Experimental modeling of the methane recovery from gas hydrate saturated sediments by the flue gas / nitrogen injection

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Abstract: Nowadays, there is a problem of traditional resources exhausting. Thus, unconventional resources have the primary interest for modern gas companies, such as gas hydrates. Gas hydrates are clathrate crystalline compounds, which are formed under the specific thermobaric conditions [1]. 1 m3 of gas hydrate contains 160 m3 of the methane [2].

There are several methods of methane recovery from gas hydrate formations: depressurization, thermal stimulation, inhibitor injection and CO2 injection [2]. The main principle of all these methods is the shift of methane hydrates stability boundary. In this work advantages and disadvantages of these methods will be analyzed.

The CO2 injection was successfully tested on the North Slope of Alaska in 2012 [3]. After that, active research started on the possibility of methane recovery by different gases injection in the reservoir. This method will allow to produce the large amount of methane and to sequestrate greenhouse gases. In this work, research of methane recovery by nitrogen/flue gas injection will be described.

For the methane recovery by gas injection, special equipment was invented. The procedure of the experiment includes methane hydrate formation in the sand sample, injection of flue gas/nitrogen in the system, dissociation of the methane hydrates and flue gas hydrate formation. On each of these stages, gas composition samples were taken and analyzed with the use of the gas chromatograph. The object of research is sand from North sea, Fife, Scotland.

As the result, we obtained kinetics of the methane recovery/CO2 sequestration, and established that the process is influenced by the temperature, pressure, gas composition, hydrate saturation.

[1] Unconventional Oil & Gas Production Technology Brief / IEA ETSAP, 2010.

[2] Andreassen K., Mienert J., Bunz S., Knies J. et al. Arctic gas hydrates in petroleum provinces, 2017.

[3] Wang, X. H., Sun, Y. F., Wang, Y. F., Li, N., Sun, C. Y., Chen, G. J., and L. Y. Yang, Gas production from hydrates by CH 4-CO 2/H 2 replacement, Applied Energy, 188, 305-314, 2017.