MATHEMATICAL MODELING OF THE DRILL STRING BENDING ELASTIC CHANNEL CURVILINEAR OIL AND GAS BOREHOLES

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Аннотация

Using the theory of curvilinear flexible rods, the problem of elastic bending of drill strings in the channels of curvilinear boreholes with geometric imperfections of their axial lines when performing the drilling operation is posed. The improved mathematical model of non-linear elastic deforming of drill strings in the channels of curvilinear boreholes is created. In the model, the stiffnesses in bending, inhomogeneous gravity forces as well as forces of contact and friction interaction of the drill columns with the bore-hole wall are taken into consideration. On the basis of usage of a specially chosen movable reference frame, the simplified constitutive equations are elaborated. They differ by absence of singularities connected with transformation of the radii of curvature and twist into infinity.

Through the use of computer simulation methods the problems about determining the resistance forces and moments in performing lifting-lowering operations are solved. The investigation of the forces sensitivity to the bore-hole trajectory shape is carried out.

The problems about modeling of elastic bending and origin of critical states for drill strings in curvilinear bore-holes with spiral and cosinusoidal imperfections are solved. To the consideration were taken lower fragments of wells, the axial line of which is conventionally straight and inclined to the horizontal plane at an angle, as well as whole composite wells, consisting of the upper curvilinear section and the lower conditionally rectilinear. In both cases, it was considered that geometric imperfections in the form of a circular cylindrical spiral or flat harmonic with the same values of their amplitude values and wavelengths were imposed on straight lines on the axial line. The diapasons of geometry and imperfection parameters corresponding to favorable and unfavorable regimes of functioning are found; their critical values corresponding to the drill columns sticking are calculated.

Ключевые слова

Ключевые слова автора: drill string; curvilinear bore-hole; direct and inverse problems; geometric imperfections; internal and external forces

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