

Contact Angle Analysis of Water Droplet and Hydrate/Pipe Surface Interfaces

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Clathrate hydrates, commonly known as hydrates, are three dimensional crystalline compounds made from hydrogen-bonded water cages which enclose guest molecules (e.g. methane, propane, carbon dioxide, cyclopentane, etc.). Hydrates will form at high pressure and low temperature conditions, which are typical of deep ocean environments. Hydrates when formed in natural settings in marine and arctic sediments present a vast potential fuel source. However, when hydrates form in industrial settings, specifically in offshore oil and gas pipelines, they can lead to blockages and delayed production. Interfacial interactions of hydrate/water, hydrate/hydrate, and pipe-surface/water systems are a key consideration in determining pipeline plugging risks. Currently, an effective way to measure and quantify the interfacial interactions between hydrate/water and pipe surface/water interfaces is through contact angle measurements, i.e. evaluating the hydrate/surface wettability. In this paper, contact angle measurements and analysis procedures are reviewed for hydrate/water and pipe surface/water systems as a function of a number of different parameters. In addition, statistical analysis of the contact angle measurements are incorporated into the procedures, which are important for reliable data collection and interpretation.