Thermodynamics of Gas Hydrates

Author: Daria Sergeeva

E-mail: Daria.sergeeva@skolkovotech.ru

Abstract

Permafrost occupies about 25% of the world's land and 67% of the land of Russia, including arctic shelf. Oil and gas reserves and resources in Russia are mainly situated in the permafrost area. The development of oil and gas fields in the Arctic is complicated by many factors. One of the factors is gas hydrates. Gas hydrates are crystalline substances like ice or snow, which are formed from gases and water phases (liquid water, ice or water vapor). Hydrates are strongly affected by properties and behavior of frozen soils. Gas hydrate component affects significantly on physical and mechanical properties of frozen sediments, particularly during technogenic interaction between producing wells and field equipment facilities and permafrost.

Some new Russian gas and gas-condensate fields with very low formation temperatures (282-290 K) now are ready for development. The thermodynamic conditions of such fields are very close to hydrate formation conditions. During field development, the technogenic hydrates may occur in the bottom hole zones, lift pipes, in-field pipelines and field gas processing systems. Also, at the latest stage of the field development the icing deposits inside in-field pipelines are possible.

Phase equilibrium data of gas hydrates are required to design and optimize the aforementioned processes. To simulate, design or optimize any of these processes, the knowledge of hydrate forming conditions is essential. Such data can be helpful in testing existing thermodynamic models or tuning new thermodynamic models for phase behavior of hydrocarbon systems under hydrate forming conditions.

The presentation is aimed at investigating the equilibrium dissociation conditions of simple hydrates of methane and ethane. It is worth noting that several data sets are available for the water + methane or water + ethane systems as summarized in tables. In most cases, good agreement is observed between the various literature sources. However, literature data for these systems near 0˚C are scarce and have a poor agreement between the different sources. In present work is provided the data processing method, which allows checking the thermodynamic consistency of the experimental data and doing their correct interpolation.