

# Petroleum Engineering

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## Impact of H<sub>2</sub>S content on thermodynamic stability of hydrate formed from CO<sub>2</sub>/N<sub>2</sub> mixtures

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The total global energy of CH<sub>4</sub> trapped in crystalline form as hydrates is huge and may exceed twice the amount of energy of known sources of conventional fossil fuels. Most of the natural gas hydrates found in nature are from biological degradation of organic material in the upper few hundred meters and correspondingly high purity of CH<sub>4</sub>. These hydrates form structure I hydrate, which contains a ratio of 1:3 of small to large cavities. The small cavity is very well stabilized by CH<sub>4</sub> while CO<sub>2</sub> fits the largest cavity better, and the water is having stronger short range interactions with CO<sub>2</sub> than CH<sub>4</sub>. CO<sub>2</sub> gas or liquid that is brought in contact with CH<sub>4</sub> hydrate will therefore replace the CH<sub>4</sub> in most of the large cavities. This is possible through two mechanisms, a solid state direct conversion and a second mechanism in which CO<sub>2</sub> form a new hydrate with free pore water. The released heat from this hydrate formation assists in dissociating the in situ CH<sub>4</sub> hydrate. Substantial amounts of N<sub>2</sub> (often as high as 80% by volume) is proposed as one solution for reduced hydrate plugging and increased gas permeability. In this study we examine the minimum limits of CO<sub>2</sub> content for ability to form new hydrate from liquid water and injected gas, and also how this changes with small impurities of H<sub>2</sub>S. It is found that even as small amounts of H<sub>2</sub>S as 1% can substantially increase the ability of injection gas to form new hydrate, as compared to same mixture without H<sub>2</sub>S.

### Biography

Bjørn Kvamme obtained his MSc in Chemical Engineering (1981) and PhD in Chemical Engineering (1984) from the Norwegian University of Technology and Natural Sciences. After a short period with SINTEF and two years at Bergen University College, he was appointed to full Professor in 1987 and started education of MSc and PhD in Process Technology in Telemark. He entered a position as Professor in Gas Processing at Department of Physics, University of Bergen in March 2000. He is the author/coauthor of 373 publications, of which 140 are in high quality journals.

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