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Coupling the kinetics and fluid dynamics models to predict asphaltene precipitation and deposition in the oil production wells and pipelines

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Asphaltene precipitation and deposition are the problematic issues during the production of heavy crude oil due to any changes in pressure, temperature, and oil composition. Asphaltene deposition can affect the oil production by a change in wettability and viscosity as well as permeability damage. The prediction of asphaltene precipitation and deposition is a challenging issue in oil production due to the different behaviour of the heavy oil properties and asphaltenes in the reservoir. However, using modelling and simulation approaches like compositional fluid dynamics (CFD), it would be much feasible to avoid expensive and time-consuming experimental data from the field. Further, in order to have a better insight into the formation of the asphaltene particles, it is crucial to understand the asphaltene formation , particularly coupling the CFD and kinetic models to simulate the flow in the production wells and pipeline more accurately. This paper aims to develop a new model to investigate the kinetics and fluid dynamics of the asphaltene precipitation in the production wells and pipelines. The kinetic model has been developed based on the shrinking core model approach that is based on the reaction of the nonporous solid reactants with the fluid. Furthermore, the kinetic model with the optimised kinetics parameters have been coupled with a CFD model to predict the location, size of asphaltene particles as well as the fluid properties changes during the formation of the asphaltene particles. The finding from the current study has significant implications for developing a proper model to mitigate the associated risks with asphaltene deposition damage in the production wells.

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