

“Understanding the role of chemical inhibitors to the deposition of wax from crude oil”

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Abstract: The deposition of paraffin waxes from crude oil during pipeline transport results in flow disruption and eventual blockage. Waxes precipitate from the oil when the warm oil comes in contact with the cooled pipeline walls. While engineering controls such as pipeline insulation are common, the addition of small amounts of chemical inhibitors can reduce the temperature at which wax precipitates from the crude oil, the wax appearance temperature (WAT). Historically, the waxes have been characterized through high temperature gas chromatography and the WAT determined via differential scanning calorimetry and/or polarized light optical microscopy. However, little has been done in regards to understanding the crystalline structure or lamellar packing of the various waxes and the effect that chemical inhibitors have on them.

In this study we have used in situ wide angle X-ray scattering (WAXS) and small angle X-ray scattering (SAXS) to understand the effect of two different chemical inhibitors on a high paraffin, low asphaltene, containing crude oil. WAXS of crude oil as a function of temperature provides a clear indication of the WAT, in good agreement with more traditional techniques. Extended studies at fixed temperature indicate a rapid nucleation process, allowing for equilibrium in the system to be reached quickly. SAXS at various temperatures shows evidence of a freezing out of the chemical inhibitor, allowing for a tighter packing of lamellar crystals in the paraffin waxes.