OPTIMIZATION OF THE OIL AND GAS GATHERING NETWORK BASED ON THE USE OF AN INTEGRATED APPROACH

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An integrated approach is widely used in the oil and gas industry for monitoring the development status and designing various operations. Approach is based on determining the relationship between factors acting on the process under study [1]. Currently, optimization of ground-based infrastructure is often carried out using an integrated approach, since this process requires taking into account development data that can be updated over time [2, 3]. This paper presents an integrated approach implementation to optimizing the project of oil and gas gathering network of the X field based on the use of the information system (IS) "Flow" as an integrator (developed by JSC "Tomsk Petroleum Institute").

IS "Flow" is a tool for data exchange between a model of production facilities and gathering network created in the "PIPESIM" software product and an "Excel" spreadsheet. Thus, it is possible to enter development data into a spreadsheet for subsequent exchange with the "PIPESIM" simulator. In fact, IS "Flow" performs the function of an integrator between development data contained in an "Excel" spreadsheet and a model of production facilities and gathering networks. This approach involves the use of a small set of licenses, which is currently a big advantage. So, in this case, it is necessary to have only the licenses "PIPESIM" and the IS "Flow", which will be available in the future within the perimeter of PJSC "Rosneft Oil Company". This combination has a simplified description of the underground part of the field and can solve the problem of optimizing the gathering network without the use of expensive hydrodynamic simulators and special integrators. Figure 1 shows the logical chain for planning optimization of the gathering network. The procedure includes transferring the production profile to the IS "Flow" for exchange with the "PIPESIM" model and transferring optimization results to the economic model.

Figure 2 shows the result of the hydraulic calculation (HC) of the gathering network at the base production profile for the year of maximum load. The results show the optimal load of the initial gathering network for the base production profile. The optimal loading is determined by the general compliance with the boundary conditions for the fluid velocity in sections of the gathering network. Thus, the fluid velocity in the gathering network should not exceed 3.6 m/s per year of maximum load and should not fall below 0.3 m/s; if possible, it is also necessary to ensure a velocity higher than 0.8 m/s to minimize corrosive processes (according to internal standards of PJSC "Rosneft Oil Company"). The corresponding lines are reflected on the results of all HC.

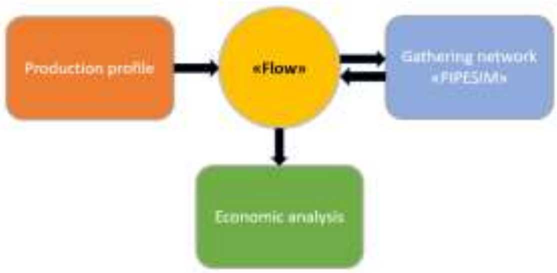

Fig. 1. The logical basis of the implemented approach

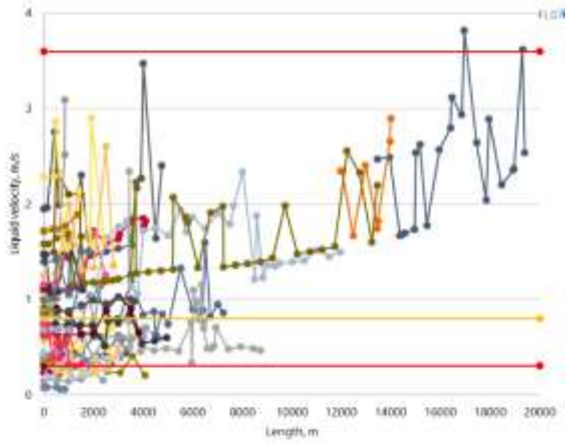

Fig. 2. Liquid velocities of base production profile

After updating the production profile, a series of surveys were carried out to determine the optimal configuration of the gathering network. Figure 3 shows the result of HC with an updated production profile, from which a decrease in the load on the gathering network can be seen compared to the base profile. Reducing the load determines the possibility of optimizing the gathering network. Figure 4 shows the result of the HC with an optimal configuration of the gathering network, which shows an acceptable load on the gathering network.

A decrease in the load on the gathering network indicates the need for optimization in the form of reducing the diameters of pipelines in sections of the system. Reducing diameters leads to a decrease in the overall metal intensity of the project and, accordingly, to a decrease in capital expenditures (CAPEX). A change in the production profile leads to a change in operating expenditures (OPEX) and net present value (NPV). All these parameters affect the discounted profitability index (DPI). To calculate economic indicators, a corporate economic model in the form of an "Excel" spreadsheet was taken as a basis, which was customized and adapted for this optimization project. The table presents the results of calculations of economic indicators for the base and optimized case.

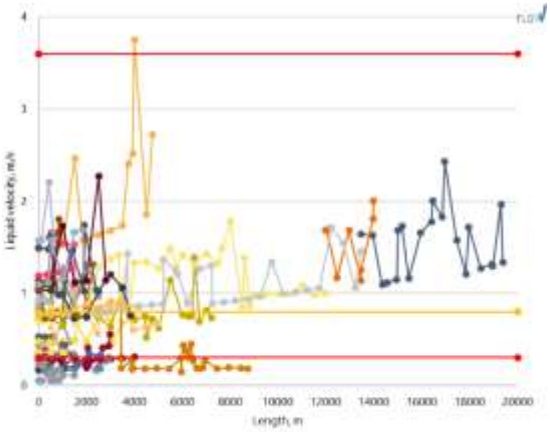

Fig. 3. Liquid velocities of updated production profile before gathering network optimization

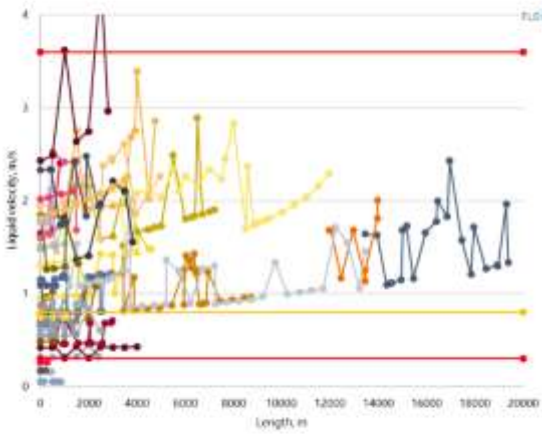

Fig. 4. Liquid velocities of updated production profile after gathering network optimization

Table

Comparison of economic indicators

Case	Oil recovery, million tons	CAPEX, billon rubles	OPEX, billon rubles	NPV, billon rubles	DPI
Base	7,195	55,222	8,481	33,695	1,83
Optimized	7,191	53,564	8,434	35,268	1,97

As a result of a series of surveys, sections of the gathering network were identified for which a reduction in diameters is necessary. A decrease in the metal intensity of the gathering network was determined from 21.193 to 14.049 thousand tons. Economic calculations showed a decrease in CAPEX by 1.658 billion rubles, a decrease in OPEX by 0.047 billion rubles, an increase in NPV by 1.573 billion rubles, an increase in DPI by 0.14, with a decrease in cumulative production of oil for the analyzed period by 4 thousand tons.

Thus, an integrated approach based on the use of the IS “Flow” made it possible to identify the possibility of optimizing the oil and gas gathering network with a clear positive economic effect. The compiled system, consisting of simplified development data, the model of production facilities and the gathering network in “PIPESIM” and the IS “Flow” as an integrator, helped to determine the reduction in the load on the gathering network and determine the program for its reconfiguration. The program includes reducing the diameters of sections of the gathering network, which leads to a reduction in its metal intensity from 21.193 to 14.049 thousand tons. An economic comparison of two options for the development and operation of X field determined that the option with the updated production profile and the optimized gathering network is more profitable even though the cumulative production of oil is less by 4 thousand tons. In this option, NPV is greater by 1.573 billion rubles.

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