AAPG Datapages/Search and Discovery Article #90319 ©2018 GEO 2018 13th Middle East Geosciences Conference and Exhibition, Manama, Bahrain, March 5-8, 2018

CFD Modeling of Particle Transport into Perforation Clusters for Horizontal Multistage Fracturing Applications

Vijaya Patnana[1] and Travis Larsen[1]

[1]Halliburton, Pune, India.

ABSTRACT

Multistage fracturing operations rely on efficient transport of solid proppant and diverter particles to maintain fracture conductivity and control fluid distribution along the wellbore, respectively. Delivery of solid materials involves two steps: conveying material through the wellbore and delivering the material into the desired perforations and fractures. Previous publications have focused extensively on proppant transport (i.e., high density particles), but little information is currently available that describes transport of low-density particles into perforations of varying orientation. Low-density particle movement through the wellbore and into differently oriented perforations is modeled using commercial computational fluid dynamics (CFD) software. The numerical methodology and models used for simulations are explained, and the importance of accounting for gravitational effects and sufficient entry length for flow establishment before encountering the first perforation is emphasized. The effects of changing flow rate, pressure drop across the perforations, and perforation orientation on the transport efficiency (TE) of delivering particles to the perforations are investigated. The transport efficiencies calculated in this work, where gravity and long entry lengths are accounted for, are substantially different from values previously reported in the literature where insufficient entry length was considered. Detailed analysis is used to emphasize the importance of these considerations and explain how these factors affect the results. Within the limits of a heterogeneous slurry flow regime, the results show that increasing pump rate increases the inertia of the particles, which proportionately reduces particle mass flow rates into down- or side-oriented perforations; however, no significant change is observed for the top-oriented perforation in the range of simulated flow conditions. This work provides recommendations that can be used to optimize treatment design parameters to help achieve more efficient and uniform delivery of solid particles into perforation clusters during horizontal stimulation operations. The CFD-based methods and procedures developed in this work can be further extended to study a variety of applications where similar transport and delivery concerns are present.