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Features of the dynamics of a non-Newtonian fluid to ensure flight safety

For the production of aircraft parts, equipment is widely used in which the flow occurs in a doubly connected region, i.e. slotted cylindrical gaps, in which the fluid flows in a magnetic field.

Investigation of the flow of non-Newtonian fluid at the hydrodynamic initial section under the action of an electromagnetic field.

Examples of such equipment are machines for producing polymer films, coatings, tubular products. The most important task in the design of such equipment is to determine the size of its working elements and hydrodynamic parameters of the flow taking into account the rheological properties of the flow and taking into account the rheological properties of the material, which is also related to calculating technological features of the process. Depending on the kinematics and dynamics of the flow in the gaps between the cylindrical surfaces, the calculation of both the temperature parameters of the flow and the residence time of the material in the working areas of the forming equipment is usually performed. This is especially important for those areas where the motion is unstabilized and act in addition to the forces of viscous friction, the forces of inertia from convective acceleration. In the absence of taking into account such features of the channel may be the phenomenon of destruction of polymeric materials or elastic turbulence, which leads to a lack of products. In this regard, the urgent problem is the problem of physical and mathematical modeling of this type of laminar isothermal flows with the subsequent development of recommendations for correct design.

The purpose and objectives of the study. The aim of this work is to solve the scientific problem of improving the methods of hydrodynamic calculation of the flow of viscous and anomalous viscous fluid moving in a magnetic field in the working elements of the forming equipment, taking into account both rheological properties of the fluid and inertial forces from convective acceleration and increase the efficiency of its work.

To achieve this goal in the dissertation the following tasks are set and solved:

The analysis of existing constructions of forming equipment is carried out and it is found out under what circumstances the forces of inertia from convective acceleration and their influence on a hydrodynamic initial site under the influence of a magnetic field play an important role in hydraulic calculations.

A mathematical model has been developed to determine the kinematic and dynamic characteristics of the flow of anomalous viscous fluid at the initial section of a cylindrical slit gap.

Rheological researches of the used liquids which with certain accuracy model real melts of polymeric materials are carried out.

Physical modeling of flow hydrodynamics under the influence of inertial forces from convective acceleration is carried out, on the basis of which the results on velocity distribution for liquids of Ostwald de Ville type are obtained.

The dependences for the distribution of energy losses at the initial section of the isothermal flow are determined. For the first time, a method for calculating the length of the initial section for slotted cylindrical gaps and kinematic parameters based on physical and mathematical modeling is developed.

Object of study - unstabilized hydrodynamic processes during the flow of anomalous - viscous fluid in cylindrical gaps in a magnetic field.

Subject of research - kinematic and dynamic characteristics of the unstabilized flow of anomalous - viscous fluid at the initial section during flow in an electromagnetic field.

Research methods - The conducted research methods are based on the analysis and scientific generalization of scientific sources, which allowed to substantiate the relevance of the scientific problem and to formulate research tasks. Mathematical and physical modeling of unstabilized flows in cylindrical gaps is carried out taking into account certain boundary and initial conditions, modern methods of studying the kinematic characteristics of the flow based on the Doppler effect are used. The results of theoretical research were compared with experimental data.

Conclusion

In this work the improvement of the existing methods of hydraulic calculation of the parameters of the unstabilized flow is carried out, namely:

1. A model of laminar unstabilized flow in slit gaps is developed.
2. For the first time methods of experimental research of kinematic and dynamic characteristics of a stream in slotted cylindrical backlashes with use of a modern method of laser Doppler anemometry are developed.
3. The obtained characteristics of the flow and the factors influencing them.
4. New scientifically substantiated methods of calculation of hydrodynamics of a stream of anomalous - viscous liquid in the forming tool are offered.

The practical significance of the results. The results of the presented study provide an opportunity to develop more efficient technological modes of processing of polymeric materials in the molding equipment. The proposed methods and calculations can be used not only in the field of chemical engineering but also in other areas such as thermal power, metallurgy where it is important to predict the parameters of the flow in its unstabilized flow

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