Numerical solution of the multiphase one dimensional model of gas lift process

Nurlan TEMIRBEKOV [1], Amankeldy TURAROV [1]

[1] *Department of Higher Mathematics, East Kazakhstan State Technical University, Ust-Kamenogorsk, Kazakhstan*
E-mail: temirbekov@rambler.ru, t010183@gmail.com

Abstract: Study of the processes of field development is of great practical importance in the oil and gas industry due to the increasing need to improve production methods. A very large number of works is dedicated to the mathematical modeling of these processes [1–3]. We consider and conduct a numerical simulation of a one-dimensional model of gas-lift process, where the movement in gas-lift well is described by partial differential equations of hyperbolic type. Difference schemes for the gas-lift model of the process on a non-uniform grid condensing near the boundaries of subdomains with gas, liquid and a gas-liquid mixture are developed.

In this paper, the mathematical model of gas lift wells is developed. A one-dimensional model of gas-lift wells is examined in which it is assumed that the flow is two-phase and isothermic in the annular portion and in the well. The system, which describes the process under study, consists of the equations of motion and continuity equations of thermodynamic state, concentration, and hydraulic resistance. At the interface, matching conditions for pressure, velocity and concentration are set that allows to obtain a formula for determining the density of the liquid phase in an explicit form. Finite-difference scheme on adaptive non-uniform grid condensing on the boundaries of the gas, liquid and liquid-gas phase, is developed. When building a grid, cubic spline function is used. The results of the proposed algorithm is illustrated by the example of a real well.

Keywords: gas lift process, multiphase flow, finite difference method, numerical solution

2010 Mathematics Subject Classification: 47.85.Dh

References

[1] Aliev, F.A. and Ilyasov, M.H. and Dzhamalbekov, M.A., "Simulation of gas lift wells", *Izvesitiya AN SSSR*, Vol. 4, pp. 107–116, 2008.

[2] Shurov, V.I., "Technology and engineering oil", *Moscow, Nedra*, pp. 510, 1983.

[3] Barashkin, R.L., "Development of models and algorithms for operation of gas-lift well as the object of an operational management system", *I.M. Gubkin Russian State University of Oil and Gas*, pp. 152, 2011.