Determining Pressure Drop and the Minimum Fluidization Velocity across a Gravel Pack Completion to confirm its Integrity

Research Themes

Themes: Production Engineering and optimization, Well Completions, Finite Element Modeling, Fluid Dynamics

In a gravel pack completion, a non-uniform reservoir inflow with very high velocity could be capable of eroding the sand screen or may fluidize the gravel. Hence, it is crucial to maintain the integrity and avoid the failure of a gravel pack completion along with optimizing the well production. Previously, works have been carried out to address the risks of fluidizing the gravel pack in high flow rate - deepwater wells, however, there is an absence of formulas or verified safety cutoff velocity values below which a well should be produced to avoid damaging the gravel pack completion.

Recent Accomplishments

The aim of this research is to understand the relationships determining pressure drop across an undamaged gravel pack such that the velocity for non-uniform inflow can be determined at the screen and at the sandface (of the gravel pack) for open and cased hole completions at various annular pack thickness. With large pressure drop from the reservoir to tubing or gravel pack, this research determines the jetting action of the fluid within the gravel pack. Further, this study aims at determining the minimum inflow velocity sufficient to destabilize the gravel pack bed and thus, impair it, hence determine the minimum fluidization velocity. This fluidization of the gravel pack is explained by the particle motion phenomena and simulated using the Eulerian approach where the fluid phase (inflowing hydrocarbon) is treated as a continuum and the dispersed phase (gravels) is tracked. With the aid of ANSYS-FLUENT this research focuses on understanding and mimicking the physics inside the bottomhole gravel pack completion by generating a model.

- The CFD model is successfully established in ANSYS - Fluent
- Fluidization phenomenon is observed for different flow rates in a small section of the gravel pack completion
- The change in the Volume Fraction of the gravel as the fluid enters the gravel pack region signifies a successful fluidization phenomenon

Issues

- The same model needs to be run on a larger scale and geometry of the completion (to mimic the actual size in terms of feet in length). Currently, the simulations are being carried out on a smaller cross section of the geometry.
- Incorporating different geometry (size of the completion) and alignment of the perforations to observe jetting action more closely is a topic that's being worked upon.
- The CFD model with high number of mesh (in millions), requires longer time to compute and needs computers with high computing capability.
- Validating the model with real field data needs to be performed.

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