Viscosity Measurements of Hydrate Slurries Formed from Water-In-Oil Model Emulsions

Ahmad Afif Abdul Majid [S]
Department of Chemical and Biological Engineering, Center for Hydrate Research, Colorado School of Mines, Golden, CO, U.S.A.

David Wu
Department of Chemistry and Geochemistry, Colorado School of Mines, Golden, CO, U.S.A.

Carolyn Koh [C]
Department of Chemical and Biological Engineering, Center for Hydrate Research, Colorado School of Mines, Golden, CO, U.S.A.
ckoh@mines.edu

Viscosity measurements for methane hydrate slurries were performed using a high pressure rheometer with a straight vane impeller as a stirring system. Measurements were conducted using model water-in-oil emulsions to ensure reproducibility of the results (*cf.*[1]). The model emulsion consists of mineral oil 350T, water, and a surfactant mixture of sorbitane monooleate 80 (Span 80) and sodium di-2-ethylhexylsulfosuccinate (Aerosol OT, AOT). The emulsions that could be prepared with a water content (water cut), of up to 30 vol.%, are highly stable with no phase separation for up to one week, and have water droplets in the range of 2-5 µm. A general equation that describes the viscosity of the emulsion as a function of the temperature, pressure and water cut was developed. This general equation was then used as a baseline to analyze the effect of hydrate formation on the transportability of gas hydrate slurries. Results of this work are presented in terms of the viscosity of the hydrate slurry relative to the viscosity of the emulsion or continuous phase at similar temperature and pressure conditions. In addition, the results obtained in this work are compared with recent flowloop measurements. This allows further analysis and comparison between laboratory-scale rheometer measurements and large scale flowloop tests.

References

[1] A. A. A Majid, E. D. Sloan, D. T. Wu, A. K. Sum, and C. A. Koh, “Understanding The Flow Properties of Gas Hydrate Slurry Using Model Emulsion System,” in *The 8th International Conference of Gas Hydrates*.