



AUGMENTATION OF HEAT TRANSFER PERFORMANCE WITH ALUMINIUM AND COPPER TWISTED TAPE INSERTS

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ABSTRACT

An experimental investigation of heat transfer, friction factor and pressure drop characteristics in a pipe fitted with the Al twisted tape and cu twisted tape inserts with different twist ratio. The experimental work was conducted and the analysis of heat transfer was investigated with laminar flow. The experimental data were obtained from the double pipe heat exchanger with concentric tube fitted with insert of aluminium and copper material twisted tape inserts. The results of the Al and cu were investigated and compared these two results. The results shows that the heat transfer enhanced in the copper material inserts compared to Aluminium material inserts. The heat transfer augmentation was enhanced with 1.1 to 1.3 times compared to the Aluminium. The experimental results reveal that the different material of inserts. The Reynolds number various from 2570 to 7891. The twist ratio of both the material is $\gamma = 4.3$.

Key words: Twisted tape, Heat transfer, Aluminium, Copper and friction factor.

INTRODUCTION

Twisted tape is one of the passive heat transfer enhancing techniques, which has been experimentally studied due to steady performance results and easy installation. Z. H Ayub et al.¹, studied the effect of twisted tape on the pressure drop in turbulent water flow. S. Eiamsa et al.², was analysed the experimental investigation of heat transfer in circular tube fitted twisted tape. S. Ray et al.³, were investigated the laminar flow and heat transfer for square duct twisted tape inserts. S. K. Saha et al.⁴, studied the heat transfer and pressure drop characteristics of laminar flow. V. Zimparov et al.⁵ was analyses the heat transfer

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enhancement by a combination of three spirally corrugated tubes with twisted tape. M. Rahimia et al.⁶, were investigated the experimental heat transfer and friction factor characteristic of twisted tape inert tube. R. M. Manglik et al.⁷ were conducted and analyses the heat transfer and friction factor correlations. S. Jaisankar et al.⁸ the experimental studies on heat transfer and friction factor characteristics at the trailing edge twisted tape. S. R. Shabanian et al.⁹ were discussed the CFD and experimental studies on heat transfer enhancement in an air cooler equipped with different tubes inserts.

EXPERIMENTAL

The geometry configuration of the tube with a thickness (t) 0.075 cm, length (L) 220 cm is used for experimental investigation. In a double pipe heat exchanger is utilized as the main heat transfer test section, which is insulated to minimize heat loss to the surrounding. It consists of two concentric tubes in which hot water flows through the inner tube and cold water flows outer tube in flow through annulus. The outer tube is made of a cast iron having inside and outside diameters of 28 mm and 32 mm, respectively. The inner tube made of an aluminum having inside and outside diameters of 20 mm and 18 mm, respectively. Four thermocouples T_1, T_2, T_3, T_4 , surface temperature data was recorded using data acquisition unit. The cold water is supplied from storage tank into the outer tube and hot water is supplied in the inner tube. The mass flow rate of the flow varied regularly for obtained the different experimental data. The experimental data occurred for plain twisted tape and triangular-cut twisted tape (TCT). The temperature of the inlet and outlet of hot and cold water data's were gathered. The experimental configuration illustrated in Fig. 1.

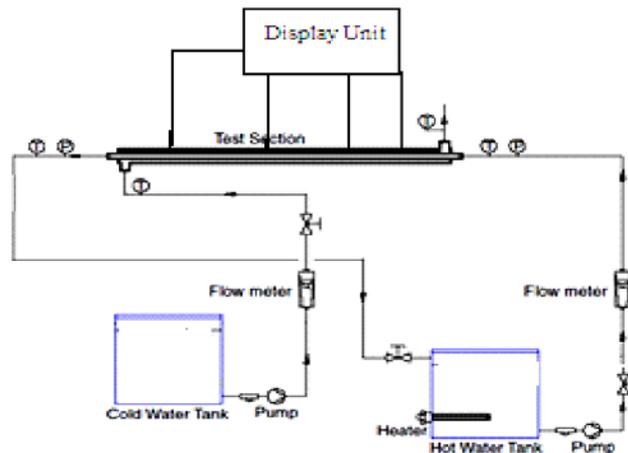


Fig. 1: Experimental setup

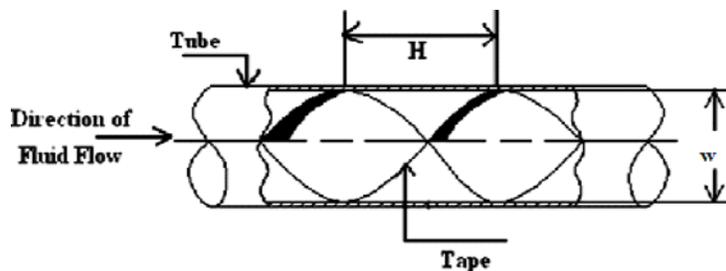


Fig. 2: Twisted tape model

Heat transfer rate was calculated by –

$$Q = m C_p (T_{out} - T_{in}) \quad \dots(1)$$

Heat transfer coefficient can be calculated by –

$$h = q / (T_w - T_b) \quad \dots(2)$$

Reynolds number was calculated by –

$$Re = UD / \varepsilon \quad \dots(3)$$

Nusselt number can be obtained from –

$$Nu = h D / K$$

RESULTS AND DISCUSSION

Reynolds number and Heat transfer characteristic

The comparison of Reynolds number and heat transfer characteristic were analyzed with Aluminum and copper shown in Fig. 3. The heat transfer rate of Al and Cu enhanced with increase of Reynolds number. The heat transfer rate of copper twisted tape was enhanced from 1.6 to 2.0 times compare with aluminium twisted Tape.

Variation of Reynolds number and Nusselt number

The results shows the variation of Reynolds number and Nusselt number, which shows Nusselt number increases with increase of Reynolds number. The Nusselt number of cooper twisted tape increases with 2.5 times to 3.3 times of compare with aluminium twisted tape.

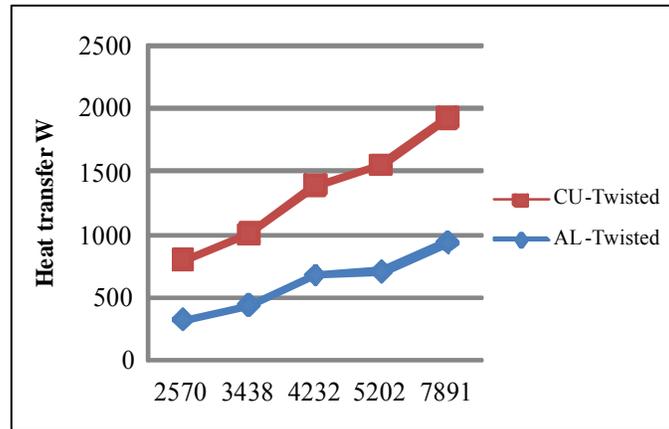


Fig. 3: Comparison of Reynolds no and heat transfer

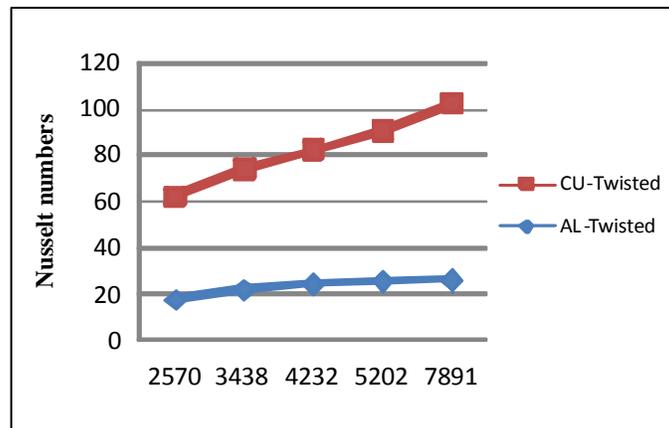


Fig. 4: Variation of Reynolds number and Nusselt number

Reynolds number and heat transfer co-efficient

The effect of heat transfer co-efficient enhanced with increase of Reynolds number. With comparable of aluminum twisted tape, Nusselt numbers were enhanced with 1.9 to 2.2 times of copper twisted tape.

Reynolds number and Friction factor

The results shows the correlation between the Reynolds number and friction factor, which results analysis with friction factor was decreases with increase of Reynolds number.

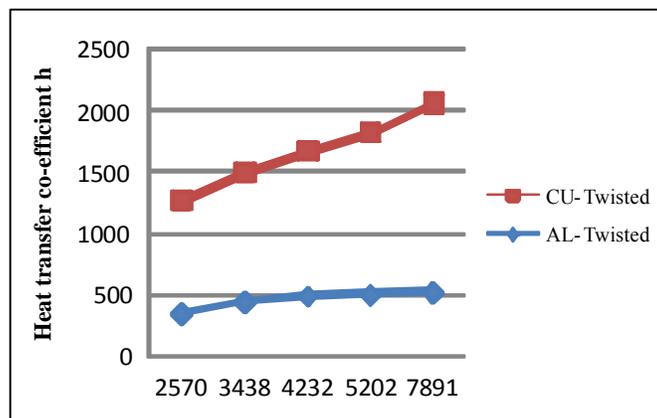


Fig. 5: Shows the variation of Reynolds number and heat transfer co-efficient

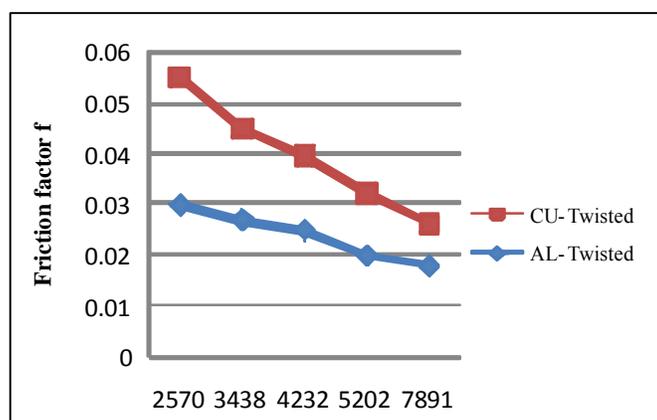


Fig. 6: Comparison of Reynolds number and friction factor

CONCLUSION

The value of the friction factor and heat transfer investigation of circular tube fitted of twisted tape inserts analysed with aluminium and copper material has been studied. The heat transfer enhancements were takes place with increase of Reynolds number. The heat transfer of copper twisted tape increased 1.5% to 3% compare with aluminum twisted tape inserts. The data obtained from the aluminum and copper twisted tape friction factor were reduced with increase of Reynolds number. The heat transfer co-efficient and Nusselt number characteristics of copper twisted tape were enhanced rapidly comparable of aluminum twisted tape. The enhancement heat transfer twisted tape was achieved by due to the swirl flow action obtained from circular tube of copper twisted tape inserts.

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Nomenclature

C_p-specific heat capacity, J/kg.K, h-heat transfer co-efficient, W/m²K, k-Thermal conductivity, W/m K, Nu-Nusselt number, Re-Reynolds number, D-Internal diameter of the tube,m.

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