

## **Dimethyl Sulfoxide as a Gas Hydrate Inhibitor: Phase Equilibria, Freezing point, Density, and Viscosity Measurements**

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Gas hydrates are ice-like crystalline compounds that form when water and low-molecular-weight gases interact under certain temperature and pressure conditions. The formation of gas hydrates is a typical complication in the production and transportation of hydrocarbons. The main strategy to prevent hydrate formation is associated with the use of thermodynamic hydrate inhibitors (THIs), which affect the thermodynamics of the process. The literature survey has shown that the hydrate phase equilibria in systems with dimethyl sulfoxide (DMSO) have been insufficiently studied. At the same time, DMSO has antifreeze properties and is widely used as a bipolar aprotic solvent capable of dissolving substances of various nature. In this work, new experimental data on the methane hydrate phase equilibria were obtained in a wide concentration range of DMSO (0 – 55 mass%) at pressures of 3 – 13 MPa. An empirical correlation describing the dependence of the hydrate equilibrium temperature depression  $\Delta T$  on DMSO concentration and pressure with high accuracy (average absolute deviation of  $\Delta T = 0.08$  K or 1.84 %) was proposed. The antihydrate activity of DMSO was compared with other nonionic THIs (methanol, monoethylene glycol (MEG), diethylene glycol (DEG)). It was found that the inhibition power of DMSO is close to that of MEG, is significantly inferior to methanol, and exceeds DEG at a concentration of up to 33 mass%. In the range of 33 – 53 mass%, the antihydrate activity of DMSO occupies an intermediate position between MEG and methanol. At a concentration > 53 mass% DMSO is a more powerful THI than methanol. Structure of gas hydrates formed in the methane - water - DMSO system was studied by powder X-ray diffractometry. DMSO aqueous solutions were characterized in detail by capillary viscometry, densimetry, and freezing point measurements.

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