
Modeling of convective heat transfer in prismatic channels of different cross section geometry

© N.V. Kiryukhina¹, A.K. Gorbunov², N.A. Silaeva²

¹ Kaluga State University named after K.E. Tsiolkovsky, Kaluga, 248023, Russia

² Kaluga Branch of Bauman Moscow State Technical University, Kaluga, 248000, Russia

The article describes a mathematical model of heat transfer in developed laminar flow in prismatic channels of rectangular and triangular cross-sections, including the equation of fluid motion and the energy equation with boundary conditions of the second kind on the channel walls. The analytical solutions for the velocity field have been derived from the equations of liquid motion. Solution of the energy equation has been obtained by numerical method of finite differences. The computational algorithm was based on the difference scheme approximating the boundary value problem, based on five-point pattern. This algorithm implements programs allowing calculation of the velocity and temperature fields in the channels and determination of the local and average heat transfer characteristics. In future we plan to build an algorithm and to develop a program for the numerical solution of the problem of convective heat transfer in channel of more complex geometry with projections on the walls.

Keywords: convective heat transfer, mathematical modeling, finite difference method.

REFERENCES

- [1] Loytsyanskiy L.G. *Mekhanika zhidkosti i gaza* [Fluid Mechanics]. 5th ed. Moscow, Nauka Publ., 1978, 736 p.
- [2] Mikheev M.A., Mikheeva I.M. *Osnovy teploperedachi* [Fundamentals of Heat Transfer]. 2nd ed. Moscow, Energiya Publ., 1977, 344 p.
- [3] Dulnev G.N. *Teoriya teplo- i massoobmena* [Theory of Heat and Mass Transfer]. St. Petersburg, Reseach University ITMO Publ., 2012, 194 p.
- [4] Fletcher C.A.J. *Computational Techniques for Fluid Dynamics*. London, et al., 1988. [Russian edition: Fletcher C. *Vychislitelnye metody v dinamike zhidkostey. Tom 1: Osnovnye polozheniya i obshchie metody* (Computational methods in fluid dynamics. Vol. 1: Fundamentals and general methods) Moscow, Mir Publ., 1991, 504 p.].

Kiryukhina N.V. graduated from Kaluga Pedagogical Institute named after K.E. Tsiolkovsky. Ph.D., assoc. professor of the General Physics Department at Kaluga State University named after K.E. Tsiolkovsky. Research interests: Thermal physics, physics teaching theory and methods. e-mail: natakir21@gmail.com

Gorbunov A.K. (b. 1947) graduated from Moscow Institute of Physics and Technology. Dr. Sci. (Phys.&Math.), head of the Physics Department at Kaluga branch of Bauman Moscow State Technical University. The author of several articles on condensed matter physics. e-mail: kf_mgtu_fiz@mail.ru

Silaeva N.A. (b. 1968) graduated from the Kaluga Pedagogical Institute named after K.E. Tsiolkovsky. The senior lecturer of the Physics Department at Kaluga branch of Bauman Moscow State Technical University. The author of several articles on strength characteristics of the material properties. e-mail: silseva1968@list.ru
