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Laminar heat transfer in the constant width coaxial conic channels

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In the last years great interest is shown in polymer melts flow and heat transfer in the channels of the forming arrangement in connection with the incremental polymer production. A large number of the apparatus for continuous extrusion have the coaxial conic channels through which the polymer melts are pressured. Isothermal slow flow of the Newtonian polymer melts in the coaxial conic channels was investigated in the paper [1] by the author. The laminar heat transfer in such channels is studied in the presented paper.

The problem of laminar heat transfer is formulated with the help of the heat transfer and flow parameters estimation and it is solved both for confuser and diffuser flows with boundary conditions of the first and third kinds. The solutions were received with the help of eigenfunction expansion method in the biconical co-ordinates. In case of the first kind boundary conditions the results are presented both for constant boundary temperatures and for ones varying along the flow. The solutions are received both taking into account the viscous dissipation and without dissipation.

The approximation expressions for determination of the thermal entrance length is obtained in this paper both for confuser and diffuser flow too.

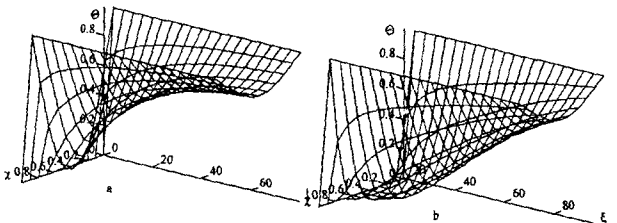

Fig. 1. Dimensionless temperature distributions: (a) – for confuser flow; (b) – for diffuser flow.

It is interesting that for the first kind boundary conditions the solution is superposition of two solutions, each of them has its own eigenfunction and eigenvalues. The solution has one set of eigenfunctions only for equal in absolute value boundaries temperatures.

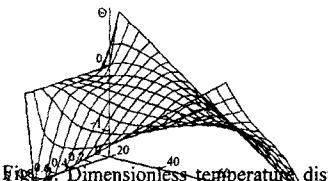

Fig. 2. Dimensionless temperature distributions for diffuser flow with the different varying of the boundary temperatures.

Dimensionless temperature distributions are represented on fig. 1 for the case of the boundary conditions of the first kind and for confuser flow – (a) and for diffuser flow – (b) with the equal remaining parameters, but on fig. 2 for diffuser flow with the different varying of the boundary temperatures.

REFERENCES: 1. Ulyev L.M. Slow flow between coaxial conic surfaces // *Inzh.- Fiz. Zh.*, (Minsk). 1998. Vol. 71, No. 6. P. 1092-1098.