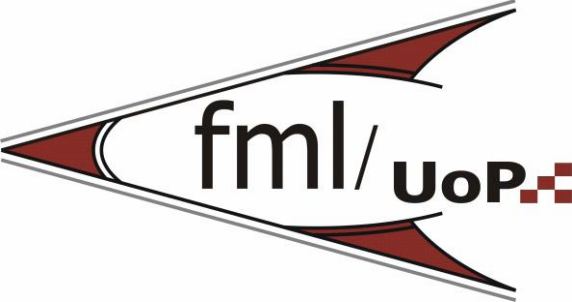




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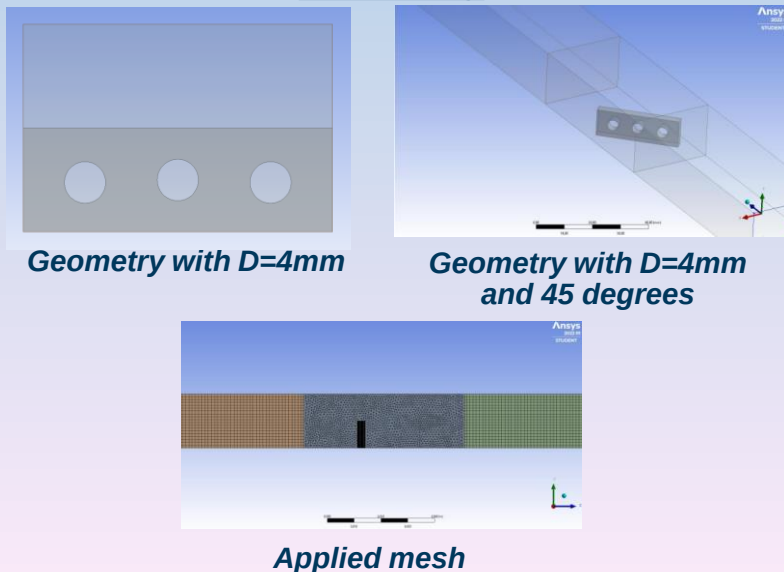
Diploma Thesis 2021-2022 Supervisors: Emeritus Prof.D.Margaris-Prof. T. Panidis COMPUTATIONAL STUDY OF THE EFFECT ON THE FLOW AND THERMAL FIELD IN A TUBE OF RECTANGULAR CROSS-SECTION OF A FLAT TILE TYPE VORTEX GENERATOR WITH THREE CIRCULAR HOLES FOR DIFFERENT VALUES OF HOLE DIAMETERS AND ANGLE OF ATTACK OF THE TILE

STAVRAKOGLU KONSTANTINOS, A.M.:1054466

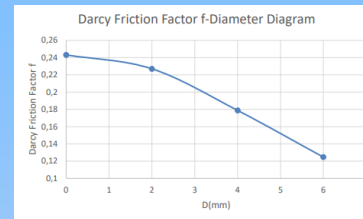
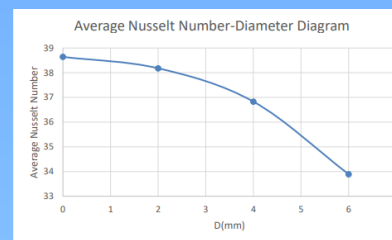
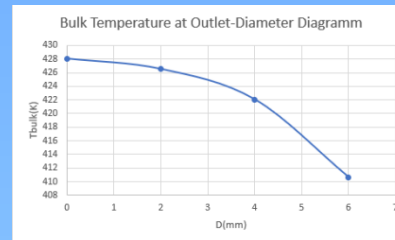
Abstract

The subject of the present diploma thesis is the investigation of the effect of a flat tile type Vortex Generator with three circular holes in the flow and thermal field of a heated tube with rectangular cross-section. The aim of this study is to enhance the heat transfer inside the tube, while achieving the lower possible pressure drop. For each simulation the value of constant temperature that applied at the inner walls of the tube is 650K while the temperature of the air at the inlet is 273K. For the first group of simulations the different hole diameter values of the tile were investigated ($D=0,2,4,6$ mm), where the optimal one was selected. Then the second group of simulations followed with an investigation for the tile with the optimal hole diameter in terms of its different angles of attack (0,30,45,60,80 degrees). The quantities which were calculated at each simulation were the average outlet temperature, the average Nusselt number and the pressure drop coefficient. The tiles with the optimal holes diameter and then with the optimal angle of attack were further examined for different values of the Reynolds number (5000,10000,15000,20000) at the inlet and compared with an empty tube of the same dimensions.

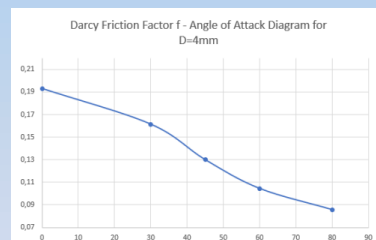
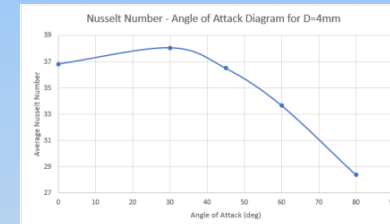
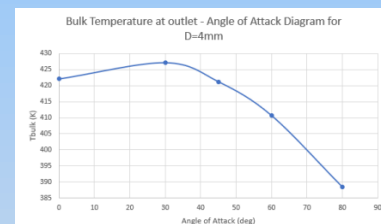
Geometry



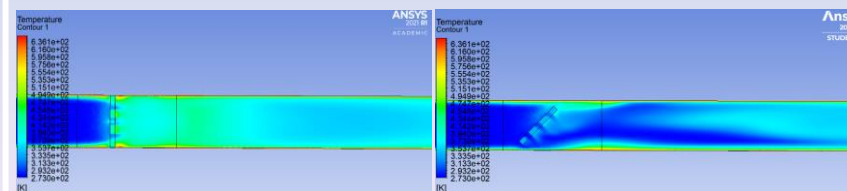
Results



Diagrams of Outlet Temperature, Nusselt Number and Darcy for different holes diameter



Diagrams of Outlet Temperature, Nusselt Number and Darcy for different angles of attack



Contour of Temperature for D=4mm

Contour of Temperature for D=4mm and angle 45 degrees

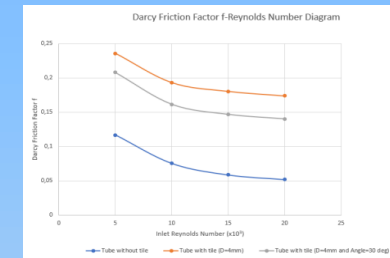
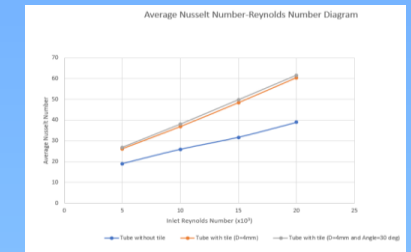
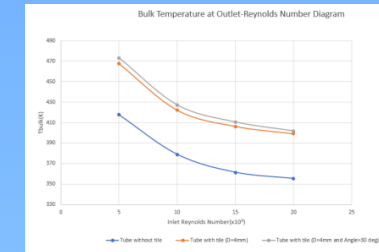


Diagram of Outlet Temperature, Nusselt Number and Darcy for different Reynolds number for the cases of an empty tube, a tube with VG and 4mm holes and a tube with VG with 4mm holes and 30 degrees angle

Conclusions-Comments

- The increase of the diameter of the tile's holes causes the decrease of the average outlet temperature, the average Nusselt number and the pressure drop coefficient.
- For the different values of Reynolds number for the cases of an empty tube and with a tile we conclude that as long as the value of Reynolds increases, the outlet temperature and the pressure drop coefficient decrease. On the other hand, the Nusselt number increases.
- The optimal angle of attack for the tile is 30 degrees because it showcases the most beneficial results (increase of outlet temperature and Nusselt number with an important decrease of the pressure drop coefficient).
- The use of the VG inside the tube affects positively the heat transfer, increasing the outlet temperature and the Nusselt number, but resulting in an increase of pressure losses.