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Summaries
7

Microsymposium on Engineering Rheology
Fluid Flow • Mixing • Fludization
Particulate Solids
Mechanical Separations

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G5.2

Pressure characteristic with non-isothermal flow of high-viscosity liquids in circular confuser

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Melts of some thermoplastic polymers within the alteration of processing parameters are alike high-viscosity Newtonian liquids with Arrenius dependence of viscosity on temperature $\mu(T)=\mu_0\exp[E/R(1/T-1/T_0)]$, where $\mu_0 \approx 10^3 Pa\cdot s$, $E\approx(10^5...2.7\cdot10^5)\ J\cdot mol^{-1}$, $T_0 = 463°\ K$, $R=8.31\ J\cdot mol^{-1}K^{-1}$ [1], their flow takes place in condition of the big gradients of the temperature and viscosity in consequence of sharp viscosity - temperature dependence. Therefore it is necessary with investigation of such fluid flows to take into account both dissipation and heat exchange at boundary of confuser.

To solve this conjugated problem the region of flow is separated into N concentric conical layers in confuser and it is assumed that viscosity over cross-section of each layer is constant and equal to one taking for average temperature over cross- section of this layer. Owing to this method the set of equations of motion and heat transfer is reduced to the set N+1 ordinary differential equations for the mean temperatures in layers and mean pressure and analytical expressions for components of velocity, dissipation function and heat transfer coefficients between layer.

The effects connected with the dissipation of mechanical energy become dominated on some distance from entrance. It carries out to appearance of small viscosity high-temperature shear layer and to the pressure gradient which is considerably less than pressure gradient for isothermal flow. Basis behavior of pressure- volumetric flowrate characteristic can be seen in flow with adiabatic wall of the channel. On small flow rate the pressure distribution along the channel is distinguished a little from isothermal distribution therefore pressure characteristic is linear here (Fig.). With increase of flowrate the small viscosity layer appears at the exit from confuser in consequence of mechanical energy dissipation. The pressure gradient on the exit is considerably decreased in comparison with the isothermal that leads to nonlinear pressure drop - flowrate dependence (Fig.).

The small viscosity shear layer will be extended on more and more part of confuser with further increase of flow rate and the dependence $\Delta P(Q)$ will be distinguished more and more from linear (Fig.). For confusers with small angle of opening high-temperature shear layer will have been extended almost on all confuser beginning in some flow rate. It means that high - temperature flow with small pressure gradient has appeared in the channel of confuser. The pressure drop for this flow is decreased beginning with the some flow rate and pressure characteristic with the flow of melts of thermoplastic polymers is non-monotonous (Fig). It is necessary to note that all presented dependencies are only for steady-state flow. Pressure drop - flowrate dependence was investigated for different intensity of heat exchange with ambient too.

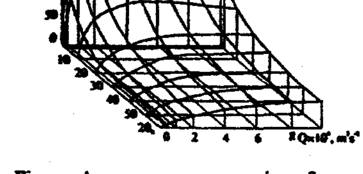

Figure. Average on cross- section of confuser pressure drop vs. flowrate Q and angle of opening of confuser $2\theta_0$.

REFERENCES: 1. Ponomarenko V.G., Potebnya G.F., Uliev L.M., Zhitinkin A.A., Olkhovikov O.A. // *Inzh.-Fiz. Zh.*,(Minsk). 1990. Vol. 59, No. 1. P. 158-159.