Synergism of Thermodynamic Inhibition of a S II Gas Hydrate with a Mixture of Salts and Methanol

Anton Semenov^{C, S}, Andrey Stoporev, Pavel Gushchin and Rais Mendgaziev Department of Physical and Colloid Chemistry, Gubkin University, Moscow, Russia semyonovanton@mail.ru

> Vladimir Yakushev Gas Production Department, Gubkin University, Moscow, Russia

Vladimir Vinokurov Department of Physical and Colloid Chemistry, Gubkin University, Moscow, Russia

Natural and associated gases, oil and gas condensate contain components such as C1-C4 alkanes, carbon dioxide, hydrogen sulfide, which can form gas hydrates at certain temperatures and pressures in the presence of free water (liquid or vapor). Application of thermodynamic hydrate inhibitors (THI) is the most commonly used method for hydrate control. Despite their drawbacks (high concentration in water phase), THI are a technologically proven solution for simultaneously preventing gas hydrates and ice formation under low-temperature conditions (< 0 °C). In this work we have measured phase equilibrium conditions for structure II gas hydrates in systems containing mixture of salts (NaCl, KCl, CaCl₂, MgCl₂) and methanol using a high pressure autoclave. The concentration of salts in aqueous solution was constant in all experiments and equal to 19.26 % wt. (mass ratio 11.96/2.24/2.32/1.00 respectively). Phase equilibrium conditions were measured by the isochoric method for pressures ranging from 1 to 5 MPa and for mass fraction of methanol from 0 to 50 % wt. The phase equilibrium data were obtained for water + salts, water + methanol and water + salts + methanol systems. From the results obtained, it follows that 20 % wt. of methanol in distilled water gives thermodynamic shift of the hydrate decomposition temperature close to the brine. Mixtures of 10 % methanol + 19.26 % salts and 20 % methanol + 19.26 % salts significantly better reduce the equilibrium temperature of hydrate decomposition compared to samples of 30 % and 40 % methanol in water, respectively. At the pressures of 3 – 5 MPa combination of 20 % methanol + 19.26 % salts provide the same thermodynamic inhibition as 50 % wt. of methanol in water.

This work was supported by President of Russia (grant MK-6886.2018.3).