

Phase Equilibria of CH₄ and CO₂ Hydrates Formed from Aqueous Solutions of Glutaric Acid and Malonic Acid

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The equilibrium boundaries of CH₄ and CO₂ hydrates were examined in the presence of di-carboxylic acids, glutaric acid and malonic, at a mass fraction of 0.1 and 0.01. Including di-carboxylic acids in the water phase shifted the phase boundaries to higher pressure and lower temperature conditions, which we attributed to the formation of hydrogen bonding between the inhibitors and water molecules rather than to the formation of water structures serving as hydrate precursors. In addition, the inhibition effect of shorter carbon-chained malonic acid was better than that of longer-chained glutaric acid due to its low molecular weight. This inhibition effect was compared with that of conventional thermodynamic hydrate inhibitors (THIs) used in commercial processes. The comparison showed that the effect of malonic acid was close to that of tri-ethylene glycol for inhibiting the CH₄ hydrate.

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