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SIMULATION OF FLUID MOTION IN A TUBES OF DIFFERENT CROSS-SECTIONS

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The geometry of heat exchange elements is a very important factor that significantly affects the parameters of convective heat transfer. Selection of optimal and rational geometric parameters of heat exchange elements, as a rule, is carried out experimentally. As a result of experimental research, a sample of significant factors and physical quantities are selected, which allow to determine the coefficients of the Nusselt criterion equations to determine the heat transfer parameters. The methodology described above is a rather complex, time-consuming and expensive process [1]. The alternative is a modeling using computer-aided design (CAD) systems. The use of such systems reduces the cost of resources for the production and conduct of pilot studies.

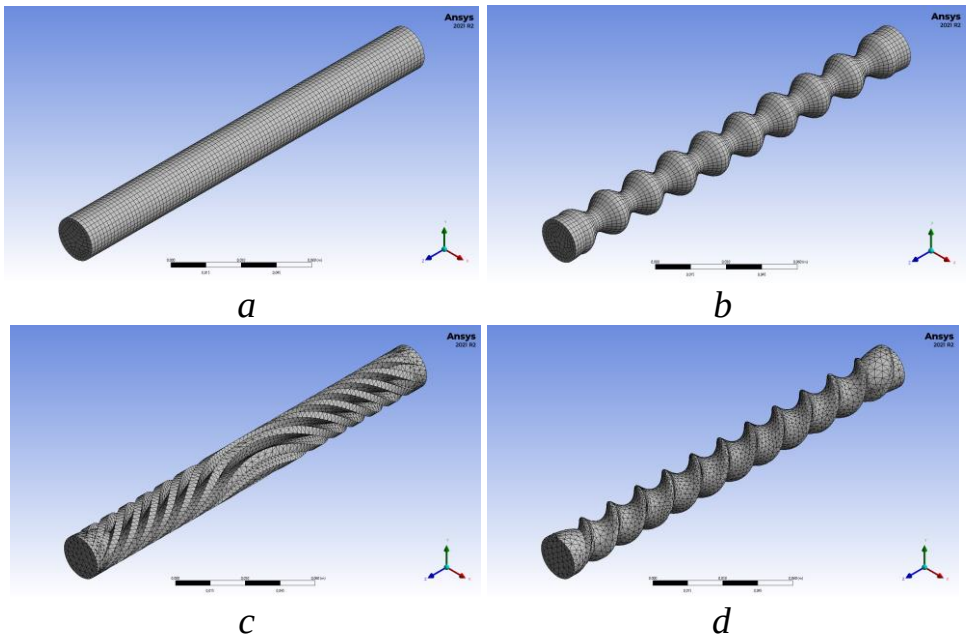

Fig. 1 Scheme of geometry of heat exchange tubes: a – round cross-section, b – spherical cross-section, c – star-reversible cross-section, d – helical cross-section

Features of the cross-sectional shape of the channel through which the fluid moves affects the change in its velocity and in turn can change the mode of flow from laminar to turbulent. Turbulence of the coolant flow has a positive effect on the efficiency of heat transfer. This study demonstrates a comparative analysis of the results of computer simulation of fluid motion in the channel of a tubular heat exchange element of different cross-section (Fig. 1).

Using the universal software system for finite element analysis ANSYS, the movement of fluid in pipes of different cross-sections was simulated. The contours of the velocity distribution and the trajectory of the fluid motion are obtained (Fig. 2).

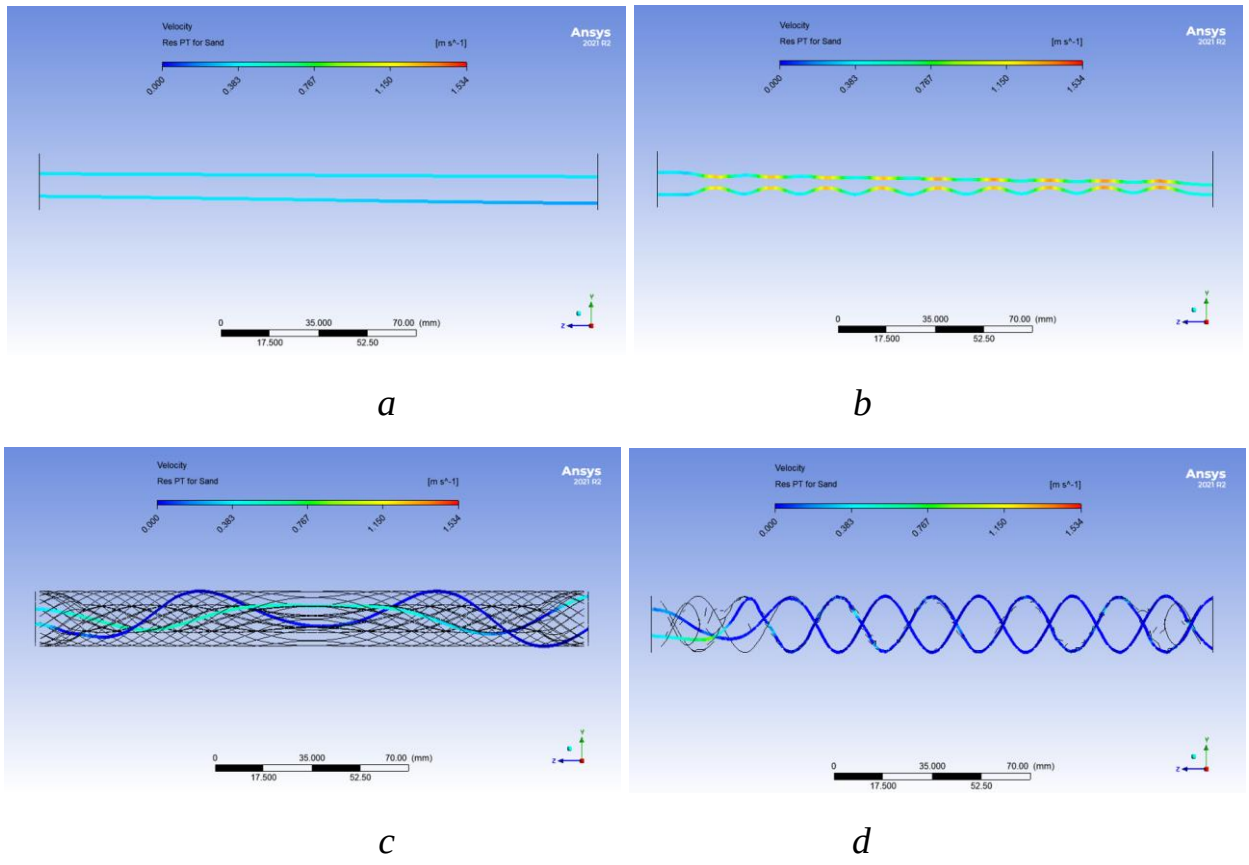

Fig. 2 Velocity trajectory of liquid points in a pipe: a - round cross-section, b - spherical cross-section, c - star-reversible cross-section, d - helical cross-section

The analysis of the simulation results allows to qualitatively estimate the turbulence of the coolant flows and to quantify the fluid flow velocities. Estimation of parameters of heat exchange process by means of CAD deserves special attention and is one of perspective directions in designing of heat exchange equipment.

References:

1. Kostyk, S.I., Shybetskyi, V.Yu., Plashykhin, S.V., Bykoriz, Y.O. Determination of heat transfer efficiency in the conditions of forced convection from pipes with special ribs. TTPE. 2021. 43. P. 21–29.