

## **Thermodynamic Properties of Hydrogen-Natural Gas Blends in the Presence of Salt**

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Up until recent years, hydrogen gas was not considered a hydrate former but when hydrogen is introduced into a system, the hydrate phase equilibrium boundary shifts to more extreme conditions (lower temperatures and higher pressures) signalling that hydrogen must enter the hydrate cages (confirmed with Raman spectroscopy), resulting in an inhibition effect. Current research into the hydrate thermodynamic properties of hydrogen-natural gas (NG) blends focuses on hydrate formation in pure water environments to observe the inhibitory effects of hydrogen. However, interest in offshore production and blending hydrogen mixtures has raised questions regarding the effects of sea water on hydrate formation in H<sub>2</sub>-NG blends. This study explores the effects of several salts, commonly found in sea water, on the hydrate phase equilibrium of H<sub>2</sub>-NG. Gas hydrates are crystalline clathrate structures composed of a network of cages of hydrogen-bonded water molecules that are stabilized by the presence of “guest” molecules, which in this case is hydrogen and other hydrate formers that may be present in offshore natural gas.

To identify the hydrate equilibrium phase boundary of H<sub>2</sub>-NG hydrates, high-pressure differential scanning calorimetry (HP-DSC) is utilized. Through HP-DSC heat flow diagrams, the dissociation temperature of hydrates can be identified at any given pressure, also known as the temperature search method. Following heat flow mapping of the hydrate equilibrium, experimental data is compared to phase equilibrium models (e.g., CSMGem, Multiflash) with varied equations of state.