Real-Time Monitoring of Asphaltene Deposition for Solvent Job Cycle Optimization

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Abstract

Asphaltene agglomeration and deposition is a complex process, leading to progressive production losses without mitigative actions. Injection of asphaltenes inhibitors (solvents) in the tubing is a common practice to avoid deposition in production tubing. This does however not avoid deposition in the near-wellbore. Wells suffering from asphaltenes depositions are regularly shut in for 'solvent jobs', injection of chemicals to dissolve asphaltenes in the (near-)wellbore. After a solvent job the well performance slowly degrades again due to new deposition. The goal of this study was to optimize the production-solvent cycle in terms of maximizing production profit, by means of a data-driven model capturing both well and reservoir performance.

TNO and ENI have developed a grey-box model to capture the impact of asphaltenes deposition in the near-wellbore on oil production. This effective PI-model is calibrated to actual field data and has shown to predict the effect of deposition and the resulting production decline well. This paper describes the background and modelling approach for both the grey-box reservoir deposition as well as the wellbore and choke pressure drop – predicting near-future oil prediction based on current performance. Examples of calibrating the grey-box deposition parameters are given and for the used well data the prediction window shows to be consistent for at least 20 days ahead. The outcome of the developed functionalities is an estimated 'optimal cycle length' and therefore a suggested next date of performing a solvent job at a specific well.

The methodology was developed using production data from a well equipped with multiphase flow meter (MPFM), but is applicable to wells with intermittent flow readings as well. The methodology can handle any realistic trend in production fluid (GOR, WC) as well as operator input (choke, FLP back pressure) and economic constraint (OPEX, solvent job cost relation).

The developed functionalities are applicable for real-time implementation, even without optimization of the code in terms of computational speed. Current production data is available on an hourly basis, wheras the calculation of the optimal solvent job cycle (including predicting oil production rates one month ahead) takes a few minutes maximum.

A demonstrator implementation in OVS software can be used to optimize solvent job cycles on individual well basis. The operator can through choke variations manipulate the predicted date of the next optimal solvent job when scheduling solvent jobs at multiple wells (under equipment constraints). Extension of this work can include optimization of an asset of wells, maximizing total production under practical solvent job constraints.

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