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THE STRUCTURE OF SEPARATED FLOW AND HEAT TRANSFER IN A ROUND TUBE WITH SINGLE DETACHED DIAPHRAGM

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Results of numerical study of the flow structure and turbulent heat transfer in a round tube with one diaphragm of height ***h*** and some clearance ***c*** between the tube and diaphragm are presented. The clearance between the diaphragm and tube wall was varied within ***A*** = *c/h* = 0 ÷ 0.33 (Fig.1).

Calculations were performed in the framework of the model of incompressible liquid based on a system of stationary Reynolds averaged Navier-Stokes and energy equations (RANS). The main instrument of this study is universal computational complex FLUENT. The problem statement is two-dimensional; the flow is stationary and axisymmetric. The turbulence model k-ω SST is chosen as the most appropriate for calculation of detached flows. The Reynolds number calculated by the tube diameter and mean-mass velocity was constant Re = 27500.

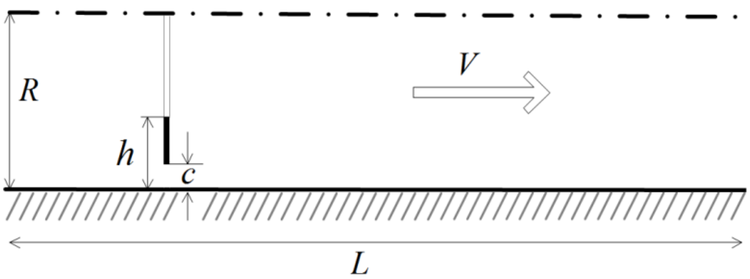

Fig. 1. The scheme of computational domain

It is shown that the near-wall jet formed in a clearance deforms the detached flow behind the diaphragm. With the large scales of the jet (A > 0.2) reattachment of the flow does not occur. Due to destruction of the recirculation zone, the level of kinetic energy is decreased and carried away downstream.

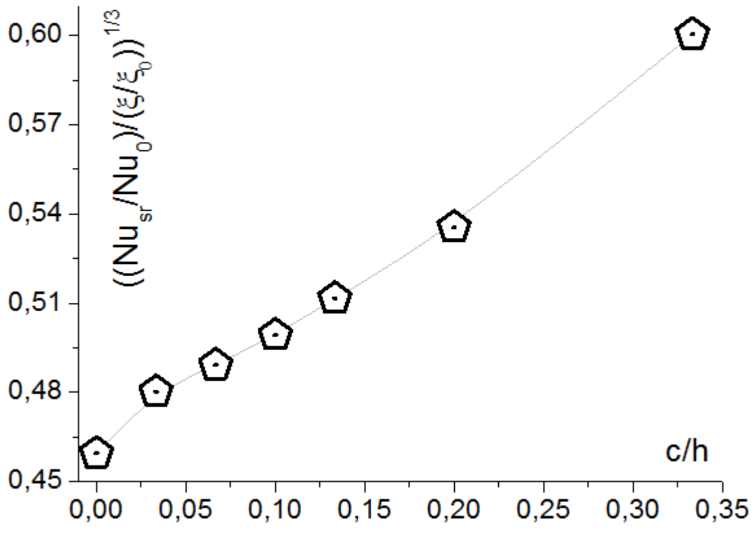

Fig. 2. Thermal enhancement factor

It is determined that a rise of a distance between the diaphragm and tube wall reduces maximal heat transfer significantly.

The integral characteristics demonstrate that for clearance *c/h* = 0.033 and 0.067, heat transfer is enhanced due to an increased heat removal on the tube wall under the diaphragm.

The pressure losses are reduced by the factor of 3 at a change in the size of near-wall jet from *c/h* = 0 to 0.33. At that, thermal enhancement factor increases by 30% (Fig.2).

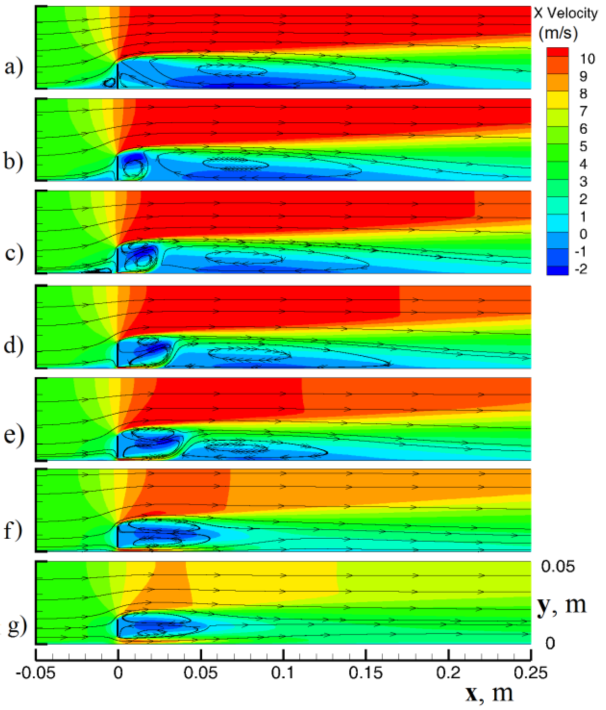

Fig. 3. The stream lines and the longitudinal component of the velocity field in the area of the diaphragm. a) c / h = 0, attached diaphragm; b) 0.03; c) 0.07; d) 0.1; e) 0.13; f) 0.2; g) 0.33.

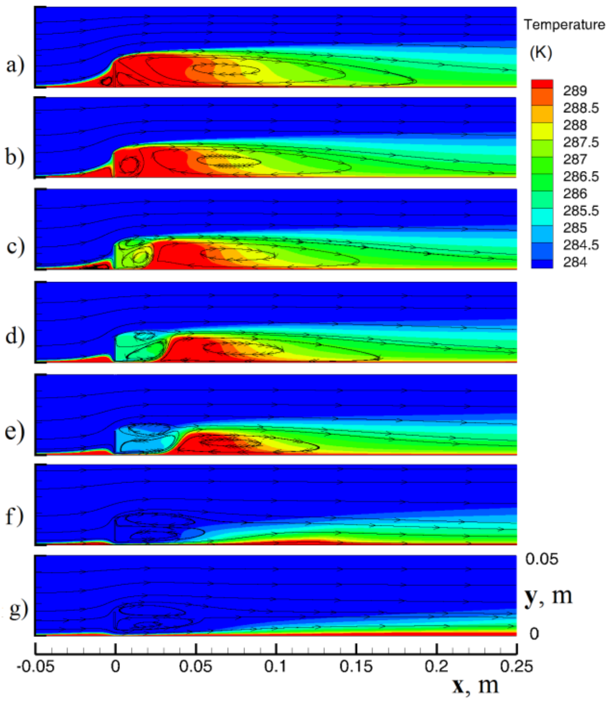

Fig. 4. The stream lines and temperature field around the diaphragm. a) c / h = 0, attached diaphragm; b) 0.03; c) 0.07; d) 0.1; e) 0.13; f) 0.2; g) 0.33.

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