

P.18 Deposition of colloidal asphaltene in capillary flow from computer simulation and homogeneous deposition models

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We have investigated the deposition of colloidal particles, such as crude oil asphaltenes, in capillary flow as a function of increasing flow rate using the hybrid Stochastic Rotation Dynamics – Molecular Dynamics approach. The simulation results are compared with experimental results and homogeneous deposition models. First, we derive expressions for the deposit thickness $e(t)$ for both constant flow rate (as in the experiment) and constant pressure drop (as in the simulations). We investigate the accuracy of expressions, based on the assumption of Poiseuille flow, to estimate the deposit thickness from pressure drop or flow rate measurements. Our conclusions are twofold. First, for low flow rates ($Pe \leq 10$ for our system), we observe that the dimensionless deposit thickness $e(t) / r(0)$ as estimated from the flow rate is in good agreement with direct fractional deposition measurements. This implies that the homogeneous deposition approximation works well at low flow rates. Second, for higher flow rates ($Pe > 10$ for our system), we observe that the difference between the estimated deposit thickness and the actual deposition thickness increases with increasing flow rate. This suggests that the homogeneous deposition approximation is no longer valid at high flow rates. Detailed calculations of the flow field confirm that, at high flow rates, large clusters of colloids are flowing through the capillaries and generate transient plug flow, disturbing the laminar flow field. Therefore care must be taken when estimating the dimensionless deposit thickness from flow rate or pressure drop measurements.

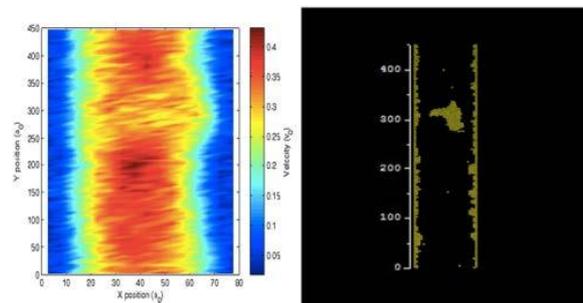


Figure 1: Flow field showing the solvent velocity magnitude across the capillary with corresponding snapshot of the capillary. As can be seen there is a distortion in the flow field present at the position of the large cluster in the capillary.