Compositional Simulation of In-Situ Combustion EOR: A Study of Process Characteristics - DTU Orbit (22/01/2019)

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In order to facilitate the study of the influence of reservoir process characteristics in In-Situ combustion modeling and advance the work of Kristensen et al. in this domain, a fully compositional In-situ combustion (ISC) model of Virtual Kinetic Cell (VKC; single-cell model) for laboratory scale combustion simulation is used. Preceding research work primarily focused on a kinetic model that was based on six components and incorporated four chemical reactions. However, modeling of a thermal process as complex as In-situ combustion requires in-depth understanding of detailed reaction kinetics and multidisciplinary process data. This paper extends the understanding of previous research done in this domain by performing the process simulations to study further the impact of oxidation reactions and combustion reactions of crude oils along with their saturate, aromatic, resin, and asphaltene (SARA) fractions. This incorporates fourteen pseudo components and fourteen reactions (distributed amongst thermal cracking, low temperature oxidation and high temperature oxidation). The paper presents a set of derivative plots indicating that reservoir process characterization in terms of thermal behavior of oil can be well construed in terms of thermo-oxidative sensitivity of SARA fractions. It can be interpreted from the results that operating parameters like air injection rate, oxygen feed concentration and activation energy have significant influence on oil recovery; an increase in air injection rate can lead to cooling of the combustion front and thus decrease oil recovery, while increase in oxygen feed assists combustion and contributes towards improved oil recovery. The critical properties of the pseudo components are not determined experimentally, thus extending significance to fluid characterization. The composition plays a key role e.g. due to asphaltenes being most resistant toward oxidation and saturates being the easiest oxidizable ones.

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