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A Bird view on Heat Transfer Enhancement in a Tube with Twisted Tape Insert

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Abstract -Different kinds of methods used to enhance heat transfer rate of heat exchanger without influencing overall performance of the heat exchanger referred as heat transfer enhancement techniques. This technique are categorized into three types i.e. active technique, passive technique, and compound technique Some of the application of heat exchanger which require enhancement in heat transfer are – Air conditioning equipments, radiators, refrigerators, thermal Power plants etc. The intention of enhanced heat transfer is to encourage high heat fluxes, this result in reduction in size of heat exchanger. The present paper is a review of research work in last decade on heat transfer enhancement in a Heat Exchanger.

Keywords:-*Heat transfer enhancement, passive method, twisted tape, heat transfer coefficient*

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I. INTRODUCTION

At the present days, twisted-tape has been generally applied for enhancing the convective heat transfer in distinct industries, because of their effectiveness, low cost , Energy and material saving consideration, as well as economical, have led to produce more efficient heat-exchanger equipment. Therefore, the conservation of thermal energy leads to possible the economical handling of thermal energy through heat-exchanger. The heat transfer techniques permit heat exchanger to operate at smaller velocity, but still accomplish the same or even higher coefficient of heat transfer. This means that a Decrement in pressure drop with respect to less operating cost.

II. METHODS OF HEAT TRANSFER ENHANCEMENT

Generally, heat transfer enhancement methods are classified in three methods:

A] Active method: **-** In this method, some external power input used for the enhancement in heat transfer. Examples of active methods are induced pulsation by cams and reciprocating plungers,, use of a magnetic field to disturb and seeded light tiny pieces in a flow, etc.

B] Passive method: **-** In these cases, external power is used to help the desired surface or geometrical modification and the improvement in the rate of heat transfer. For example, use of inserts, use of rough surfaces etc.

C] Compound method: **-** When any two or more techniques are employed together to obtain enhancement in heat transfer that is greater than that produced by any one of them when used individually is termed as compound enhancement. This technique included complex design and it has finite applications.

III. TWISTED TAPE

To increase the rate of heat transfer, in the flow passages some kind of insert is placed and they also reduce its hydraulic diameter. Heat transfer enhancement leads to flow blockages, partitioning of the flow and secondary flow. Flow blockages enhance the pressure drop and leads to viscous effects, because of a reduced free flow area. The selection of the twisted tape depends on performance and cost. Therefore this paper concentrates on the review of enhancing heat exchanger performance by twisted tape, Fig 1 shows geometry of twisted tape.

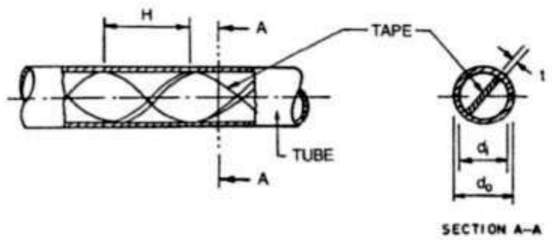

Figure 1. Schematic view of twisted-tape insert inside a tube

A literature review on heat transfer enhancement in laminar flow and turbulent flow using twisted tape is explained in following sections.

A] Twisted tape insert in laminar flow-

Saha, S. K. and Dutta, Saha (2001), S. K. and Bhunia K (2000) Studied experimental data on a twisted tape generated laminar swirl flow friction factor and Nusselt number for a large Prandtl number (205- 518) and they observed that, If pumping power is constant then short-length twisted tape is a selected because in this case swirl generated by the twisted tape breaking downstream slowly which cause increases in the coefficient of heat transfer with minimum pressure drop, compared with a full-length twisted tape [1, 2, 3]. Suresh Kumar, P., Mahanta, P. and Dewan (2003) studied the thermo hydraulic twisted tape performance. The thermo hydraulic performance in laminar Flow with a twisted tape is better than the wire coil for the same helix angle and thickness ratio [4]. Ray S. and Date A. W. (2003) studied a correlation for the Nusselt number and friction factor for a square duct from the forecasted data. They compared the correlation for the friction factor with experimental data and the deviation was found within +10 % [5]. Anil Yadav (2009) studied influences of the half length twisted tape insertion on heat transfer & pressure drop characteristics in a U-bend double pipe heat exchanger, experimentally. The results obtained from the heat exchangers with twisted tape insert are compared with those without twisted tape i.e. Plain heat exchanger. The experimental results revealed that the increase in heat transfer rate of the twisted-tape inserts is found to be strongly influenced by tape-induced swirl or vortex motion. The heat transfer coefficient is found to increase by 40% with half-length twisted tape inserts when compared with plain heat exchanger. It was found that on the basis of equal mass flow rate, the heat transfer performance of half-length twisted tape is better than plain heat exchanger [6]. P. Bharadwaj, A. D. Khondge, A. W. Date (2009) experimentally Studied pressure drop and heat transfer Characteristics of flow of water in a 75-start spirally grooved tube with twisted tape. The grooves are clockwise with respect to the direction of flow. Range of Reynolds numbers have been considered from Laminar to fully turbulent. The heat transfer enhancement due to spiral grooves is further increased by inserting twisted tapes having twist ratios are

Y= 10.15, 7.95 & 3.4 -----------------[7].

K. N. Sheeba, S. Jaisankar, and T. K. Radhakrishanan (2009) studied of friction factor, heat transfer and thermal performance of thermosyphon solar water heater system fitted with helical twisted tape having different twist ratios and Conclusions made from the results show that heat transfer enhancement in twisted tape collector is higher than the plain tube collector with minimum twist ratio and gradually decreases with increase in twist ratio [8].

B] Twisted tape insert in turbulent flow-

K. V. Sharma, L. Syam Sunder, P. K. Sharma (2009) Studied heat transfer coefficient and friction factor for transition range of flow with Al203 nano fluid in a tube with twisted tape. The results show that compared to flow with water, convective heat transfer has been enhanced with Al203 nanofluids [9].

S. Eiamsa-ard, K. Wongcharee, P. Eiamsa-ard, c. Thianpong (2009) Studied flow friction , heat transfer and thermal performance factor characteristics in a tube fitted with delta-winglet twisted tape, Influences of the oblique delta-winglet twisted tape (0-OWT) and straight delta-winglet twisted tape (S-OWT) arrangements are also described. The experiments are carryout using the tapes with three depth of wing cut ratios (DR = dlw = 0.11, 0.21 and 0.32) and three twist ratios (ylw = 3, 4 and 5) over a wider range of Reynolds number (3000-27,000). The obtained results show that mean Nusselt number and mean friction factor in the tube with the delta-winglet twisted tape increase with decreasing twisted ratio (y/w) and increasing depth of wing cut ratio (DR) [10]. S. Eiamsa-ard, P. Eiamsa-ard, C. Thianpong (2009) Studied evaluation of Effects of twin-counter/co-twisted tapes on friction factor (f), heat transfer rate (Nu), and thermal enhancement index (7). The tests are carried out using the co-twisted tapes and co-twisted tapes with four different twist ratios y/w = 2.5, 3.0, 3.5 & 4.0 for range of Reynolds numbers between 3700 and 21,000. The twin co-twisted tapes are used as coswirl flow generators while twin counter twisted tapes (CTs) are used as counter-swirl flow generators [11]. C. Thianpong, S. Eiamsa-ard, P. Eiamsa-ard (2009) were Studied heat transfer and friction characteristics for water, ethylene glycol, and ISO VG46 turbine oil flowing inside four tubes with three-dimensional internal extended surfaces and copper continuous or segmented twisted-tape inserts. During the experiments, Prandtl numbers ranged from 5.5 to 590 and Reynolds numbers from 80 to 50,000. The experimental results show that this compound enhanced heat transfer technique, a tube with three-dimensional internal extended surfaces and twisted-tape inserts, is of particular advantage to enhance the convective heat transfer for the laminar tube side flow of highly viscous fluid [12].

IV. CONCLUSION

This paper describes the influence of various type of Twisted tape used to enhances the performance of heat exchanger. A twisted tape insert mixes the flow and efficiently performs better in laminar flow, because in laminar flow the infinite thermal resistant to a thin region. The result also shows twisted tape is better for heat transfer enhancement, Up to certain Reynolds number range, Twisted tape in turbulent flow is enhance heat transfer. It is also shown that twisted tape is ineffective in turbulent flow, because it blocks the flow and so pressure drop has been increases. Hence the thermo hydraulic performance of a twisted tape is doesn’t well in turbulent flow. For the application of heat transfer enhancement in heat exchanger networks these conclusions are very useful

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