

## Cyclopentane hydrate slurry viscosity measurements coupled with visualization

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### **ABSTRACT**

One of the advanced strategies in hydrate plug prevention is to obtain an in-depth knowledge of the rheological properties of hydrate slurries. A major challenge in hydrate rheological measurements is that the viscosity profile can be difficult to attribute to physical phenomena, such as particle agglomerate breakup, particle bedding/settling and wall growth. In this work, a novel visual rheometer has been developed to help overcome these previous limitations by enabling the visualisation of the evolution of cyclopentane hydrate slurries during viscosity measurements. Two different model systems were used in this investigation: (1) non-emulsified and (2) emulsified systems. The physical phenomena, including initial hydrate formation, hydrate wall growth, bedding and sloughing were visually observed and directly correlated to the corresponding viscosity profile. For the non-emulsified system, there are four different stages of hydrate slurry development including initial hydrate formation, wall adhesion and growth and sloughing that caused changes in the viscosity profiles. Large fluctuations in the viscosity profile for a non-emulsified system were found to be the result of a sloughing phenomenon. On the other hand, the emulsified system showed a well-dispersed hydrate slurry with minimal wall and impeller growth, corresponding to a smooth viscosity profile.

### **KEYWORDS**

Clathrate hydrate; Slurry rheology; Visualisation; Emulsion

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