In the early Middle Jurassic, sedimentation in the study area occurred under the frequently changing paleogeographic conditions and was accompanied by the change in various forms of relief, which probably resulted in the formation of reservoirs with special filtration and capacitance properties [2].

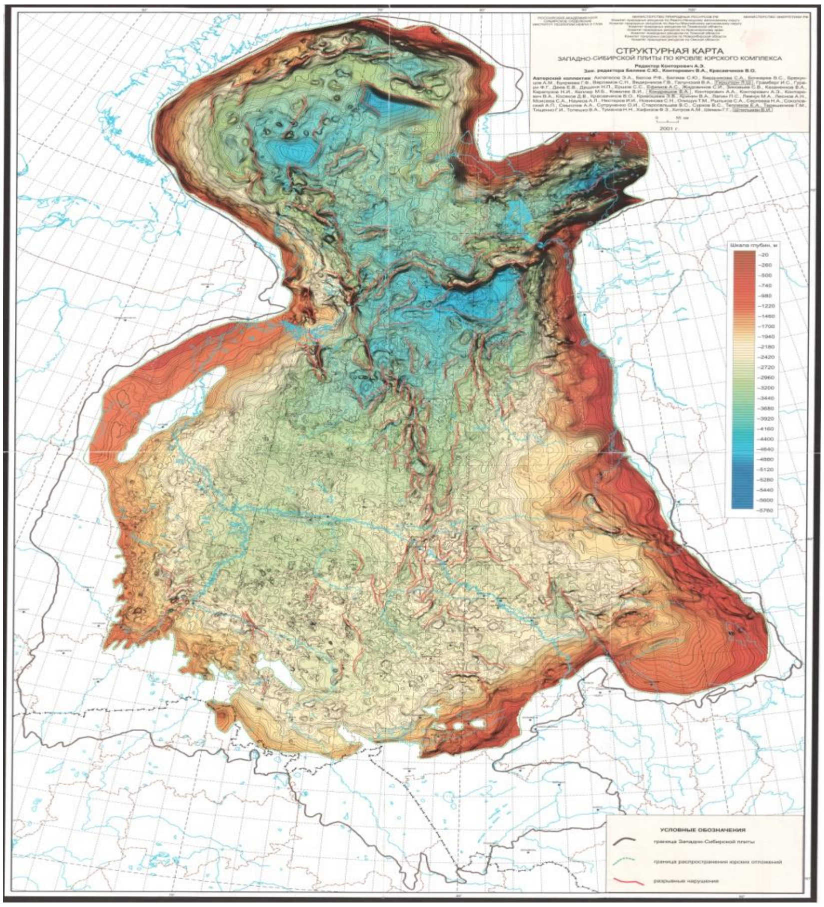

Fig. 1 Structural map of the West Siberian plate on the roof of the Jurassic sediment complex (A.E. Kontorovich, 2001)

References

1. Chernova O.S., 2008. Oil and gas bearing provinces of Russia and adjacent territories // Tutorial, 256 p., (In Russian).
2. Chernova O.S., 2002. Paleogeographic conditions for the formation of Lower Jurassic deposits of the southeast of the West Siberian plate // News of the Tomsk Polytechnic University. Engineering of geo-resources.,96-116 p., (In Russian).

HYDRATE FORMATION AS THE MAIN PROBLEM DURING GAS-CONDENSATE FIELD EXPLOITATION

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Exploitation of gas and gas condensate fields considers a lot of technical difficulties during the operation due to gas hydrate formation. Hydrates are crystals combined from water and gas at high pressure and low temperature environment. Formed hydrate can reduce the diameter of the tubing or pipeline and finally plug it. Once plugged the pipeline can't transport the fluid to the target place which is leading to significant losses in production and revenues.

The most important step in controlling hydrate formation is to determine appropriate pressure and temperature conditions for hydrate process to start. There are a lot of commercial phase equilibrium computer programs that allow performing accurate prediction of hydrate formation conditions. Incipient hydrate formation programs enable the prediction of the PVT conditions at which hydrates begin to be formed. Gibbs energy minimization programs or flash programs predict all phases and amounts at higher pressures and lower temperatures than the incipient hydrate formation point. Also it is possible to calculate the required amount of inhibitor per volume of produced gas for safe exploitation conditions (Fig.1). The hydrate formation plot allows performing quick operating decisions regarding to the exploitation regime [2].

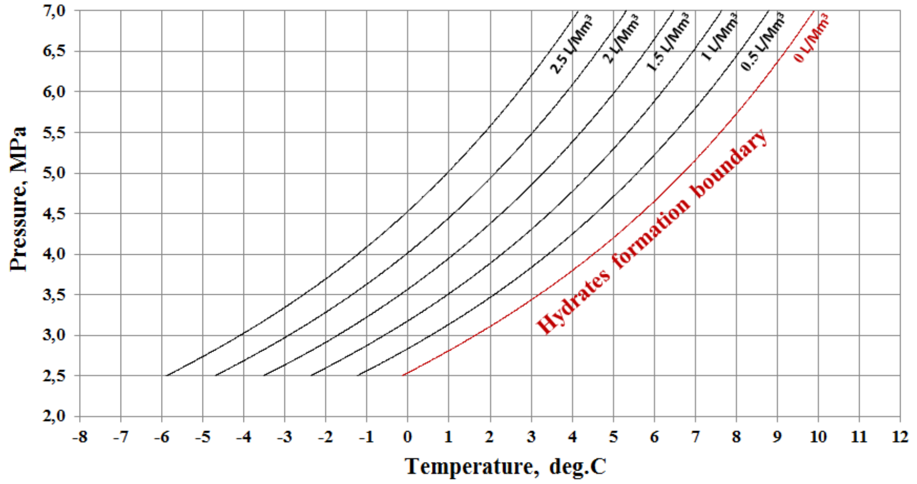

Fig.1 Hydrate formation plot

As the fluid starts to move from the reservoir up to the surface and then to the treatment unit through the pipeline it is necessary to consider separately all sections and branches with hydrate formation risk. The lifting tubing in the production well is the first section with hydrate plugging risk. Hydrates form from the water films on the tubular walls and can result in large plugs tens or hundreds of meters long. At the bottom of the well the risk of hydrate formation is less as temperature conditions are more favorable. Avoidance of hydrate formation is preferable to removal of existing plug from safety concerns and economical view. Calculation of appropriate operating regime allows controlling the production parameters of specific well and fluid lifting velocity inside the tubing [4]. Also it is important to explore and determine correct geothermal gradient of the formation in order to determine the changes in fluid temperature at different depth. Introduced well hydrate analyses shows how the application of inhibitor influence the hydrate formation temperature at different depth of the well (Fig.2).

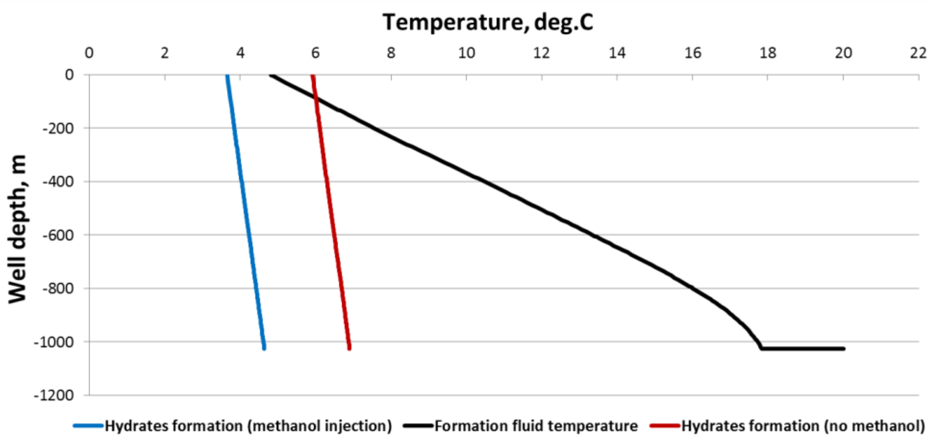

Fig.2 Well hydrate analyses

The exploitation of production gas wells is accomplished with different wellhead pressures. It is necessary to create pressure prop in order to let the well produce in the pipeline with specific operating pressure. The wellhead choke valve is one of the main control component used to manage the flow of gas as the pipeline pressure in most cases differs from the wellhead pressure. Temperature change due a nearly adiabatic expansion is referred to as Joule-Thomson cooling. The potential risk is occurred during the exploitation of wells with high wellhead pressure where Joule-Thomson effect causes high pressure drop and as a result decreasing of gas temperature. It is possible to calculate the pressure and temperature drops for specific gas composition by specialized PVT simulators [3]. Real data example shows the behavior of gas temperature across the choke valve and the necessity of inhibitor injection (Fig. 3).

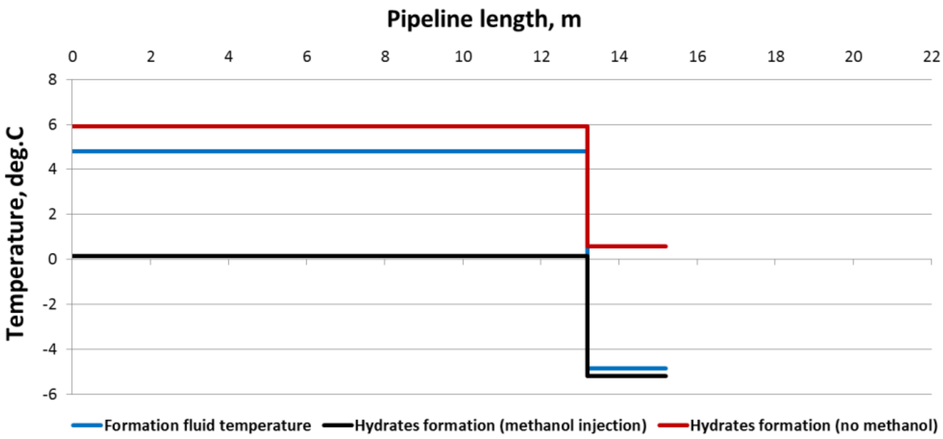

Fig.3 Hydrates in choke effect

During the transporting of gas from wells to treatment unit the formation of hydrate crystals in the pipeline should be prevented. Presence of free water is a key factor in the initiation of hydrate plugging. Wet gas can be transported when the conditions can be kept outside of the hydrate formation limits. But it is necessary to consider that specific temperature and pressure fluctuations can occur. It is necessary to use proper pipeline isolation or special skin effect coat in order to keep the gas temperature in appropriate range [1]. The amount of required inhibitor can range depending on the season. In winter cold temperature of the environment results in cooling of pipeline walls and transporting gas that can cause the necessity of increasing the inhibitor injection.

There are several types of inhibitors appropriate for production control:

Environmental inhibitors;

Thermodynamic inhibitors;

Kinetic inhibitors.

In conclusion it is necessary to notice that the hydrate formation is strongly correlated to gas composition, free water content in production stream and PT exploitation conditions. Specialized simulation programs allow to calculate the pressure and temperature changes along the lifting tubing and production pipeline, to assess hydrate formation risks in the system and to estimate required volume of inhibitor required for prediction of plugs formation. The point of inhibitor injection should be determined in advance and can be located at the bottom of the well, in the wellhead and along the production pipeline. Finally, permanent monitoring of production parameters provides safety field exploitation.

References

1. Behar, E. Hydrates problem within the framework of multiphase production and transport of crude oils and natural gases: Part 1—Physical chemistry of hydrates formation and dissociation, 1994
2. Brown, G.G. A series of enthalpy-entropy charts for natural gases in petroleum development and technology, 1945
3. Katz, D.L. Prediction of conditions for hydrate formation in natural gases in petroleum development and technology, 1945
4. Tohidi, B., Danesh, A., Burgass, R.W. et al., Measurement and prediction of hydrate-phase equilibria for reservoir fluids, 1996