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Effectiveness of experimental researches on gas-lift wells

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RESUME
Effectiveness of experimental researches on gas-lift wells.
Defined and considered the tasks on increasing of efficiency of experimental researches on gas-lift wells. Presented the results of analysis of key factors that impact to effectiveness given researches and the tasks that should be solved for increasing it.
Keywords: *gas-lift, wells, oil extraction, effectiveness, experimental research,*

I. INTRODUCTION

The gas-lift oil extraction technique uses directly after fountain exploitation when a pressure of oil reservoir is not enough for extracting of oil from deep earth. The main characteristics of gas-lift wells that use for its control build on results of experimental researches on wells. In recent years, when demand for oil and oil products increases particularly in developing countries and production in the old oil fields gradual decline, solving problem on the modeling of oil production processes and the optimal control of these processes is becoming more relevant. This is conditioned by the following facts: these are firstly, increasing of the computing power, speed and productivity of the control computers, secondly, availability of a large number of hardware and software tools for obtain of necessary measurement results and diagnostic information. All of this enables the wider use of modeling and optimization methods in the control of gas-lift wells as well as the planning of experiments. From this point of view, the issues of raising the efficiency of researches through the reduction of losses and costs that may arise during the experimental surveys and increasing the information volume and accuracy of the results obtained during investigations in the wells should be solved on required level.

Researches show that the implementation and use of transducers and measuring devices with high precision accuracy and as well as control computers with high performance for control of gas-lift wells, from the point of development of gas-lift oil production, did not allow the specialists achieve desired results. Defined that to obtain the necessary results, required the solution of the problems of building of the adequate mathematical models of wells, namely, reliable models for work of wells and optimal distribution and redistribution of the working agent. Therefore the solution of the problem of conducting experimental researches in gas-lift wells at the required level and gathering of the necessary and full information is very important aspect of process automation of oil extraction. The current period of gas-lift oil production requires the development of these mathematical models in terms of ensuring a higher level of control. Thus, the key tasks to be solved in this area are optimization of different experimental plans, which determine the mathematical models of gas-lift facilities, their algorithms, and the sequence of experimental researches, as well as improving the efficiency of control of gas-lift wells and control systems by using modern hardware and information technology. Hence, improving the efficiency of experimental research requires a higher level of mathematical, technical and algorithmic support. It is therefore necessary time to time to perform identification and correction the mathematical models of wells and to define the parameters used for their management and control, which solve during the experimental researches on gas-lift wells.

As a criterion of efficiency of experimental researches on gas-lift wells it is advisable to accept non-production losses. These losses include the loss on the transition process (from 3 hours to several days), the loss on the measurements (at least three measurements at each point of research), costs and losses associated with redistribution of the working agent, lost due to failures in wells and equipment, during experiments on wells which are very vulnerable to regime change on depending on the condition of the well, the losses on accuracy and reliability of the measuring equipment and facilities used, the maintenance duration of the wells, and other costs and the costs associated with reviewed economic indicators.

As with any process, the main purpose of investigations of gas-lift wells is ultimately to increase overall production either by stabilization or by reducing losses through proper planning. Each of these directions depends on the current state of the gas wells, the gas-lift infrastructure and support. It should be noted that the two previous tasks, namely the tasks of increasing the overall production and stabilization, are closely related to the optimal distribution of available gas between wells.

The analysis of all above mentioned processes and factors shows that the efficiency of experimental researches in gas-lift wells depends on the following key factors:

- the duration of researches conducted in wells;

- resources used during research;

- malfunctions and unforeseen events that may occur during investigations;

- completeness and validity of the information obtained;

- non-production losses during investigation of wells;

- incomes obtained through identification and appropriate calculations based on the results of the research, increase of production output, reduction of gas consumption, improvement of wells for wells, optimization of control system operation;

- income obtained from passive identification of wells, where performing of active experiment is impossible;

- general material and human resources that are spent on research.

It is desirable to divide the investigation time into two periods in order to determine the effectiveness of experimental research, given the material and time factors mentioned: the first period is the period of purely experimental studies, and the second period start from the setting of the working regimes calculated based on the research immediately after investigations and cover the period before desired results is received.

Given all the possible indicators, parameters and factors affecting efficiency, it would be more expedient to show the effectiveness of experimental research in the form of the following integral function:

$$E = \int_{\alpha}^{\beta} \varphi_z(t_1, t_2, , , t_n, V, Q, P, T, L, H, h, d, h_d, \varepsilon_V, \varepsilon_Q, \varepsilon_P, p(t)) dz$$

Here, t_1-t_n - the beginning and the end of the periods related to researches;

V, P, T - volumes, pressure and temperature of the working agent;

Q - production of the well;

L, h, d, h_d - constructive parameters of the well;

$\varepsilon_V, \varepsilon_Q, \varepsilon_P,$ - measurement accuracy of the flow of the working agent, the production of the wells and the pressure;

Thus, in order to increase the effectiveness of experimental research, it is essential to address the following key tasks:

- improving the methodology of research;

- increasing measurement accuracy;

- ensure that research is completed in acceptable time;

- planning of experiments ensuring the collection of necessary data for the building of a mathematical model of gas-lift wells;

- building of the mathematical models that ensure efficient control of the well;

- development of the methodology for taking into account the failure and malfunctions that may occur during investigations;

- using of forecast data and trends in calculations.

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