Optimization of multi-stage hydraulic fracturing design in conditions of Bazhenov formation

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This article aims to overview the prototype software for multi-stage hydraulic fracturing (MHF) design treatment. It includes HF simulator and reservoir simulator. Both of them are adapted for Bazhenov formation features such as high geological heterogeneity, vertical stress anisotropy, natural fractures, and extremely low permeability. Technological process features are also considered. As multistage hydraulic fracturing is of interest the issue of stress shadow effect and pressure distribution within the wellbore are considered.

The core of MHF module is based on cell-based pseudo-3D model with equilibrium-height growth regime, which is chosen for its reasonable accordance between accuracy and speed of numerical calculation. The hydraulic fracturing module allows setting an arbitrary design treatment (fluid and proppant properties, pumping schedule), lithology and well construction. Fracture geometry, mechanics of flow with proppant must be taken into account for proper fracture design and evaluation of packed fracture width profile. During the treatment, concentration of proppant near the fracture tip often increases causing tip screen out and making further fracture growth impossible. These aspects of fracture growth are implemented in MHF module. Once the fracture growth (with its sequent closure) is simulated, the MHF geometry may be transferred into the module for reservoir simulation in a straightforward way to calculate the inflow.

Thereby, the software allows following the HF design treatment workflow: both modules may be used in a joint way. In this article two cases are discussed: single fracture growth modelling and multi-stage hydraulic fracturing modelling.

References

1. Yew C.H., Weng Xiaowei. Mechanics of hydraulic fracturing. – Gulf Professional Publishing, 2015, pp. 65–67. – http://dx.doi.org/10.1016/B978-0-12-420003-6.09995-X.

2. Dontsov E.V., Peirce A.P., Proppant transport in hydraulicfracturing: crack tip screen-out in KGD and P3D models, International Journal of Solids and Structures, 2015, V. 63, pp. 206–218.

3. Crouch S.L., Starfield A.M., Boundary element methods in solid mechanics: With applications in rock, Boston: George Allen & Unwin, 1983.

4. Economides M.J., Nolte K.G., Reservoir stimulation, Houston: John Wiley&Son, 2000.

5. Lecampion B., Desroches J., Simultaneous initiation of multiple transverse hydraulic fractures from a horizontal well, ARMA 2014-7110, 2014.

6. Weng X., Kresse O., Chohen C. et al.,Modelling of hydraulic fracture network propagation in a naturally fractured formation, SPE 140253, 2011.

7. Baikov V.A., Davletbaev A.Y., Ivaschenko D.S., Non-Darcy flow numerical simulation and pressure/Rate transient analysis for ultra-low permeable reservoirs, SPE 171174-MS, 2014.