Hydrate Slurries Viscosity Measurements Coupled with Visualization

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The formation of gas hydrates in oil/gas flowlines can cause major safety, environmental and economic concerns. Currently, hydrate management strategies are of interest, whereby the hydrate slurries properties are controlled to prevent the formation of large hydrate aggregates and thus plug formation. In this strategy, it is critical to have in-depth understanding of the rheological properties of hydrate slurries. Several studies have been conducted to investigate the rheological properties of gas hydrate slurries. These studies include using rheometers (high and ambient pressures) and large scale flowloops. Measurements using rheometers provide high accuracy of the rheological properties, but do not properly reflect actual oil/gas flowline conditions. On the other hand, measurements using flowloops are closer representations of actual oil/gas flowlines, but rheological properties are inferred/calculated from pressure drop data. A common challenge in rheological properties measurements, regardless of the method, is the difficulty in attributing any change/trend in the rheological profiles to physical phenomena, such as bedding/settling and wall growth. Recently, we developed a visual rheometer cell that can perform in-situ rheological measurements of hydrate slurries coupled with visualization. Thus, trends in the viscosity profiles could be attributed to physical phenomena, including wall growth and bedding. It should be stated that the newly developed visual rheometer cell has a similar geometry to that of our high pressure rheometer cell. In this work, we will present measurements of the rheological properties coupled with visualization using model hydrate slurries formed from cyclopentane hydrates (sII). Viscosity profiles obtained from this study are compared with the viscosity profiles conducted at high pressure (Majid et al., 2017). The results of this investigation show that the fluctuations in the viscosity profile can be attributed to sloughing and settling of large hydrate aggregates.

References

Majid, Ahmad A. A., David T. Wu, and Carolyn A. Koh. 2017. “New in Situ Measurements of the Viscosity of Gas Clathrate Hydrate Slurries Formed from Model Water-in-Oil Emulsions.” *Langmuir* 33 (42)