NUMERICAL STUDY OF THE THERMAL WALL CONDUCTIVITY EFFECTS ON THE CONJUGATE HEAT TRANSFER IN A HEATED HORIZONTAL PIPE

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ABSTRACT. The heat transfer between a uniformly heated pipe within its entire wall thickness and an internal laminar fluid flow is considered. We present the results of the 3D numerical simulation of the conjugate heat transfer: mixed convection in the fluid and conduction in the wall. The dynamic viscosity, the thermal conductivity and the density of the fluid are temperature dependent. The thermal losses between the outer surface of the duct and the ambient are considered. The model equations are numerically solved by the finite volumes method. The sequential solution of the discretization equations of the computed variables follows the SIMPLER algorithm. The iterative solution of a system of discretization equations is achieved by the sweeping method using the Thomas algorithm and the tri diagonal cyclic algorithm. The computer code is perfectly validated by comparison with experimental results published in the specialized literature. The influence of the pipe material conductivity on the heat transfer and the fluid flow is analyzed for three different materials: inconel, tantalum and steel. It is found that the heat transfer is enhanced by an increase of the thermal conductivity of the pipe wall. Moreover, we can conclude that the inconel material pipe provides better heat transfer.

KEYWORDS: *Numerical Study, Conjugate Heat Transfer, Laminar Mixed Convection, Thermal Dependent Properties, Horizontal Duct.*