An asymptotical method for determining hydraulic resistance coefficient of gas-lift process

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Abstract: A mathematical model in oil production is formulated to determine the coefficient of hydraulic resistance [1], during the motion of the gas-liquid mixture in the lift. As it is known, the motions of the gas and gas-liquid mixture in the tubes are described by the system of partial differential equations of hyperbolic type in the asymptotic case [2]:

$$\begin{cases} \frac{\partial P}{\partial t} = -\frac{c^2}{F}\frac{\partial Q}{\partial z}\varepsilon, \\ \frac{\partial Q}{\partial t} = -F\frac{\partial P}{\partial z}\varepsilon - 2aQ, \end{cases} \tag{1}$$

where the parameters in (1) defined as [3]. Applying the lines method, we obtain from (1)

$$\dot{x} = (A_0(\lambda_c) + A_1\varepsilon)x + B\varepsilon u + V\varepsilon,$$

with initial condition $x_0 = [P_1^0, Q_1^0,\ P_2^0,\ Q_2^0]'$. It is required to minimize the functional

$$f(\lambda_c) = \sum_{i=1}^{N}\left[\tilde{Q}_2^i - Q_2^i\right]^2.$$

On a concrete example the comparison of the values of the obtained hydraulic resistance coefficient with the statistical value of hydraulic resistance is given. It is shown that they differ from each other to the order 10^{-3}.

Keywords: gas-lift, the coefficient of hydraulic resistance, lines method

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