Optimizationof Wax Deposition in Sub-Cooled Pipeline Using Response Surface Methodology

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Abstract
Key factors affecting wax deposition in sub-cooled pipelines (wall (coolant) temperature (A), inlet oil temperature (B), and the percentage of wax inhibitors in the crude (C), and oil flow rate (D)) were experimental studied using the fabricated flow loop rig designed to simulate the flow of relatively higher temperature crude oil in sub-cooled pipeline.

In an effort to investigate the possibility of minimizing the wax deposits volume in a flow of crude oil in sub-cooled pipeline, response surface methodology (RSM) was used to evaluate the individual and interactive effects of four variables affecting the wax deposits process using central composite design (CCD). It was observed that for the crude oil samples the experimental data highly fitted to the predicted data because of the predicted R-squares is in reasonable agreement with the adjusted R-square.

In the laminar-turbulent transition flow regimes (2000 < Reynolds number (Re) > 3000), A, B, C, D,AB, AC, BC, A^2, B^2, and C^2 are significant, as their individual P-value were less than 0.05 by each of the term, while AD, BD,

CD and D^2, are insignificant as their P-values were more than 0.05. While in the laminar flow regime (Re < 2000) the results were similar to that observed in the turbulent flow regime except the flow rate term, (D) which was insignificant (with P-values of more than 0.05) due to insignificant effect of shear dispersion and removal in the laminar flow regime.

In applying the response surface methodology central composite design (RSMCCD) in the Minitab-16 software to minimized wax deposit in crude oil flow in sub-cooled pipeline wax deposits were reduced to 64cm^3 in the laminar flow regime and 43cm^3 in the laminar-turbulent transition flow region. The small error percentage between the predicted and actual volume of wax deposit (4.68% in the laminar and 4.55% in the laminar-turbulent transition flow regime: indicated that the software models were valid and accurate in representing the actual experimental values and also in predicting the inhibition of wax deposit within the range studied.

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