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Design of Large-Scale Physical Simulation Model for Alkaline-Surfactant-Polymer Flooding

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More complicated than polymer flooding, alkaline-surfactant-polymer (ASP) flooding is a chemical flooding technology with higher enhanced oil recovery. To better understand the flow dynamics in ASP floods, we designed and improved a physical model that is suitable for the pressure and oil saturation monitoring.

The basic model is a three-layer heterogeneous sandpack model. The optimization of the monitoring system is to use the numerical simulation method to study the optimization method of the monitoring point of the model strength and the interpolation method. The method of optimizing the number of pressure measurement points, the position, the insertion structure and the pressure field restoration method were adopted to achieve the optimal match of test point number with the best restoration accuracy.

To obtain the best restoration effect, we optimized the model from 4 perspectives. (1) Placement of measuring point. Based on the characteristics of polymerization, 3 geometric placements were designed (matrix, one-way axial, and two-way axial). (2) Arrangement mode of measuring point. By comparing the 100 uniformly distributed 100 points in the simulated pressure field and the interpolation reduction field, the restoration rate was defined as the percentage of valid restoration point (5% relative error) in total observation point. (3) Optimization of interpolation methods. Due to the limited points, the final pressure/saturation field distribution needs to be obtained by interpolation, based on the numerical simulation results, the restoration of the pressure field were carried out by different interpolation methods for different pressure point arrangement methods. Then the numerical simulation results and interpolation results were compared. The optimal interpolation method for different pressure point arrangement method was selected. (4) Saturation process optimization.
Based on the numerical simulation, the optimal saturation method (injection order, injection-production relationship) and the corresponding saturation rate were obtained for the different pressure point arrangement modes. Finally, the auxiliary saturated wells are added to the actual model to prevent the functional wells (injectors, measuring wells) from pollution.
Through the comparison of the reduction rate to determine the program to match the interpolation of the reduction of the way, compared to different solutions under different density reduction results:
The paper provides a practical means for adjustment of physical simulation model for ASP flooding, which greatly improves the accuracy in flow monitoring.

References

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Primary authors: YANG, Hanxu; Mr HU, Jinchuan (China University of Petroleum, Beijing); Prof. LI, Junjian (China University of Petroleum, Beijing); Prof. JIANG, Hanqiao (China University of Petroleum, Beijing)

Presenter: YANG, Hanxu

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