Comparison of design optimization algorithms of multiply fractured well

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Multiply fractured horizontal wells (MFHW) are widely used for enhancing the oil recovery of low permeability reservoirs. Because of the high cost of MFHW, it is of great interest to study the optimization problem of hydraulic fracturing design to ensure economic efficiency. Moreover, the choice of a fast and steady optimization method plays a crucial role.

In our talk the optimization problem states as follows. One must choose the set of fracturing parameters (the length of horizontal wells, the number of fractures and their geometric characteristics) at which optimization targets are achieved (the maximum of cumulative well production, the maximum income based on the calculation of the Net Present Value (NPV) and the minimum treatment costs of MFHW).

The approach to solving the optimization problem combines solutions of three subtasks: the determination of the fracture geometry, the calculation of the post-fracture oil production and the calculation of economic parameters [1].

Single-objective optimization problems, where only NPV is maximized, and multi-objective optimization problems, where it is necessary to simultaneously find extremes of the oil production, NPV and fracturing costs, are considered in the paper. The optimization problem is solved using the most popular methods: genetic algorithm NSGA-II [2], the particle swarm optimization method [3] and the annealing simulation method.

The analysis of the efficiency of the considered algorithms was carried out by testing on model problems and then applied to the example of low-permeable oil reservoir. The calculations showed that NSGA-II demonstrated the greatest stability and the best convergence among the considered algorithms. The particle swarm optimization algorithm showed the least computation time and good convergence although slower than NSGA-II. The simulating annealing method showed the least stability and a strong dependence on the input parameters.

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References

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