■ **B.M. Mardonov** - Tashkent institute of textile and light industry, Tashkent, Uzbekistan, email: batsam@list.ru, **S.S. Amanov** - Tashkent institute of textile and light industry, Tashkent, Uzbekistan, email: batsam@list.ru, **L.A. Khajiyeva** - Al-Farabi Kazakh National University, Almaty, Kazakhstan, email: khadle@mail.ru

Numerical Simulation of Nonlinear Oscillatory Processes in the Columns in Drilling Oil and Gas Wells

Abstract

Non-stationary vibrations of geometrically nonlinear distributed systems are complicated problems of mechanics of a deformable solid body and the theory of vibrations. Study of these problems revealed a number of not sufficiently explored problems which comprise physically and geometrically nonlinear ones accompanied with different types of failures (loss of stability of columns, breaks of pipes, etc.), wave and oscillatory processes in elements of a drilling dynamic system (DDS). A torque from the engine and repeatedly changing loadings when drilling with chisels of the cutting type, axial stretching loadings from the drilling rig and squeezing loadings accompanied with vibrations during the work of a chisel in the well bottom can be sources of dynamic impacts on a column. Behaviour of the column at different dynamic loadings greatly depends on dynamic characteristics of the column design, its frequencies and modes at longitudinal, torsional and lateral natural vibrations. Questions of dynamics and stability of a drilling column, and ways of their realization in practice are investigated sufficiently in literature. In particular, it was revealed that impact of a torque on behaviour of a column is determined not by its magnitude, but by the possible changing nature of deflection of a column from the state of static balance. Thus, a twisted column does not lose stability due to the static bending. It depends on the type of a flutter when the energy brought to a column is transformed to energy of transverse oscillations with amplitude growing with time.

Theoretically the drilling column is to be considered as a nonlinear mechanical system with an infinite number of degrees of freedom. At the same time there is no analytical method to research work dynamics of such a system and hence, to estimate the influence of oscillations on its durability and stability when drilling.

In this work the behaviour analysis of the system of geometrically nonlinear pipes of drilling columns is carried out under dynamic effects; numerical realization of the finite element method for solving the corresponding boundary problems is offered. Considering the pipes as beams, we obtained the expression for energy at bending and compression taking into account strain geometric nonlinearity. Beam modes in the transverse direction are presented through cubic Hermite polynomials. There was obtained the system of second order nonlinear differential equations with respect to time for deflections and turning angles of the knots. It was revealed that for the same system of loading there exist stable and unstable strain states if the strain geometrical nonlinearity of a column takes place. Nonlinearity of a pipe can significantly change the nature of oscillatory processes in the transverse direction of the bar motion. As calculations show, there is symmetry breaking in bar buckling that might lead to the loss of stability. It can occur at the sharp braking realized at high values of parameter of nonlinearity. Thus, the probability of transition to the instability state in initial time moments decreases.