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EFFICIENCY OF APPLICATION OF TECHNOLOGIES FOR THE DEVELOPMENT OF OIL AND GAS FIELDS OF A SYSTEM OF HORIZONTAL AND MULTILAYER WELLS

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ABSTRACT

An analytical forecast of the economic efficiency of drilling vertical and horizontal wells for oil and gas production, depending on the type and efficiency of operation of horizontal wells, is given.

There are a large number of methods and calculation schemes that make it possible to predict the effectiveness of the use of - horizontal wells (HWs) in oil and gas fields. However, a conceptual approach and general principles have not been developed at all, on the basis of which it would be possible to design not only individual wells, but also systems for the development of HW fields with some predetermined properties. Such an approach would make it possible to solve optimization problems in designing to determine the development objects, the development system, the density of the grid of wells.

As an indicator of the efficiency of applying technologies for the development of horizontal wells (HW) [1, 3] , the efficiency indicator Z is used , which characterizes the relative growth rate of oil production rate of horizontal wells (HW) to the production rate of a vertical well to the corresponding increase in capital investments:

$$Z = q_H / K \qquad (1)$$

$$q_H = q_H^{гор} / q_H^{вер} \qquad (2)$$

$$K = K_{гор} / K_{верт} \qquad (3)$$

where q_H — relative oil flow rate of wells; K — relative capital investments; $q_H^{гор}$, $q_H^{вер}$ - flow rates of horizontal and vertical wells, respectively; $K_{гор}$, $K_{верт}$ — capital investments in the construction of - horizontal and vertical wells, respectively.

If Z > 1, then capital investments in the construction of the HW are effective; if Z < 1, then they are not effective. It should be noted that the Z indicator is not sufficiently correct, since it does not take into account a number of significant factors: the accumulated production recovery by wells; a decrease in the total number of wells and, consequently, an increase in specific reserves per well; well interference; reducing the cost of laying oilfield equipment; reduction of costs for dehydration and desalination of products; increase in geological recoverable reserves due to an increase in oil recovery factor, expenses for carrying out geological and technical measures, etc. Thus, in order to increase the efficiency of application of HW development technologies, it is required to reduce the cost of HW construction and increase the HW productivity. Bringing the values of relative capital investments to the level of countries where these technologies are widely used (USA, Canada, France, etc.), i.e. up to 1.7-2.0, will allow almost 2.5 times to increase the success of the use of capital investments in the construction of HW. This explains the success in the application of technologies for the development of HW oil deposits in the Russian Federation.

The second important task of improving the efficiency of HWs is an almost 10- fold increase in initial and 3-4 - fold increase in cumulative oil recovery from HWs compared to the surrounding WTs. The need to achieve a significant increase in the cumulative oil recovery for horizontal wells dictates the presence of almost the same difference in specific reserves per well. However, when using HS among vertical wells, the oil reserves per well (both HS and HS) are close to each other for purely geometric reasons. This excludes the possibility of fulfilling the condition of a multiple increase in cumulative production per one HW, since there is no reason to expect a multiple increase in the oil recovery factor . In mixed systems (HWs among HWs), it is impossible to fully realize the advantages of HWs, since previously drilled HWs significantly limit the capabilities of HWs. To obtain the potential effect from the use of HS, it is necessary to create separate technological cells of HS with a multiple increase in specific reserves, i.e. with relatively rare well patterns. In connection with the above, it follows that the efficiency of - capital investments in the development of - HW fields cannot be considered outside the complex of capital investments in the considered option of field development.

The need to limit capital investments, - payback periods for operating costs, man-made impact on nature is especially relevant for the modern conditions of the economy of Uzbekistan , and there is no alternative to the use of intensive and flexible technologies. The economic efficiency of the application of the HS technology should

be laid down already in the technological schemes and projects for the development of oil and gas fields [2]. For example, in [5] , a method is given for calculating the economic effect from the construction and operation of one MS depending on the number of branches, where it is proposed to take the maximum savings per MS as compared with the base case, a system with an aircraft, as the evaluation criteria.

The process of hydrocarbon production at the field is considered in dynamics and depends on natural factors (geological and physical features of the structure, volume of reserves, etc.), as well as on the means of developing reserves - it is necessary to take into account real production, economic, geographical and natural climatic the conditions of the area, the availability of infrastructure, the existing capacities of drilling and construction organizations, as well as the prospects for their development. As noted above, when planning the dynamics of technical and - economic indicators, four periods of field development are distinguished [4]. In the first period, the production of low -water production is continuously increasing due to drilling and development of the well stock. During the second period of development, the maximum production level achieved in the first period is maintained and the drilling of the main well stock is completed. The third stage covers the most difficult period of field development, which is characterized by a decrease in production due to flooding of well production, a decrease in reservoir pressure and, consequently, a reduction in flow rates and a stock of production wells. In the fourth period , for a long time, highly watered production and production rates are declining slowly. These patterns significantly affect the efficiency of capital investments. At the same time, we can only talk about the dynamics of efficiency, since practice shows that capital investments are made during the entire development period, but with different intensity and efficiency. First (during the first and second periods) they are aimed at the construction of new productive and special wells, the construction of the necessary communications and facilities for their operation. In the subsequent period, capital expenditures are required to regulate development processes. Often these directions of capital investments are carried out simultaneously and it is difficult to separate them according to statistical data. In this regard, when designing the development and infrastructure development of deposits, the problems arise of predicting the effectiveness of capital investments for the entire period of development and taking special measures to increase efficiency in the third and fourth periods.

In this regard, when designing the development and infrastructure development of deposits, the problems arise of predicting the effectiveness of capital investments for the entire period of development and taking special measures to increase efficiency in the third and fourth periods. The current guidelines provide for determination of performance indicators per year of maximum production and average production of hydrocarbons for the period under review. At the same time, the results obtained characterize the deposits in a general form without taking into account the characteristic features of the development objects that make up the deposit.

There are general (absolute) and relative efficiency of capital investments. The absolute efficiency $E_{k.a}$ is determined by the ratio of the increase in profit to the capital investments that caused this increase:

$E_{к.a} = \Delta e/a$ (4)

where Δe is the increase in annual profit for the planned period; a - capital investments in the construction of - industrial facilities for the corresponding period.

When comparing two options, one of which requires large capital investments, but at the same time provides lower cost levels, it is necessary to evaluate their comparative effectiveness. To do this, determine the payback period for additional capital investments T_0 indicating how many years the additional funds necessary for the implementation of a more expensive option will pay off by reducing the cost:

$T_0 = (a_2 - a_1) / (C_1 - C_2)$; $E = (C_1 - C_2) / (a_2 - a_1) = 1 / T$ (5)

where a_1, and a_2, are capital investments according to the compared options; C_1 and C_2 - the cost of annual output for the same options; E - the normative coefficient of comparative efficiency of capital investments.

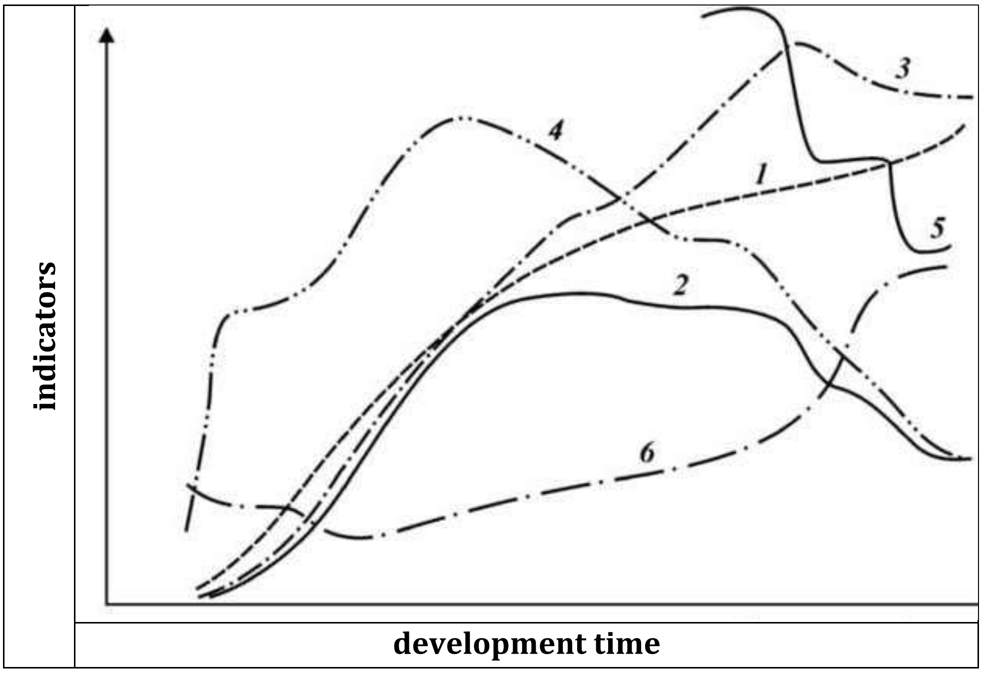
When solving complex problems with a large number of options, the efficiency of capital investments is estimated by the - minimum of reduced costs:

$a_i + T_0 C_i = \min$; $C_i + Ea_i = \min$, (6)

where a, - capital investments for the i -th option ; *e,* - the cost of the annual volume of production for the i -th option ; T_0 - industry normative payback period for additional capital investments; E - the sectoral normative coefficient of efficiency of capital investments.

Relations (4) - (6) make it possible not only to assess the effectiveness of the planned capital costs for the billing period, but also to determine whether, with a constant or increasing output, the economic effect will exist in the future. However, they cannot evaluate the results of additional capital investments outside the settlement period, if output naturally decreases and capital expenditures are required to ensure it . For an example in fig. Table 1 shows the dynamics of indicators for the main objects of which are developed with the maintenance of reservoir pressure and are at the fourth stage of development.

As can be seen from the figure, capital investments in drilling wells and construction of industrial facilities in the first period were proportional to the increase in oil production. In the second period of development, oil production stabilized , but drilling of wells and construction of field facilities continued. At the same time, capital investments were required for the development of new wells, the transfer of wells from one method of operation to another and the provision of production, collection and treatment of a continuously increasing volume of produced produced water. In third



Picture 1. Dynamics of the main technical and economic indicators . 1 - dynamics of

fixed assets, 2 - oil production, 3 - liquid production, ***4*** - dynamics of capital productivity from the initial cost, ***5*** - residual value of funds, ***6*** - cost of 1 ton of oil

Thus, when evaluating the effectiveness of capital investments in the process of - drawing up a scheme for a general field development plan and development projects, it is necessary to analyze the results of projected investments in dynamics until the end of development in order to establish the amount of depreciation deductions per 1 ton of produced products. It should be noted that the above approaches can be applied, with certain adjustments, in the preparation of projects for the development of gas and gas condensate fields using HS systems.

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