Understanding asphaltene deposition at low degrees of destabilization

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Asphaltene deposition is a costly concern in flow assurance. Precipitation and deposition can occur in the porous rock formations, well-bore, production lines and in the refinery. Capillary deposition has been considered a useful tool to measure the conditions controlling and extent of asphaltene deposition. Previous research has studied the effect of different precipitants, deposition near onset and past onset conditions, and the effect of shear rate [1,2]. Recent work in the area of asphaltene precipitation and aggregation kinetics has revealed that asphaltene destabilization occurs at conditions previously thought stable [3]. This work will investigate how this important discovery affects asphaltene deposition.

Precipitation kinetics show that asphaltenes slowly aggregate at precipitant concentrations below the onset and can take months to detect the instability by optical microscopy [3]. A capillary deposition apparatus will be used to study the deposition of asphaltene with low destabilization in the region of long onset detection times. The volume fraction of precipitant, heptane, was varied to control the degree of destabilization. Figure 1 is a schematic of the experimental apparatus used for the investigation. Note, that the apparatus has the positive side of the differential pressure (ΔP) measurement placed upstream of the mixing tee.

This new design of having the measurement of the ΔP prior to mixing allows for any deposit that is formed immediately after mixing to be detected. If the ΔP is measured after mixing there will be a section of capillary where aggregation and deposition could occur and would not be detected.

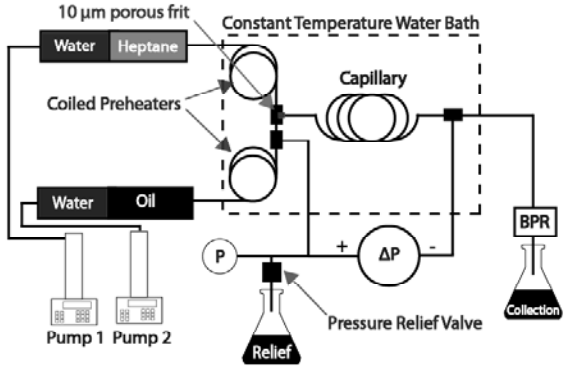

Fig. 1. Diagram of experimental apparatus used for capillary deposition.

Experiments at low destabilization reveal a new deposition mechanism for asphaltenes. Deposits were measured with oil:heptane mixtures without precipitated asphaltenes detectable by optical microscopy.

Asphaltene deposition at low destabilization needs to be considered in new experiments and models attempting to measure and understand the extent of fouling or blockage by asphaltenes. Little is known about the destabilization asphaltenes in live oil experience during solvent injection or depressurization. Current laboratory deposition experiments conducted with high precipitant concentrations may be destabilizing asphaltenes more strongly than they experience in the field.

References

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