Critical Phenomena in Hydrate Formation in Natural Gas - Water Systems

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Research on nonlinear phenomena in gas-liquid systems has both scientific and practical value [1]. In this work, the influence of the laws of modes change depending on the character of the equilibrium conditions in the natural gas-water systems investigated. Experimentally, a mix of natural gases from a Baku gas-transferring factory was used.

Practically important functional dependences in natural gas-water systems were determined. The water content in the investigated gas-liquid system is a function of temperature, pressure, water solution salinity, and gas density. The humidity of the natural gas decreases with the increase of the molar mass of the gas and of the water mineralization. The temperature appreciably influences the degree of humidity change with change of gas molar mass. The presence of carbonic gas and hydrogen sulfide in a natural gas increases its humidity.

In a gas-liquid system with natural gas and water vapor, the processes of solvation and species diffusion are investigated. The thermodynamic conditions for the formation of crystalline gas hydrates are determined. Hydrate formation of the natural gas investigated occurs at temperatures near 260 K.

The humidity of the natural gas has been determined empirically. The critical characteristics (temperature and pressure) of gas hydrate formation have been separately determined for each gas sample. Experiments have been carried out with a laboratory installation that was modeling the gas-well – gas-main system. The conditions of the experiments were close to realistic conditions.

In the gas-liquid system, the coexistence of three phases (gas, water vapor, and gas hydrate) was determined. The conditions for phase stability between gas, water vapor (as a condensate), and gas hydrate are theoretically explored.

It has been established that the dependence of the natural gas humidity on temperature and pressure is exponential. The calculated critical conditions for gas hydrate formation fit the experimental data well.

[1] E.E. Ramazanova and M.M. Asadov, *The Equations of a Critical Condition*, Baku, Azerbaijan, publication of the Azerbaijan State Oil Academy, ASOA, pp. 43, (2003).