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Investigation of Hydrate Formation of Associated Petroleum Gas From Promoter Solutions for the Purpose of Utilization and Reduction of Its Burning

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Abstract : Gas hydrates are host-guest compounds. Guest molecules can be low molecular weight components of associated petroleum gas (C1-C4 hydrocarbons), carbon dioxide, hydrogen sulfide, and nitrogen. Gas hydrates have a number of unique properties that make them interesting from a technological point of view, for example, for storing hydrocarbon gases in solid form under moderate thermobaric conditions. The hydrate form of gas has a number of advantages, including a significant gas content in the hydrate, relative safety and environmental friendliness of the process. Such technology could be especially useful in cold regions, where hydrate production, storage and transportation can be more energy efficient. Recently, new developments have been proposed that seek to reduce the number of steps to obtain the finished hydrate, for example, using a pressing device/screw inside the reactor. However, the energy consumption required for the hydrate formation process remains a challenge. Thus, the goal of the current work is to study the patterns and mechanisms of the hydrate formation process using small additions of hydrate formation promoters under static conditions. The study of these aspects will help solve the problem of accelerated production of gas hydrates with minimal energy consumption. Currently, new compounds have been developed that can accelerate the formation of methane hydrate with a small amount of promoter in water, not exceeding 0.1% by weight. To test the influence of promoters on the process of hydrate formation, standard experiments are carried out under dynamic conditions with stirring. During such experiments, the time at which hydrate formation begins (induction period), the temperature at which formation begins (supercooling), the rate of hydrate formation, and the degree of conversion of water to hydrate are assessed. This approach helps to determine the most effective compound in comparative experiments with different promoters and select their optimal concentration. These experimental studies made it possible to study the features of the formation of associated petroleum gas hydrate from promoter solutions under static conditions. Phase transformations were studied using high-pressure micro-differential scanning calorimetry under various experimental conditions. Visual studies of the growth mode of methane hydrate depending on the type of promoter were also carried out. The work is an extension of the methodology for studying the effect of promoters on the process of associated petroleum gas hydrate formation in order to identify new ways to accelerate the formation of gas hydrates without the use of mixing. This work presents the results of a study of the process of associated petroleum gas hydrate formation using high-pressure differential scanning micro-calorimetry, visual investigation, gas chromatography, autoclaves study and stability data. It was found that the synthesized compounds multiply the conversion of water into hydrate under static conditions up to 96% due to a change in the growth mechanism of associated petroleum gas hydrate.

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