Testing antifreeze protein from the longhorn beetle *Rhagium mordax* as a kinetic gas hydrate inhibitor using a high-pressure micro differential scanning calorimeter

Low dosage kinetic hydrate inhibitors are employed as alternatives to expensive thermodynamic inhibitors to manage the risk of hydrate formation inside oil and gas pipelines. These chemicals need to be tested at appropriate conditions in the laboratory before deployment in the field. A high pressure micro differential scanning calorimeter HP-mu DSC VII (Setaram Inc.) containing two 50 cc high pressure cells (maximum operating pressure 40 MPa; temperature range -40 to 120 degrees C) was employed to observe methane hydrate formation and decomposition in the presence of hyperactive antifreeze protein from *Rhagium mordax* (RmAFP) and biodegradable synthetic kinetic inhibitor Luvicap Bio. A systematic capillary dispersion method was used, and this method enhanced the ability to detect the effect of various inhibitors on hydrate formation with small quantities. The presence of RmAFP and Luvicap Bio influence (inhibit) the hydrate formation phenomena significantly. Luvicap Bio (relative strength compared to buffer: 13.3 degrees C) is stronger than RmAFP (9.8 degrees C) as a nucleation inhibitor. However, the presence RmAFP not only delays hydrate nucleation but also reduces the amount of hydrate formed (20%-30%) after nucleation significantly. Unlike RmAFP, Luvicap Bio promoted the amount of hydrate formed after nucleation. The superior hydrate growth inhibition capability and predictable hydrate melting behavior compared to complex, heterogeneous hydrate melting with Luvicap Bio shows that RmAFP can be a potential natural green kinetic inhibitor for hydrate formation in pipelines.

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