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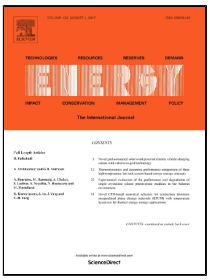

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Swapping Methane with Carbon Dioxide in Spherical Hydrate Pellets

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Abstract: Recovering CH_4 with CO_2 in hydrocarbon hydrates is renowned as an eco-friendly method for potential energy production and climate change mitigation. Due to the foamy nature of hydrates, determining the effect of hydrate surface area on the CH_4 recovering rate has always been a challenge. CH_4 hydrates in this work were shaped into spherical pellets 16 mm in diameter, and the CH_4-CO_2 replacements were carried out at about 274 K, 3.0 MPa by adding different amount of pellets in the reactor. To reveal the kinetic properties, cryo-SEM and a model based on gas diffusion theory was also employed. Results indicated that the CH_4 recovery rate in the replacement was proportional to the surface area of hydrate pellets. In each 1400-hour replacement, the CH_4 production level was found to be about 4.5%, suggesting the gas swapping process took place in each pellet was the same. The kinetic model provided well descriptions of the replacements with the average deviation no more than 10%. The SEM images and the gas diffusion constants obtained from the kinetic model suggested that water mobility determined the gas diffusion rate in hydrates and help to smooth the hydrate surface during replacements.