UDC 004.422.833

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ELECTRONIC MANAGEMENT AS A WAY OF INCREASING THE EFFICIENCY OF FUEL AND ENERGY COMPLEX

Abstract. In the article the relevance of e-management and the feasibility of the system analysis. Demonstrates the use of principles of system analysis to the simulation software algorithm. The choice of optimal algorithm of the software module for prediction of the rate of decline of production of oil or gas in the energy sector. A curve of low output.

Key words: electronic management, systems analysis, efficiency, fuel and energy complex, system analysis, flow rate, curve of decline.

Kazakhstan, like other CIS countries have to make efforts to reduce the significant gap with the developed countries in the field of effective use of electronic technology and innovation management in virtually all sectors of the economy [1]. Today in any industry for any organization is the problem of increasing the efficiency of management. You must keep up with new ideas and technologies not only in technology but also in the field of e-Informatics and innovation management. One of the ways of modernization of the economy at this stage is the effectiveness of e-management.

The growing potential of the digital technologies, in turn, stimulate the expansion, improvement and deepening of the scope of system analysis. First of all, it is necessary to clarify used the concept of system analysis. According to tradition, will refer to the origin of the compound words of the term system analysis. The word system, as we know, in the Greek systema, meaning whole composed of parts. And analysis is a set of methods and tools for the study of complex, multi-level and multi-component systems, facilities, processes based on an integrated approach, considering the linkages and interactions between elements of the system [2].

System analysis, emerged, as, not unreasonably, assumed in the era of the development of computer technology, currently, there are a whole set of definitions [3 - 4]. We believe that the most appropriate in this case is the following definition. System analysis is a research methodology complex technical, natural and social systems, solution of complex problems of arbitrary nature. Of course, system analysis plays an important role in the process of planning and management, in planning and management decisions. And the success of expanding the scope of its application in solving complex problems is largely determined by modern electronic technologies.

The instability and tendency to the fall in world oil prices before fuel and energy complex increases the problem of improving the efficiency, including effective operational management of production. As is known, the volume of oil production of any field with the increase of time of production are reduced. It is important to as accurately as possible predict the dynamics of the production volume for each well for making the right decision on time stay of proceedings on it. When the rate of production falls to the economic limit, the well is considered to be not cost-effective, and should be to stop production. On the one hand, and on the other is also not cost effective to stop production from the well if the failure rate of random, and fuel reserves are far from exhausted. Two main problems in the evaluation of performance is to determine the most likely life expectancy of the well and estimating the amount of future production of raw materials [5]. Effective solution to these problems in the modern world is possible through the use of electronic technologies, including specialized software. To create quality software it is necessary to work on information modeling using systems analysis.

The efficiency of solving problems through systems analysis is determined by the structure of problems to be solved are classified in three classes. First class is well-structured (well-structured), or quantitatively formulated problems in which the dependence is clarified very well. The second class is poorly structured (ill-structured), or mixed problems that include both qualitative elements, and little-known, uncertain hand, which tend to dominate. And finally, the third class - unstructured (unstructured), or qualitatively expressed problems containing a description of the important resources, features and characteristics of a quantitative relationship between them is completely unknown. In the process of reviewing the challenges, identify the most probable life expectancy of the well and estimate the amount of future production of raw materials and the study of literary sources came to the conclusion that these problems belong to the class of weakly-structured problems.

For solving weakly-structured problems used the well-known methodology of system analysis, systems of support of decision-making. Namely, they used the technology of application of system analysis to the solution of complex problems in which the decision-making process includes the following stages: formulation of the problem situation; defining goals; define the criteria for achieving objectives; building models to inform decisions; the search for the optimal (permissible) solution; the agreement; preparing solutions for implementation; adoption of decisions; manage the implementation of solutions; checking the efficiency of the solution.

To perform this work used the material, LLC "Sibir'SoftProekt" (SSP) [6], where the practical training. SSP is one of the companies engaged in the development of software capable of solving the above described problems for the enterprises of fuel and energy complex. The company specializiruetsya on developing innovative national software products and business applications of various kinds [7]. Currently, the SSP company is engaged in the development of a system of production planning for which you want to create a software module for analysis of decline curves, production. Our task at the internship in SSP was to create an interface - embedded software module for prediction of the rate of decline of production of oil or gas in the energy sector. To develop software module, of course need to choose the best algorithm. Began work with a review of the material domestic and foreign sources of possible methods of analysis of the fall of oil production and was faced with the necessity of using the principles of system analysis. In the review process and literature determined that the traditional means of identifying the problems of producing gas or oil wells and predicting the performance and life of the well is the analysis of the decline curve of production of oil or gas.

Considered methods of analysis the extraction method Arps, the method of Fetkovich, the method of Carter and method Palacio-Blasingame. Studied the indicators, depending on the impact of falling production in conjunction with declining oil reserves. The rationale for selecting the method for analysis was based on the factors presented below. First, the method must be universal, i.e. model of decline is applicable for oil and gas wells. Second, the method should allow analysis of existing data, such as flow rate q (m3/time unit) and time t (unit of time). In the course of studying methods of analysis of decline curves, production (production) method was chosen Arps, because it satisfies the above factors. Also important when selecting is the fact that the method Arps is fundamental to all of the considered methods of analysis of the curves of decline. For example, a method of Fetkovich completely based on the standard curves Arps. Despite the fact that Arps method can give large errors because it is based on empirical data, it is widely used in the energy sector.

Arps suggested that the "curvature" of the curve of flow time can be expressed mathematically by one of equations of hyperbolic family. Arps found the following three types of decline: exponential, harmonic and hyperbolic.

Every drop curve has a different curvature, as shown in figure 1. This figure depicts the characteristic shape of each type of fall.

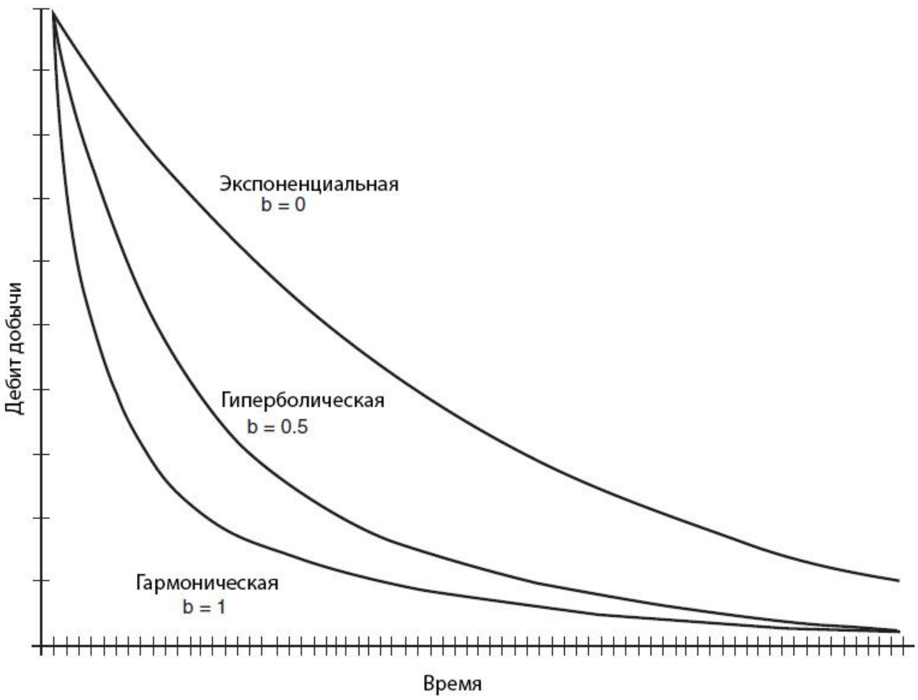

Figure 1. Typical curves of decline Arps

In General, the decline curves can be expressed as follows:

$$q_t = \frac{q_i}{(1+bDt)^{\frac{1}{b}}}, \quad (1)$$

where qt – flow rate of extraction at time t, m3/unit time;

qi – initial production rate of mining, m3/unit time;

b – constant ARPS for the curve of decline;

D – nominal rate of decline, 1/unit time;

t – time, time unit.

The index i means the initial value of the parameter.

The mathematical description of these curves of decline is greatly simplified when using the instantaneous (nominal) rate of decline D. the Rate of decline of production is defined as the rate of change of the natural logarithm of the production rate, that is ln(q) against time t, or:

$$D = -\frac{d(\ln q)}{dt} = -\frac{1}{q}\frac{dq}{dt}. \quad (2)$$

The minus sign was added because dq and dt have opposite signs and D must always be positive. Equation 2 describes the instantaneous change of the slope of the curvature dq/dt with the change of the flow rate q with time [8].

Parameters – the nominal rate of production decline D and figure b – can be used to predict future production. This type of analysis of the curve of the drop may be applied to individual wells or to an entire layer. Accuracy apply to the entire layer is sometimes better than for individual wells due to smoothing of data mining. Depending on the type of fall, the value of b ranges from 0 to 1, and, accordingly, Arps equation can be conveniently expressed in the following three forms:

Exponential, b=0,

$$q_t = q_i \exp(-Dt) \,, \tag{3}$$

Hyperbolic, 0 < b < 1,

$$q_t = \frac{q_i}{(1+bDt)^{\frac{1}{b}}} \,, \tag{4}$$

Harmonic, b=1,

$$q_t = \frac{q_i}{(1+Dt)} \,. \tag{5}$$

The nominal tempo of decline D can be calculated by the formulas 6 – 8.
The nominal tempo of decline D for the exponential fall:

$$D = \frac{ln(\frac{q_i}{q_2})}{t_2} \,. \tag{6}$$

The nominal tempo of decline D for the hyperbolic fall:

$$D = \frac{\left(\frac{q_i}{q_2}\right)^b - 1}{bt_2} \,. \tag{7}$$

The nominal tempo of decline D for harmonic fall:

$$D = \frac{\left(\frac{q_i}{q_2}\right) - 1}{t_2} \,, \tag{8}$$

where qi is the initial production rate at t = 0, m3/unit time;
q2 – the ultimate flow rate, m3/unit time;
t2 is the end time a time unit.

Total production of G for a certain period can be calculated by the following formula:

$$G = \left[\frac{(q_i)}{D(1-b)}\right]\left[1 - \left(\frac{q_t}{q_i}\right)^{1-b}\right] \,. \tag{9}$$

The time of reaching the limiting rate of ta can be calculated according to equations 10 – 12.
The exponential fall:

$$t_a = \frac{ln(\frac{q_i}{q_2})}{D} \,. \tag{10}$$

Hyperbolic decline:

$$t_a = \frac{(\frac{q_i}{q_a})^b - 1}{bD} \,. \tag{11}$$

Harmonic decline:

$$t_a = \frac{q_i - q_a}{q_a D} \,. \tag{12}$$

The total production of Ga at the time of reaching the limit of the flow rate qa can be calculated according to equations 13 – 15.

The exponential drop:

$$G_a = \frac{1}{D}(q_i - q_a). \tag{13}$$

Hyperbolic decline:

$$G_a = \left[\frac{(q_i)}{D(1-b)}\right]\left[1 - \left(\frac{q_a}{q_i}\right)^{1-b}\right]. \tag{14}$$

Harmonic decline:

$$G_a = \left(\frac{q_i}{D}\right)\ln\left(\frac{q_i}{q_a}\right). \tag{15}$$

Thus, this work demonstrates the use of principles of system analysis to produce the required optimal algorithm software module for prediction of the rate of decline of production of oil or gas in the energy sector.

The selected algorithm is suitable for prediction of the rate of decline of oil and gas on the basis of real production data of the wells. The algorithm also gives the opportunity to calculate the time of reaching the limit of the flow rate and the accumulated amount of production at the time of reaching the limit debit.