8. Maaten B., Loo L., Konist A., Nesumajev D., Pihu T., Külaots I. Decomposition kineticks of American, Chinese and Estonian oil shales kerogen // Oil Shale. - 2016. - Vol. 33 (2). – pp. 167 – 183.

PROBLEM OF GAS PRODUCTION IN RELATION TO GAS HYDRATE FORMATION

D. A. Gorodilov, E.E. Emelyanov, A.E. Artemiev

Scientific advisors: assistant professor L.V. Chekantseva, assistant professor V.E. Mironova

National Research Tomsk Polytechnic University, Tomsk, Russia

The technology of gas production is complicated by the problem of gas hydrates [2]. In general the formation of gas hydrates depends on the presence of a water phase in a gas stream.

Moreover, during certain thermobaric conditions the water phase has an ability to form hard snow-like compounds of cubic structure with gas components mainly withVan der Waals natura of interaction [6].

The process of hydrate formation depends on the physico-chemical characteristics of the gas [2]. The probability of hydrate formation increases with increasing pressure and lowering temperature [6]. The formation of hydrates in the bottomhole zone for the initial temperature below the equilibrium temperature by 2 K leads to drop of the production rate to 18-19% [3].

Figure 1 shows the hydrate curves of some gases as a function of temperature and pressure. The density of hydrates of various gases varies from 0.8 to 1.8 g/cm3. The heat of formation of hydrates at 0 ° C is from 50 to 140 kJ / mol.

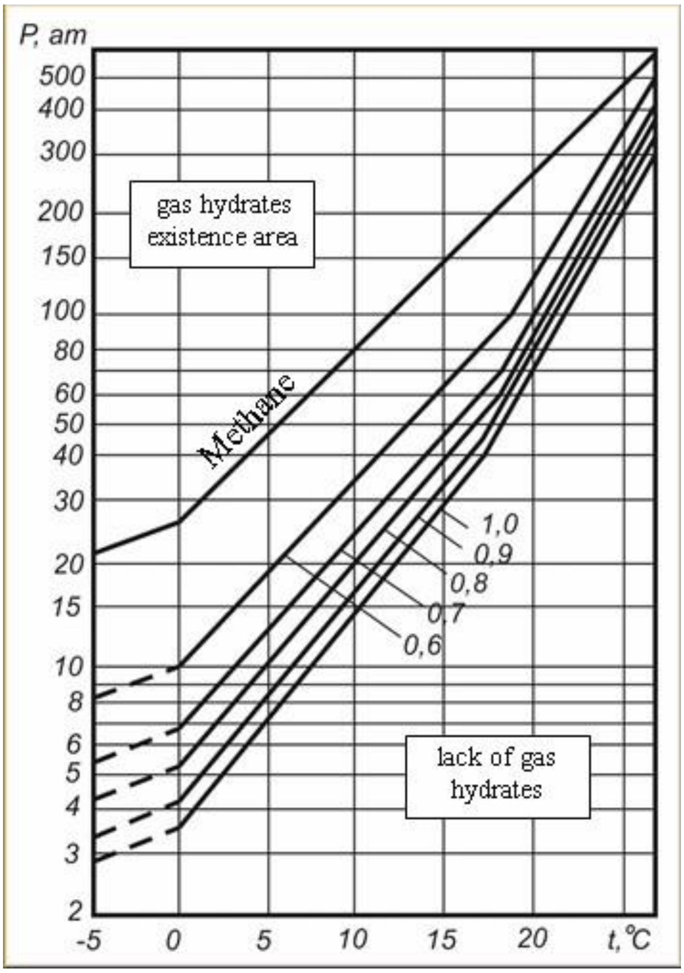

Fig. 1 - Conditions for the formation of hydrates.

There are technogenic and natural gas hydrates. Technogenic gas hydrates can be formed in gas production systems. They are deposited in the wellbore, thereby dramatically reducing its throughput. This leads to a decrease in production of the well and may lead to an emergency stop of its operation. Natural gas hydrates can form accumulations of gas hydrate deposits around production columns. With the rise of warm oil from the underlying horizons, the temperature of the surrounding rocks increases. This circumstance leads to a change in the phase state of water and gas in the hydrate-saturated intervals around the wells. This process is analogous to the process of "thawing" of frozen rocks in the development of hydrocarbon fields in permafrost regions and it leads to severe accidents: collapsing casing strings, gas leakage behind the conductor during gas manifestations, formation of griffins and a hole in the wellhead [4].

Prevention of these complications with reduced operating costs is an urgent scientific and technical and production problem. There are several basic methods for controlling gas hydrates.

The method of heating the gas is used while maintaining the pressure in the gas pipeline. With this method, the prevention of hydrate formation takes place at fields, gas mains and gas gathering networks. However, it is economically inexpedient to use gas heating for large-scale gas pipelines, since this method requires large capital and operating expenses. Gas heating can be used to control hydrate formation under conditions where hydrates are formed as a result of local reduction of gas, and the operating temperature in the gas pipeline exceeds the equilibrium temperature of hydrate formation.

The method of reducing pressure is used both to eliminate the hydrates already formed, and to prevent their formation. The method of reducing pressure gives a positive effect when eliminating the hydrate plug formed at temperatures above zero. This method shows the best results of reducing pressure in combination with the introduction of inhibitors, the use of which allows you to transfer water from the hydrate to a solution with a low freezing temperature, which allows eliminating hydrate plugs, despite low temperatures.

The most common method of counteracting the formation of hydrates, which allows localizing the formation of hydrates in a gas pipeline is the introduction of an inhibitor. The essence of the method is to absorb the vaporous moisture by the inhibitor involved in the gas stream, so, together with free condensed by gas cooling water it can form a solution. addition, it reduces the equilibrium temperature of hydrate formation [2].

In practice methanol and glycols are widely used to control the formation of hydrates. Sometimes liquid hydrocarbons, surfactants, formation water, a mixture of various inhibitors, for example methanol with solutions of calcium chloride, etc. are used [1].

Methanol is used because of low cost, anti-hydrate activity, which remains even at low temperatures, low freezing point of the solution, low viscosity even at a temperature of -50 ° C, its non-corrosivity, due to the simplicity of technological regeneration of waste solutions , high efficiency for preventing hydrate formation and elimination of emerging hydrate plugs. Instead of pure methanol, its aqueous solutions can be used [5].

To minimize the consumption of methanol (with a corresponding environmental impact reduction), hydrate formation prevention technology, implemented by intelligent process control system (automated process control system), is needed. The bottom line is that methanol is fed into the gas stream only when the hydrate formation process starts, and in the required quantities. To do it, it is necessary to monitor the progress of real processes with their parallel modeling. It will ensure the possibly minimized consumption of methanol due to high accuracy and the rate of determination of the moment of hydrate formation [2].

This problem can be solved by comparing in real time the actual temperature of the transported gas from the first stage separator to the low-temperature separator with a high-precision model of this temperature. For this purpose, the system measures in real time the pressure, temperature and gas flow on the lines of the complex gas treatment unit and transfers them to the database of the intelligent automated process control system (APCS). Simultaneously, the APCS measures the gas temperature and pressure at the inlet of the complex gas treatment unit [2].

Having considered the main methods of combating hydrate formation in the systems of extraction, preparation and transportation of natural gas, it can be concluded that the best method includes the usage of hydrate inhibitors-menthanol. Also, the use of automatic control of the supply of methanol to prevent hydrate formation and eliminate hydrate plugs makes it possible to improve the efficiency of gas collection and transport systems.

References

1. Accountant E.B. Methanol and its use in the gas industry. - M .: Nedra, 1986. 238p.
2. Aksyutin OE, Men'shikov SN, Lapperdin A.N. Conditions of formation and methods of fighting hydrates in the gas field of the Yamsoveiskoye field: A survey of information. Moscow: Gazprom Expo, 2010. 88 pp. (Geology, drilling, development and operation of gas and gas condensate fields).
3. Bondarev EA, Argunova KK, Rozhin II, Popov VV Dynamics of formation of hydrates in the bottomhole zone of gas wells // The gas industry. 2010. № 2. P. 14-16
4. Fedorov BV, Posting wells in difficult conditions: a textbook for students.-Almaty: Scientific and Technical Publishing Center. Satpaeva KI, 2011.-161s.
5. Glebova LV, MO (2014). Methods to combat hydrate formation. Materials of the V International Scientific and Practical Conference, (pp. 71-73). Astrakhan.
6. Gromovykh SA, Nechepurenko A.E. Hydrate formation in the development of oil and gas fields in Eastern Siberia. Tyumen: Vector Buk, 2005. 80 p.