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Short Communication

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Simulation Of Flow And Heat Transfer In Pipes With Surface Turbulators At Cross-Sections In The Frame Of Square (S/H=1) And Edge (S/H<<1) On The Basis Of Low-Reynolds Menter Theory

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The study of the structures of the turbulent flow was mainly carried out by experimental methods, while the current computational studies on this topic are quite few and only partially devoted specifically to the structure of intensified flows; in part of the methods (for example), an integral approach to the problem under consideration is mainly used [1,2].

This report is directly devoted to the study of flow structures in pipes intensified by surface periodically installed projections with a cross-section in the form of an edge in a comparative analysis with turbulators of square cross-section.

The main goal is to theoretically investigate the vortex zones formed for a pipe with protrusions of square and rib-like cross sections using factorized finite-volume methods (FCOM), which were successfully tested in the calculations of similar flows in, where the calculations of the parameters of the averaged intensified flows and heat exchange were mainly considered[2].

The calculation of streamlines for tubes with transverse annular baffle having a cross section in the form of a rib (s/h<<1, where s is the width of the baffle height of baffle) for the considered range of the governing parameters (Re=104÷105; Pr=0,72÷10; d/d=0,95÷0,90; t/D=0.25÷1,00) is based on the fact that earlier in the result, for example in, numerical calculations were obtained for local and integral characteristics of flow and heat transfer in straight circular pipes round and square turbulence with reduction of corresponding streamlines[2].

Characteristic calculated current lines were constructed for pipes with surface turbulators with cross sections in the form of a square (s/h=1) and in the form of an edge (s/h=0.15) for the above flow conditions.

Obtained in this study for nischalananda model calculated data on heat transfer and hydrocortisone for the conditions of Re=104; Pr=0.72; the d/d=0,98÷0,90; t/D=0.25 for the turbulators in the form of a square, and edges with s/h=0,15 showed that the transition from the square to the edge is the increase of hydraulic resistance and heat transfer: ξP/ξΠ=101,5%; PIR/PIP=of 100.75% for low turbulence and ξP/ξΠ=138,5%; PIR/PIP=105,5% for high turbulence (ξP/ξΠ, Peer/Peep (ξ —coefficient of hydraulic resistance; Nu — Nusselt number; indices: "N" — rectangle, "P", — edge)).

For higher Reynolds numbers, all other things being equal (Re=105; Pr=0.72; d/D=0.98÷0.90; t/D=0.25), the corresponding data will be as follows: ξp /пр=109.0%; Nup/Nup=104.3% for low turbulators and ξp /пр=155.2%; Nup/Nup=107.9% for high turbulators.

Similar data of large Reynolds numbers Pr=10, other things being equal, the analysis of which allows us to come to the following conclusions: the decrease in the values of PR/NP with an increase in the Prandtl number from 0.72 to 10 for relatively low turbulators is about 1%; for relatively medium (d/D=0.95÷0.93) — about 2%; for relatively high-about 6%.

In conclusion, we would like to add that local and averaged parameters of flow and heat exchange in pipes with surface flow turbulators with a cross-section in the form of an edge (s/h=0.15) were obtained for a wide range of determining parameters (Re=104÷105; Pr=0.72÷10; d/D=0.98÷ ÷0.90; t/D=0.251.00); for comparison, similar parameters were calculated for turbulators of square cross-section (s/h=1).

In practical terms, the method allows to improve the weight and size, power, hydraulic, temperature, etc. indicators of heat exchangers and heat exchangers of modern aviation and rocket and space production.

References

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