

Storage and Separation of Gas Mixtures with Double Clathrate Hydrates: Physicochemical Basis

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Gas hydrate technologies can be employed to extract hydrogen, carbon dioxide, xenon, etc. from various gas mixtures as well as to store gas (C₁-C₄ hydrocarbons, CO₂). This may solve the most acute problems of ecology, hydrogen power engineering, and rational nature management. In the current work, a set of physicochemical information necessary for the development of the mentioned technologies was obtained. The formation of double gas hydrates with non-classical auxiliary hydrate-formers was studied at moderate pressures. Specific problems to be solved included the study of phase equilibria, structures, and composition of the formed hydrates depending on temperature, pressure, and composition of the aqueous solutions. A general approach was to systematically examine the properties of double hydrates formed from chosen auxiliary components (C₃-C₅ alcohols and some components of different chemical nature such as acetonitrile and diethylamine) with pure methane or carbon dioxide. Structures of the hydrates were identified by powder X-ray diffractometry at low temperature (-100 – -10°C). Thermovolumetry technic allowed the hydrates gas capacity to be determined. Then, double gas hydrates' efficacy in the separating methane-carbon dioxide and hydrogen-carbon dioxide mixtures was assessed. The compositions of gas mixtures were chosen to be close to those occurring in the industry. The information obtained can be useful for the assessment of the prospects for gas hydrate technologies.

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