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Effects of coke formation on the pore structure and permeability during heavy oil in-situ combustion

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In-situ combustion (ISC) is an important thermal enhanced oil recovery technique. Significant open ISC questions are raised including the effect of coke formation on the pore structure and permeability during high temperature reaction in ISC process. In this study, a combination of X-ray computed microtomography (uCT) and LB simulation was used to evaluate the alteration of the geometric properties and the reduction of permeability by coke deposition. The geometric properties, such as porosity, geometric tortuosity and pore throat size distribution, were extracted by image analysis at different coke depositions. The permeabilities of the microstructures were computed by LB simulationmethod. The results showed that the permeabilities of the microstructures with coke deposition were overestimated averagely by 40.6% through Kozeny-Carman correlation. This is due to the complication of the microstructures by code deposition, which leads to more fluid stagnant flow with the increasing tortuosity. According to the workflow, the permeability reduction with coke deposition during ISC can be characterized accurately at the Darcy scale. The permeability change was then correlated with coke deposition for numerical simulations of ISC processes in sandstone reservoirs.

References

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