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Carbon Neutral CH₄ production during CO₂ Storage in Permafrost and Marine Environment

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Abstract Text:

CO₂-rich gas injection into natural gas hydrate reservoirs is proposed as a carbon-neutral, novel technique to store CO₂ while simultaneously producing CH₄ gas from methane hydrate deposits without disturbing geological settings. Geological sequestration of CO₂-rich gas in natural gas hydrate reservoirs for CO₂ capture and storage technique has a lower technical and cost barrier compared to other industrial alternate. This novel technique has ability to contribute to global warming mitigation strategies, including carbon capture, utilization, and storage (CCUS) and methane release prevention into the atmosphere hydrate melting caused by global warming. CO₂ storage and simultaneous CH₄ production is known as hydrate swapping. In this study, we have studied hydrate swapping in sands in the presence of low dosage chemicals including alcohols, surfactant and amino acids.

Through this study, we have demonstrated the novel application of anti-agglomerate and hydrate inhibitor additives when used in low concentration to enhance CH₄-CO₂ hydrate exchange. This research opens the possibility of CO₂ storage in methane hydrate without disturbing the geological formation using the CH₄-CO₂ hydrate exchange processes in the presence of anti-agglomeration additives. Presence of these chemicals in water would delay hydrate formation at the gas-liquid interface during CO₂ injection into methane hydrate and would create dispersed hydrate morphology. Delay in hydrate film formation and its dispersed nature would allow additional CO₂ gas molecule availability for CH₄-CO₂ swapping, thus improving both CH₄ recovery and CO₂ storage.

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