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MATHEMATICAL MODEL OF PLACED CURRENT OF AN INCOMPRESSIBLE VISCOUS LIQUID IN CYLINDRICAL PIPES HAVING HELICAL INSERTS

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In many works the mathematical models of mechanics of a liquid and gas in cartesian, cylindrical and spatial polar coordinates are esteemed. However in a number of cases there is convenient formulation of a problem in curvilinear non-orthogonal coordinates.

There are many ways of twisting of flows. For example, twisted tubes are simple and convenient means permitting to give to a fluid flow rotary motion and by that to promote to processes of intensification of heat- and a mass-transfer. Besides the twisting of a flow can be realized with the help of helical inserts arranged as on center, and on perimeter of a channel.

The R-functions method usage gives unique capabilities for coprocessing the analytical and geometrical information during mathematical modeling. With the R-functions theory the normalized equations of channels having helical inserts are constructed. The metric tensor is constructed. The Christoffel characters and basic differential operators (gradient, divergence, curl, Laplacian) are constructed with the help of a tensor analysis. The Navier-Stokes equation and continuity of motion one in curvilinear non-orthogonal coordinates are obtained. For definition of pressure profile in a liquid on a known velocity distribution the Neumann problem for a Poisson equation is formulated. For cylinders with helical inserts of infinite length with uniform cross section the 3D problem is reduced to 2D. The numerical implementation was conducted by R-functions method and Ritz one. The calculations of tangential component of speed and radial pressure gradient are conducted also.

Thus, at placed current the picture of a field of allocation of speeds does not vary from a cut to a cut, and only turns on a corner αz around the axis Oz. It was possible to reduce the 3D task formulated in a curvilinear non-orthogonal coordinate system to 2D one for one vector component. In summary it is necessary to mark that at increase of a corner of a curling the modification of allocation of axial speed happens. The process of the tangential components of velocity vector formation is watched also. All problem solvings were conducted with the POLYE system, which was developed in Podgorniy's Institute for Mechanical Engineering under the direction of Acad. V.L. Rvachev and SAGE system, which was developed in University of Wisconsin-Madison under the direction of Prof. V. Shapiro. The visualization of 3D surfaces was conducted with the RANOK system, which was developed in Zaporozhye State University under the direction of assistant professor A.V. Tolok.

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