

**Phase Equilibria of Double Semiclathrate Hydrates Formed with Tetraamylammonium Bromide plus CH<sub>4</sub>, CO<sub>2</sub>, or N<sub>2</sub>**

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Semiclathrate hydrates (SCH) formed with organic salts have empty cages that could encage gas molecules, and some showed high melting temperatures (higher than 300 K) at atmospheric pressure. In this work, phase equilibrium data for the semiclathrate hydrates formed with tetraamylammonium bromide (TAAB: C<sub>20</sub>H<sub>44</sub>NBr) + CH<sub>4</sub>, + CO<sub>2</sub>, or + N<sub>2</sub> were measured in the pressure range of (1.33 to 20.37) MPa and temperature range of (279.8 to 291.9) K at (0.05 and 0.10) mass fraction of TAAB. The experimental data were obtained by employing an isochoric pressure-search method. The results showed that at a given pressure, the temperature required to form double TAAB + CH<sub>4</sub>, + CO<sub>2</sub>, or + N<sub>2</sub> hydrates was higher than that required for the corresponding pure CH<sub>4</sub>, CO<sub>2</sub> or N<sub>2</sub> hydrates. And as the TAAB concentration increased, its effect of enlarging the hydrate stability zone was strengthened. However, the experimental equilibrium temperatures for double semiclathrate hydrates were lower than those for TAAB hydrates formed without guest gases. In addition, the data for double semiclathrate hydrates formed from TAAB generated in this work were compared with those formed from some other semiclathrate hydrate formers (such as tetrabutylammonium bromide, tetrabutylammonium chloride, and tetrabutylammonium fluoride) reported in literature. The comparison demonstrated that at a same mass fraction, the stabilization effect of TAAB was weaker than those of TBAB, TBAC, and TBAF.