

A New Strategy of Surfactant Combination: Boosting the Growth of Methane Anhydrates for Sustainable Environment & Clean Energy



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News Article

By successfully synthesizing surfactant micelles at low hydrate forming temperatures, Indian scientists from the CSIR-National Chemical Laboratory, Pune and Indian Institute of Technology, Madras claim to have finally settled the long ranging debate on whether surfactant micelles actually enhance gas hydrate formation kinetics. Gas hydrates are ice like crystalline materials that are formed when small gas (guest) molecules coming in contact with water (host) molecules at low temperature and high pressure conditions. The guest molecules such as methane and carbon dioxide get trapped in hydrogen bonded water cages thus stabilizing these cages. Massive hydrate deposits of natural gas have been formed under the seabed or in permafrost over millions and millions of years and have of late come under immense scrutiny due to their enormous potential as a clean energy source.

India is estimated to have 2000 TCM (trillion cubic metres) of natural gas in the form of hydrate reserves which is sufficient to meet the country's total energy demand for the next 200 years. The Indian deposits constitute only 10 % of the world's total estimated reserves of gas hydrates thus making this clean source of energy one of the most exciting frontiers of science and engineering in recent times. Apart from their viability as a future energy source, gas hydrates also boast huge potential in a number of technological applications such as gas capture, separation and storage. Prime amongst these is as a technology

for methane storage. It augurs well for the use of gas hydrate based technology that 1 volume of gas hydrate can store up to 170 volume of methane at STP.

The use of gas hydrates for methane storage requires rapid hydrate formation kinetics which is usually brought about by the use of specific additives called as surfactants. It was long hypothesized that surfactant micelles promote hydrate formation by acting as nucleation sites. The hypothesis however, was later refuted owing to the fact that the surfactant of choice for most of these studies, sodium dodecyl sulfate does not form micelles at the typically low hydrate formation temperatures. Now, researchers have used a hybrid surfactant mixture made up of anionic surfactant SDS and zwitterionic surfactant cocoamidopropyl betaine to synthesize surfactant micelles at methane hydrate forming temperatures and subsequently investigated the effect of the same on the kinetics of gas hydrate formation. The study conclusively proves for the first time that the presence of surfactant micelles enhances hydrate formation kinetics. These findings can contribute significantly towards improving the utility of surfactants in gas hydrate based technological applications such as gas separation and methane storage [1].

References

1. Bhattacharjee (2017) Effects of Micellization on Growth Kinetics of Methane Hydrate. Industrial & Engineering Chemistry Research 56(13): 3687-3698.



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