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Enhancement of energy transferred in a pipe that equipped with a fixed Spiral Tape – Review

Suha K. Jebir
Al-Nahrain University, Baghdad, Iraq

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ABSTRACT
Among many techniques to improve heat transfer rate, indirect heat transfer techniques are more popular since they are simple to apply compared to others. In this research, the plain pipe in the circle tube heat exchanger has been replaced with wrapped copper wire, which has increased the heat transfer characteristics by 9-11 percent. Researchers discovered, in this article, that such a simple but important consideration to increase the thermally effectiveness of the warmth exchangers was always use irregular structures, such as baffles, versus wires to build a solid heat exchanger. Investigators analyzed that heat transfer rate element on such a mound, then assessed this heat exchanger's productivity based on the number of thermal performance events as well as the ratios of stream with circumferential irregularities.

I. INTRODUCTION

Todevelop heat diffusion, different inserts had been placed within the tubing of a horizontally double tube heat exchanger. Water passing through a simple tube with inserts in it will create turbulent flow in this kind of heat exchanger. With the insert, the radiative thermal radiation from the simple tube increases due to the swirl movement. Inserts have a major impact on heat transmission, but this results in pressure reductions as well. Several research articles have investigated and shown that adding a twisted - pair brushing inserts into something like a twin pipe heat exchanger produces a swirl flow that induces a tangential flow velocity and improved fluid combining in the center and close wall area. This kind of heat exchanger may be used in a number of different systems, including for solar thermal, climate control, refrigerators, autoclaves, and agricultural and food products [1-3].

In order to use thermal storage designs such as these, heat transport rates and pressure drops should be tested. It's essential to do exhaustive economic analyses and performance tests on heat exchangers, apart from the major concern. Previous research demonstrated that using twisting wires to boost the effectiveness of passively heat transport methods produced remarkable results. Scientific checks are conducted using coiled wires that has a radius of 1.2 mm. The influence of the insert on the Nusselt number was investigated, once without barriers then with disturbances [4-8].

Active methods are so much more complicated from an engineering and usage perspective, since they need to draw on an outside power source to initiate the heat transfer enhancement they induce. This technology's usage is restricted since it relies on outside power. Other methods don't work as well as this one since it is impossible to get outside energy, in several situations. There are a number of different methods to consider, for example:

1. Assistive Devices
2. two kinds of vibrating, surfaces and fluids
3. electrically charged fields application
4. sucking power

Passive flow channel changes are often comprised of simple insertions or additions. These raise heat transfer characteristics through changing or disrupting the flow in such a way that all other exceptions except longitudinal fins will experience a rise in pressure loss. When a layer appears longer, more heat is transferred on the sides of the surface. Because they need no outside help, passive methods are preferred over significant ones. The passive techniques are all predicated on the same idea [9-13]. The method used here will create turbulence in the fluid and disrupt the boundary layer, which will result in a greater effective shallow area, longer habitation time, and a higher heat transfer ratio. Main surfaces were frequently regarded: Treated substrates, Devices such as swirled flows and helical pipes, sucking power.

Hybrid Methods: The word "composite" is used to such as that use several types of heat

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transfer improvement techniques. Compound techniques provide higher heat transmission than an other method alone. Tough areas modified using substances or extruded materials.

The identical pipe heat exchanger has a twisted wire brush insert that improves heat transfer efficiency of heat transfer devices. The straight copper tubing with sizes of 15 and 25 mm are used to make the horizontal twin pipe heat exchanger. Wire paintbrush plugs were created by rolling copper cables with such a diameter of 0.2 mm around iron cores that have been coiled to a diameter of 2 mm. The flow shape is important in determining the flow's internal thermal convection thermal efficiency and range of measures. Research found that warpedropeconfrontation inserts led to great transmission of heat and coefficient of friction improvements but also added a 4-5 percent decrease in pressure. The computed thermal resistance for convection from the warpedcordconfrontationpipe is developed, between 9 to 11% greater than without strip. This stayed due to the eddy flow generated besidesinstability created. Nusselt number for twistingropeencounter tubes varies between 1.78 and 2.98 [14].

Thermal transmission as well as pressure losses properties were studied empirically in a plain cylinder containing tape inserts inserted in such a viscous liquid under Boundary - layer swirling circulation using Prandtl numbers ranging from 20 to <518. This spiral came through inserting small lengths of tapes with very many turns. These were put in equal intervals sections, which were then linked by tiny shafts. Lastly, they were finished with such a uniform change in pitched. The relatively brief contorted had reduced friction coefficient and Nusselt number. A cylindrical pipe exposed to a homogeneous surface thermal gradient gives rise to turbulent swirling flows with a high Prandtl number (205≤ Pr ≤ 518). The friction coefficient as well as Nusselt number are given for such a instance. Shorter-length helically coiled inserts produced swirl with degradation [15]. With tight twisting (y<5), this reductionwithin Nusselt number was greater than the drop in friction influence for short-length perverse-tapes compared to standard contorted. Based on continuous pumping power and constant heat duty, shorter contorted have been shown to be ~33% as long as the tube itself! Additionally, helically coiled components, whereby the amount of twisting was two, have shown a 14%–47% decrease in thermodynamic drag coefficient as well as similar transverse and overall Nusselt number decrease relative with tapes modules with just one twist in them. The additional torque caused by expanding the number of rotations by 2 to triple doesn't really increase thermal hydrodynamic characteristics. Even if it costs cooling efficiency, if the goal is to reduce energy input, the tapes unit could proposed a set of turns of three [16-17.

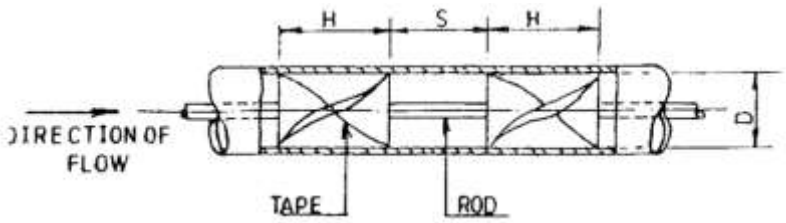

Fig. plan of a round tube comprehending regularly spread out twisted-tape [17]

The comprehensive twist ratio component was placed inside a plain cylinder to study heat transmission and friction factor features. Twisted relation may well be made to change in either rising or reducing values, and this has been examined with the uniform application of heat. When flow is tumultuous. A Reynolds number ranging from 2700 to 13,500 was applied. Comparisons are made of the empirical observations to available data.Found in publicly available information in an unadorned tube. The Nusselt number for a 1.95 twist was measured. The Spiral Twist Insertion results were compared to results existing in the literature on helically coiled effectiveness. It was discovered the tape inserts fell short of functionality [18]. The increase in heat transmission via helix twist and growing rotation amount was included by way of empirical observation, the relationship between twist ratio and Reynolds was discovered Nusselt number and friction feature, respectively, were accepted in the interior±13% in addition to±15% error. The research on evaluating the effectiveness of the spiral twist insertion has just been provided.

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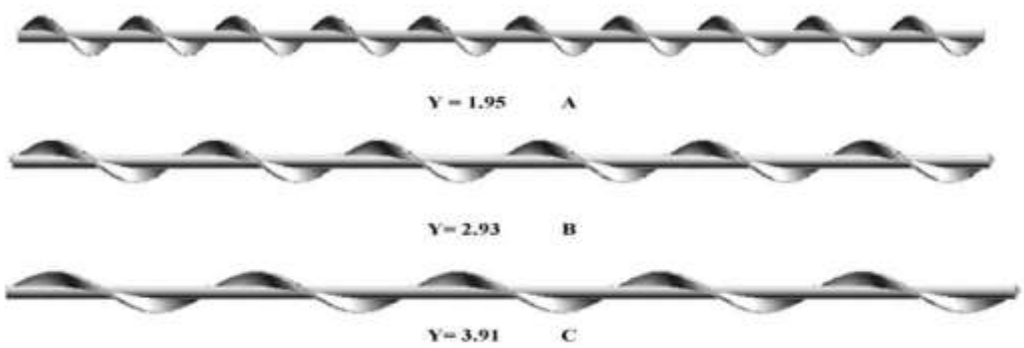

Fig. 2 Impeller inserts: There are three options for raising or reducing the twist ratio, including (a) options that increase the twist ratio by various amounts, (b) options that gradually increase the twist ratio, and (c) options that reduce the twist ratio [18].

The experimental data temperature distributions for the laminar regime of hybrid nanofluid in an electrically heated metal pipe with twist insertions have been used to calculate the flow plans for various fluid flow situations. In fully developed turbulent flow, a relationship of tape twisting ratios, Reynolds number, and Prandtl number was discovered to equal the Nusselt number.In Nusselt numbers, the unfilled tubes' steady property values approximated almost eight times their current property values. A relationship between these facts and the mathematical forecasts that are accessible is still in good accord. At different Reynolds numbers, the friction coefficient is solely influenced by the tape twisting. During testing, the supplemented pipes were examined alongside vacant tubing to see how they'd function in comparable circumstances. They may get Nusselt values higher than 40 using the experiment. The pressure loss statistics show that the Reynolds number is the primary driver of resistance [19-22]. A slightly increased drag force is seen with higher flow rates and a swirling stream.

II. CONCLUSIONS

The difference between the real and theoretical Nusselt numbers at low shear rates (up to 9000) trendy plain pipebe able to be credited to free convective, happens concurrently by convection and causes variation hip Nusselt numbers. Such a phenomenon is particularly noticeable in conditions of low Re. The abundance of organic turbulence is minimal in comparison to the amount of conduction and convection in the presence of greater Re. Specifically, we assess the thermal performance exchanged in relation to that same Reynolds number just on the basis of actual assessment criteria in this section. Finally, other factors such as the drag coefficient, Prandtl number, that rise when different inserts are used in comparison to a portion, were discussed. Variations in the length of a baffle, as well as changes in the distance between the baffles, cause variations in the velocity profile, which could be for fully grown turbulence.

REFERENCES

[1]. DeepaliGaikwad andKundlik Mali , “Heat Transfer Enhancement for Double Pipe Heat Exchanger Using Twisted Wire Brush Inserts”,International Journal of Innovative Research in Science ,Engineering and Technology , Vol. 3, Issue 7, July 2014

[2]. M. Ahmed, L. Deju, M.A.R. Sarkar, and S.M.N. Islam, “Heat transfer in turbulent flow through a circular tube with twisted tape insert”, Proceedings of ICME-Dhaka, TH-08, 2005.

[3]. S.K. Saha and A. Dutta, Thermo-hydraulic study of laminar swirl flow through a circular tube fitted with twisted tapes. Trans. ASME, J. Heat Transfer, 2001, 123, 417–421.

[4]. W. Noothong, S. Eiamsa-Ard, and P. Promvonge, "Effect of twisted-tape inserts on heat transfer in a tube", The 2nd joint international conference on “sustainable energy and environment., Pp. 21-23, 2006.

[5]. P. Sivashanmugam and S. Suresh , “Experimental studies on heat transfer and friction factor characteristics of turbulent flow through a circular tube fitted with helical screw-tape inserts” , Appl.Therm.Eng.15March2006

[6]. P. Murugesan, K. Mayilsamy, S. Suresh, and P.S.S. Srinivasan, "Heat transfer and pressure drop characteristics of turbulent flow in a tube fitted with trapezoidal-cut twisted tape insert", Vol. 1, No. 1, Pp. 123-128, 2009.

[7]. Hong, S. W., and Bergles, A. E., 1976, ‘‘Augmentation of Laminar Flow Heat Transfer in Tubes by Means of Twisted-Tape Inserts,’’ ASME J. Heat Transfer, **98**, No. 2, pp. 251–256.

[8]. A. Kumar, and B.J.N.J.o.t.I.o.E. Prasad, "Enhancement in solar water heater performance using twisted tape inserts", National Journal of the Institution of Engineers., vol. 90, Pp. 6-9, 2009.

[9]. Sundar L. S. and Sarma K. V., “Turbulent heat transfer and friction factor of Al2O3 nanofluid in a circular tube with twisted tape inserts”, International Communications in Heat and Mass transfer 53, pp.1409-1416, 2010.

[10]. S. Eiamsa-ard, C. Thianpong, P. Eiamsa-ard, and P. Promvonge, "Thermal characteristics in a heat exchanger tube fitted with dual twisted tape elements in tandem", International Communications in Heat and Mass Transfer., Vol. 37, No. 1, Pp. 39-46, 2010

[11]. A.A. Mohammed, and A.A. Jadoaa, "Experimental investigations heat transfer and pressure drop characteristics of flow through circular tube fitted with drilled cut-conical rings", Eng. & Tech. Journal., vol. 29, no. 14, Pp. 477-487, 2011.

[12]. S.K. Agarwal, M. Raja Rao, Heat transfer augmentation for the flow of a viscous liquid in circular tubes using twisted tape inserts, Int. J. Heat Mass

[13]. P. Promvonge, and S. Eiamsa-ard, "Heat transfer behaviors in a tube with combined conical-ring and twisted-tape insert", International Communications in Heat and Mass Transfer., Vol. 34, No. 7, Pp. 849-859, 2007.

[14]. M.M.K. Bhuiya and M.S.U. Chowdhury , “Heat transfer performance evaluation for turbulent flow through a tube with twisted wire brush inserts”, International Communications in Heat and Mass Transfer Volume 39, pp. 1505-1512, 2012.

[15]. K. Yakut, and B. Sahin, "Flow-induced vibration analysis of conical rings used for heat transfer enhancement in heat exchangers", Applied Energy., Vol. 78, No. 3, Pp. 273-288, 2004.

[16]. S.W.Hong and Bergles, A. E. Techniques to augment heat transfer. In Handbookof Heat Transfer Applications (Ed. W.M. Rosenhow),1985, Ch. 3 (McGraw-Hill, New York).

[17]. A.A. Mohammed, A.A. Hussein, "The effect of inclination angle on the convective heat transfer in tube fitted with conical ring and swirl generator inserts", International Journal of Mechanical & Mechatronics Engineering (IJMME-IJENS), Vol. 15, No. 06 15, Pp. 51-58, 2015.

[18]. D.V. Ahire, Y.J. Bhalerao, and M.S. Dholkawala, "Expermentalinvestegation of heat transfer enhancementin circular pipe using conical ring inserts", International Journal of Mechanical And Production Engineering., Vol. 5, No. 3, 2017.

[19]. W. Liu, K. Yang, Z.C. Liu, T.Z. Ming, A.W. Fan, and C. Yang, “Mechanism of heat transfer enhancement in the core flow of a tube and its numerical simulation", The Open Transport Phenomena Journal., vol. 2, Pp. 9-15, 2010.

[20]. R.L. Mohanty, S. Bashyam, and D. Das, "Numerical analysis of double pipe heat exchanger using heat transfer augmentation techniques", International Journal of Plastics Technology (Springer)., Vol. 18, No. 3, Pp. 337-348, 2014.

[21]. W. Liu, and B. Bai, "A numerical study on helical vortices induced by a short-twisted tape in a circular pipe", Case StudiesinThermalEngineering., Vol. 5, Pp. 134-142, 2015.

[22]. M.H. Fagr, Q.A. Rishak, and K.S. Mushatet, "Performance evaluation of the characteristics of flow and heat transfer in a tube equipped with twisted tapes of new configurations", International Journal of Thermal Sciences., Vol. 153, Pp. 106323, 2020.