Indirect Indexes of the Operational Regimes of Gaslift Wells

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Abstract— **As author's opinion, there are different important points to get main formulas and thought about output productivity of oil-lift wells. Necessary information such as the instantaneous relative velocity of change of a production rate was given for wells to find suitable way. Moreover, interval of change of a working substance was explained with concrete numbers in the sheet.**

Keywords— gaslift; wells; operational; regimes

I. Introduction

Both in our republic, and all over the world specific gravity of gaslift oil extraction grows constantly. It puts forward the problem of increasing of the gaslift oil extraction technical-economic indexes. A decision of the estimation problem of gaslift wells operational regimes on the basis of modern information technology is one of the conditions of the achievement to this purpose.

II. Problem Statement

As it is known, the relation of a production rate of wells (Q) from injected agent (V) is the basic performance of a gaslift wells, on which one the applicable operational mode is established [1].

It was shown in [2] that using the natural logarithm is reasonable during the approximation of the Q(V) curve. 22 years later the expediency of logarithmic expressions was noted in works of western scientists [3].

In [2] this characteristic have been expressed as:

$$Q=\beta_0+\beta_1\ln V+\beta_2(\ln V)^2, \tag{1}$$

where β_0, β_2, and β_2 are the coefficients, which characterize the gaslift well and are defined on the base of experimental data investigation.

On the basis of an external characteristic Q(V), except for the determining of characteristic operational modes of well described in [2], it is possible to find some derivative parameters, on which one matching separate current and integral operational modes of gaslift well implements.

The main derivative characteristic of the gas lift well is the specific consumption of a working agent, which is determined in view of the logarithmical-parabolic relation Q (V) under the formula:

$$R(V)=\frac{V}{\beta_0+\beta_1\ln V+\beta_2(\ln V)^2} \tag{2}$$

It is possible to offer output productivity of gas-lift well corresponding to the flow rate of well, to the extracted oil, applicable to the quantity, on unit of the consumption of a working agent, which is discovered as an inverse function from R (V), i.e.

$$\Pi\ (V)=R^{-1}\ (V)=\left[\beta_0+\beta_1 \ln V+\beta_2\ (\ln V)^2\right]/V\ . \tag{3}$$

III. Problem Decision

At the solution of the distribution problem of the consumption of working agent between wells there is a necessity for consideration of speed of change of a production rate, equal tangent of slope of touching line angle to the characteristic Q (V). The speed of change of a production rate is one of indexes of relation Q (V), which one is determined by the value of a gain of a production rate, at minor increase of the consumption of the working agent, i.e.

$$Q'\ (V)=\ (\beta_1+2\beta_2 \ln V)\ /V\ . \tag{4}$$

The specific consumption of a working agent on a production rate of oil is determined as the reverse value of the speed of change of a production rate:

$$R^*\ (V)=\frac{dV}{dQ}=\ (Q'\ (V)\ )^{1}=\frac{V}{\beta_1+2\beta_2 \ln V}\ . \tag{5}$$

The optimal value of a production rate at the given consumption of a working agent corresponds to the tangent α of teaching line of the characteristic Q(V). It is reached in a point V, when the section connecting an origin to the schedule (chart) Q (V), has a maximum slope (tilt). In view of a differentiability of a function Q (V) in this point is satisfied condition:

$$\underline{V}=exp\left[1-\beta_1\ \ /2\beta_2-\sqrt{(\beta_1-2\beta_2)^2-\beta_0/\beta_2+1}\right]$$

$$\overline{V}=exp(-\beta_1/2\beta_2)/$$

It is difficult to show, that the optimal distribution of a working substance between in bridge working wells is provided at equaling of relative incremental, i.e.

Q ' (V) =Q ' (V2) =… =Q ' (Vn),

R * (V1) =R * (V2) =… =R * (Vn).

This circumstance is necessary in the basis of designed algorithm of the optimal reallocating of a working substance.

The instantaneous relative velocity of change of a production rate is determined as follows:

$$\frac{Q'(V)}{Q} = (lnQ)' = \frac{\beta_1 + 2\beta_2 lnV}{V\left[\beta_0 + \beta_1 lnV + \beta_2 (lnV)^2\right]}. \quad (6)$$

The factor of flexibility is determined as a limit of individual (private) relative incremental and demonstrates percent of a gain (increment) of a production rate at increase of argument at 1 %:

$$Э(V) = (lnQ)'/(lnV) = \frac{V}{Q}Q'(V) = = R(V)Q'(V) = \frac{\beta_1 + 2\beta_2 lnV}{\beta_0 + \beta_1 lnV + \beta_2 (lnV)^2}. \quad (7)$$

Convenient of the formulation of a derivative parameter (index) Э (V) is connected to abundance in trade practice of a -percent (relative) way of an estimation of changes of a mode and matching of these changes.

On the basis of data processing of well data 1573 Oil and Qas Extraction Enterprise "«SurahanOil" the factors of an approximating function Q (V) are obtained:

B_0 =-7420,79 b_1=1532,37 b_2 =-78,40.

Under these data the values of offered derivative parameters (indexes) for different modes are determined, which one are submitted (shown) in the table I. Here interval of change of a working substance is determined outgoing from necessity of cover (coating) of an interval of permissible modes, boundary values which one pursuant to make V = 12210,7; V = 17555,3 m/day.

TABLE I. THE VALUES OF OFFERED DERIVATIVE INDEXES

V, m^3/ day	R (V), m^3/т	П (V) $*10^{-2}$ т/m^3	Q ' (V) $*10^{-2}$ т/m^3	R * (V), m^3/т	(lnQ (V)) '* *10-4	Э (V)
12000	214,66	0,47	0,50	201,24	0,39	1,07
13000	216,05	0,46	0,36	276,13	0,60	0,78
14000	221,41	0,45	0,25	394,81	0,40	0,56
15000	229,69	0,44	0,16	608,72	0,25	0,37
16000	246,36	0,42	0,09	1101,77	0,14	0,22
17000	253,12	0,40	0,03	3389,08	0,04	0,07
18000	267,89	0,37	-0,02	-4561,25	-0,03	-0,06

IV. CONCLUSION

As it is visible from the table, in a point an extreme of a curve Q (V), i.e. at V=$\overline{V}$ the parameters Q (V) and R* (V), (lnQ)' and Э (V) are intercepted by axes of an abscissa, that testifies to an output of a mode from permissible area in the party of increase. Besides the indicated relations numerically characterize the main parameters in different operational modes permitting messages a comparative estimation of operational modes of individual wells.

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