fractures and natural fracture networks will be discussed too.

Novel/Additive Information: This paper offers several novel insights on several aspects: the existing issues of the open hole multistage stimulation method, natural fracture prediction, a new framework for calculating perforation breakdown pressure and optimal perforation direction, HF-NF interaction, and guidelines for selecting fracturing methods, etc.