

Rheological and Computational Analysis of Crude Oil Transportation

Authors : Praveen Kumar, Satish Kumar, Jashanpreet Singh

Abstract : Transportation of unrefined crude oil from the production unit to a refinery or large storage area by a pipeline is difficult due to the different properties of crude in various areas. Thus, the design of a crude oil pipeline is a very complex and time consuming process, when considering all the various parameters. There were three very important parameters that play a significant role in the transportation and processing pipeline design; these are: viscosity profile, temperature profile and the velocity profile of waxy crude oil through the crude oil pipeline. Knowledge of the Rheological computational technique is required for better understanding the flow behavior and predicting the flow profile in a crude oil pipeline. From these profile parameters, the material and the emulsion that is best suited for crude oil transportation can be predicted. Rheological computational fluid dynamic technique is a fast method used for designing flow profile in a crude oil pipeline with the help of computational fluid dynamics and rheological modeling. With this technique, the effect of fluid properties including shear rate range with temperature variation, degree of viscosity, elastic modulus and viscous modulus was evaluated under different conditions in a transport pipeline. In this paper, two crude oil samples was used, as well as a prepared emulsion with natural and synthetic additives, at different concentrations ranging from 1,000 ppm to 3,000 ppm. The rheological properties was then evaluated at a temperature range of 25 to 60 °C and which additive was best suited for transportation of crude oil is determined. Commercial computational fluid dynamics (CFD) has been used to generate the flow, velocity and viscosity profile of the emulsions for flow behavior analysis in crude oil transportation pipeline. This rheological CFD design can be further applied in developing designs of pipeline in the future.

Keywords : surfactant, natural, crude oil, rheology, CFD, viscosity

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