Impact of Geomechanics on Fracture Flowback

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We aim at the development of a general modeling workflow for design and optimization of the flowback operation on a multistage fractured well. In our methodology, we employ a coupled modeling approach, where geomechanics phenomena are considered together in the framework of a global model for fluids displacement in a fracture. Among the solid mechanics effects considered are: proppant embedment with plastic deformations of the rock near the fracture surface, proppant crushing, proppant flowback, proppant pack compaction under the action of the closure stress, tensile rock failure at high filtration rates from the reservoir to the fracture (when drawdown pressure drop is excessively high). These geomechanics effects are implemented into the global fluid flow model in a fracture, which takes into account: displacement of fracturing fluid by oil, two-phase effects, suspension filtration with particle trapping and mobilization, resulting in permeability damage, colmatation and skin buildup inside the fracture in the near-wellbore zone (where particles are mainly formation fines and crushed proppant). In our numerical experiments and parametric study, we made the following observations, structured by the discipline. Geomechanics: proppant embedment may result in fracture width decrease by tens percent from the original (ideal) estimates, thus having a profound impact on the fracture conductivity. One of the most risky phenomena are proppant flowback and tensile rock failure in the near-wellbore, for which we present illustrative results. Fluid mechanics: unstable displacement of fluids may result in formation of immovable “islands” of fracturing fluid, which are not cleaned up, this leaving parts of the fracture surface unproductive. We also present the considerations of our resuls against real field data from Western Siberian fields with evidence that flowback operation should (and can) be optimized by using a proper modeling workflow. The novelty of our approach stems from the ambition to construct a general framework for a coupled geomechanics-fluid mechanics model of flowback, accurately equipped with proper submodels for each important physics phenomenon peculiar to the flowback operation.

References

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