INTEGRATED ASSET MODELING FOR OPTIMIZATION OF WESTERN SIBERIA GAS CONDENSATE FIELD PRODUCTION

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The application of integrated approach for production problems solving is widely developed in foreign companies. They managed to achieve effects from the use of this technology and to show its value. Today integrated asset modelling is rapidly developing in Russia. It is one of the most prospective areas which supposed to be a tool for field development efficiency advancement. Integrated asset modelling allows predict the fluid behavior along the whole production system from the reservoir to the surface facilities. This approach is highly effective when it is necessary to evaluate different field development scenarios. It is possible to examine different situations according to the pressure and temperature limits in order to get the optimal field development strategy. The evaluating of new oil and gas projects is not the only assignment of integrated modelling [1]. This paper describes the application of integrated model for monitoring of Western Siberia gas-condensate field exploitation and online field development strategy correction. Integrated asset modelling allows connect reservoir simulation with the calculation of the well, gathering and facility systems including the interference between them. Integrated model consists of several submodels:

- Reservoir simulation model;
- Well model;
- Pipeline model;
- Facility model.

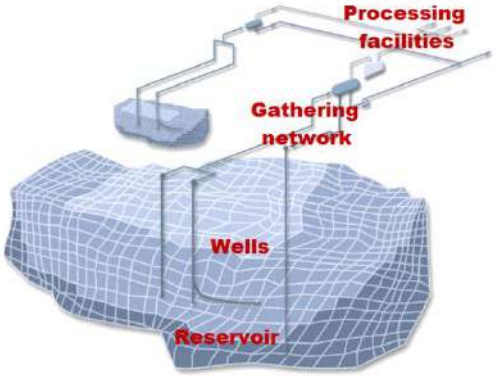

Fig. 1 Integrated model components

The development of gas and gas-condensate fields is commonly carried out with depletion drive. When starts a new well the pressure in the well drainage area decreasing intensively. Then the pressure decline becomes smoother. A gas-condensate reservoir can be choked by its own components. On the first stage of exploitation the reservoir pressure is above the dew point pressure [3]. But condensate liquid saturation can build up near a well because of drawdown below the dew point pressure ultimately restricting the flow around the well. The near-well choking effect can seriously reduce the productivity of a well. This phenomenon, called condensate banking, results from combination of factors that include the fluid properties, flow regime in the formation and reservoir pressure. Considering the well exploitation at the maximum drawdown the gas flowrate will decrease with pressure decrease. It occurs because the productivity of gas wells is not linear function. The real gas-condensate well example shows that the decrease in 5 MPa of formation pressure can results in 100 Msm3/day decrease of gas flowrate (Fig. 2).

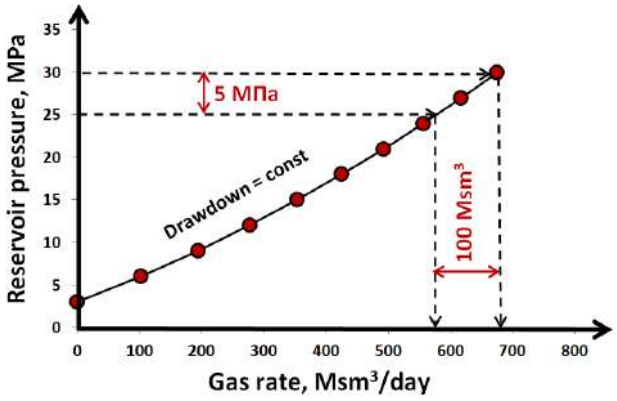

Fig. 2 The influence between the reservoir pressure and the gas production flowrate

Another important factor in the gas well exploitation is the pipeline pressure which depends on the facility inlet pressure. It means that wellhead pressure must be higher than pipeline pressure. Commonly, at the first stage of field exploitation the reservoir pressure is high enough to provide required wellhead pressure. According to the material balance equation - gas production leads to reservoir pressure decrease [2]. In this case wellhead pressure is decreased until the pipeline pressure is reached. Then the well production rate starts to decrease (Figure 3). It is very important for low productivity gas wells because once the production rate reaches the minimum limit the well will be shut down.

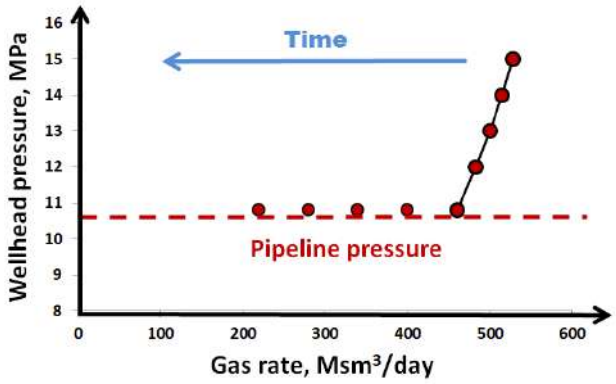

Fig. 3 The impact of the pipeline pressure on the gas well production rate

Exploitation of gas and gas condensate fields considers a lot of technical difficulties during the operation process. On the considered field of Western Siberia the main problem is liquid loading. There are two phases encountered on the bottomhole of the well. The first phase is gas condensate, because the reservoir pressure is less than the fluid dew point pressure. The second phase is the reservoir water. The gas velocity along the wellbore in high flowrate wells is high enough in order to lift the liquid to the surface. But there are several wells with low production rates. It results in liquid loading problems.

It is necessary to understand that the integrated model perform calculation based on the real knowledge about the formation and the exploitation data. But it is difficult to predict changes in well productivity, water break through and as a result to predict change in operating parameters of a well. It is the main reason why integrated modelling is necessary to use not only on the planning stage but also during the whole reservoir production process. Reservoir simulation model can show that the well productivity allows achieve required production rate. But the fact that well is loaded with liquid on the bottomhole is not considered in simulation model calculation. Calculation on the integrated production model allows take into account actual operation mode of each well and to apply the restriction from the gathering network. That is the main reason why integrated asset modelling became leading technology for reservoir simulation.

References

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2. Dake L.P., «Fundamentals of reservoir engineering», Seventeenth impression, 1998
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