OPTIMIZATION OF EXPERIMENTAL INVESTIGATION OF GASLIFT WELLS

Salahaddin Yusifov

Azerbaijan State Oil Academy, Baku, Azerbaijan, *siyusifov@yahoo.com*

Exploitation of oil production by gaslift method is widely spread. It is causeries with modern development of technique and technology of this exploitation method.

At last time the interest of investigates and practical workers to gaslift extraction method is increased. It is caused by following advantantages: taking large quantity of output,by using any diameter of expatitation column, using of energy of layer gas and avicability of successful exploitation wells with face pressure while is lower than saturated pressure.

As it is known the reliability of obtained dependence $Q(V)$ depends on the quantity of material resources, which are available for using in oil wells investigation. As far as exploitation indexes depend on the wells working mode and the mode depends on the reliability of $Q(V)$ characteristics. The $Q(v)$ is in a great importance for successful exploitations. As a rule the experimental researches in conducted by repeatedly measuring of measure-agent expenditure. The determination of an optimal resource norm can be formulated in the task of minimization of expenses on different work-mode of investigation. The reliability of Q(v) characterizes which is stood by n cutting, can be obtained by the following formula:

$$F\left(Q^*_1, Q^*_2, Q^*_3, \ldots, Q^*_n\right) = P\left\{\left|Q\left(V_i\right) - Q^*_i\right| <= \delta_I, i = \overline{1,n}\right\} = \prod_{i=1}^{n} P_i\left(\left|Q_i - Q_i^*\right| <= \delta_i\right) \qquad (1)$$

where P_i is reliability

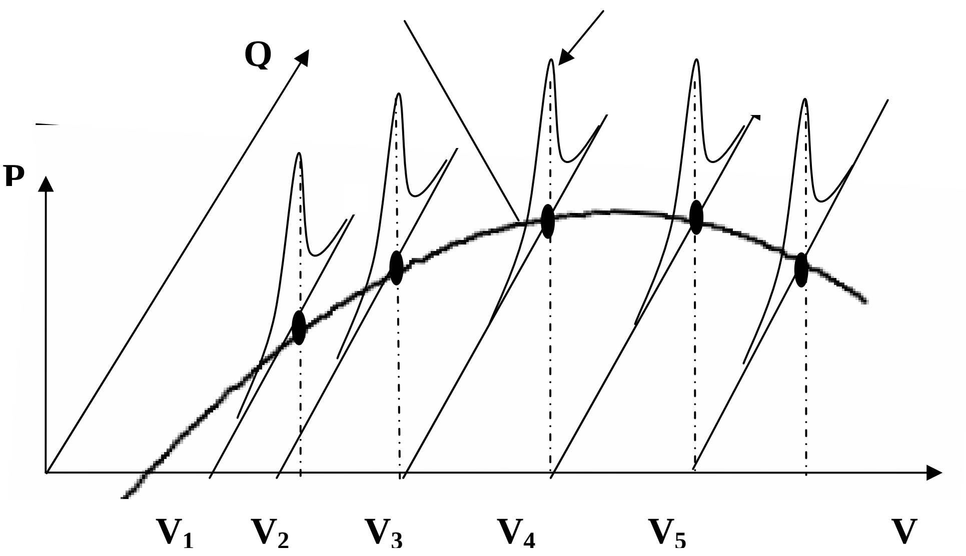

Figure 1. The model of the characteristic of gaslift well

If we have planned the independence measurement on each work-mode paints, then for obtained the Q_i we can use the following averaging formula:

$$Q_i^* = \overline{Q_i} = \frac{1}{m}\sum_{j=1}^{m} Q_{ij}, \quad j = \overline{1,n} \qquad (2)$$

where Q_{ij} is a debit value, which is obtained at i-th work mode on j-th measurement.

The C_i is the cost of the unit measurement at *i*-th work mode. Then the to total cost C of whole investigation is

$$C = \sum_{i=1}^{n} c_i m_i \tag{3}$$

So the general task is to determine the number of measurement m_i in each mode I when the total cost is minimal.

The mathematical model of this task can be represented in the following form:

$$\text{minimize } F(m) = \sum_{i=1}^{n} C_i m_i$$

Subject to

$$\prod_{i=1}^{n} P_i(\left|Q_i - Q_i^*\right| \le \delta_i) \ge P_0, \quad \vee\, m_i - \text{integer}, \tag{4}$$

where P_0 is the given probability. It determines the necessary reliability of $Q(v)$ characteristics.

As it is known the normal distribution describes many random phenomena that occur everywhere, including also measurement processes. Therefore assume that the distribution of measured values defined by normal distribution law.

We can derive a formula of relying probability:

$$P_i\left(\left|Q_i - Q^*{}_i\right| \le \delta_i\right) = \frac{1}{\sigma_i\sqrt{2\pi}} \int_{-\delta}^{\delta} \exp\left[-\frac{\left(Q_i - Q^*{}_i\right)^2}{2\sigma^2{}_i}\right] dQ_i \tag{5}$$

Using Laplace function (ω) to the formula (5) we have:

$$P_i\left(\left|Q_i - Q_i^*\right| \le \delta_I\right) = 2\varphi\left(\frac{\delta_i}{\sigma_0}\sqrt{m_i}\right) \tag{6}$$

where, σ_i is a standard deviation of the debit measurement at *i*-th work mode.

Using equation (6) the math model (4) can be determined

$$\left\{\min \sum_{i=1}^{n} C_i m_i \middle| \prod_{i=1}^{n} \phi(\varepsilon_i \sqrt{m_i} \ge P_0 * 2^{-n}\right\} \tag{7}$$

where, $\varepsilon_I = \dfrac{\delta_i}{\sigma_0}$ and m_i – integer.

So the task of determination of an optimum resource is formulated or the task of integer – statistic programming. To solve this task the algorithm (7) was developed. The basic of this algorithm is a principle of dynamic programming optimality.

Let the experiment is conducted only at the first mode. Then the minimal cost of the experiment will be:

$$f_1(P_0) = \min C_1 m_1$$

Subject to

$$2\phi\left(\varepsilon_1\sqrt{m_1}\right) \ge P_0$$

But considering that the constraint of initial task is a multiplicative function exceeding some level, then all mi must be only positive.

So far the first step m_i must satisfy the following cont…

$$\phi\left(\varepsilon_1\sqrt{m_i}\right) \ge P_0 * 2^{-n} \prod_{i=1}^{n} \Phi\left(\varepsilon_1\right).$$

Let new the experiment be conducted in first and second mode. For this case we designed the minimal cost as $f_2\ (P_0)$.

If there were m_2-conducted measurement at the second mode, them the reliability must exceed.

$$P_0 2^n \prod_{i=1}^{n} \phi(\varepsilon_i)\phi\left(\varepsilon_2\sqrt{m_2}\right).$$

The minimal cost of the first experiment will be

$$f_1(P_0 * 2^{-n}\phi\left(\varepsilon_2\sqrt{m_2}\right)).$$

The minimal cost of second experiment will be C_2m_2.
The minimal total cost of will be

$$f_2(P_0) = C_2m_2 + f_1\left(P_0 * 2^{-n}\phi(\varepsilon_2\sqrt{m_2})\right),$$

where m_2 must satisfy the following constraint

$$\phi\left(\varepsilon_2\sqrt{m_2}\right) \geq P_0 * 2^{-n}\prod_{i=1}^{n}\Phi(\varepsilon_i).$$

By adding the other mode point to the experiment we will obtain the following recurrent function:

$$F_n(P_0) = \{\min C_n m_n + f_{n-1}(P_0 * 2^{-n}\Phi(\varepsilon_n\sqrt{m_n})\},$$

where m_n must satisfy the constraint

$$\phi\left(\varepsilon_n\sqrt{m_n}\right) \geq P_0 * 2^{-n}\prod_{i=1}^{n-1}\Phi(\varepsilon_i).$$

Here $f_n(P_0)$ is the minimal total cost of the experiment for all (n) work-modes C_nm_n-the cost of the experiment at n work-mode.

$f_{n-1}\left(P_0/2^n\,\Phi\left(\varepsilon_n\sqrt{m_n}\right)\right)$ is the minimal cost of the experiment for remainder (n-1) work-mode.

The reliability of, which is more or equal to $P_0 * 2^{-n}\Phi\left(\varepsilon_n\sqrt{m_n}\right).$

On the basis of defined algorithm one develop the application computer program. In this case program the task is solved in two steps:

1. The values of $f_i(P_0)$; $i=\overline{1,n}$ calculated and entered into the tables with corresponding probabilities.
2. From the tables the resulting optimum solution is derived.

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