

Experimental Investigation & Modelling Studies for Different Tubes of Heat Exchanger using CFD

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Abstract

Metal matrix hybrid composites (MMHCs) are now gaining their usage in aerospace, automotive and other industries because of their inherent properties like high strength to weight ratio, hardness and wear resistance, good creep behaviour, light weight, design flexibility and low wear rate etc. Al alloy base matrix reinforced with silicon carbide (10

Index terms— taguchi method, orthogonal array, ANOVA, metal matrix hybrid composites.

1 Introduction

A Heat Exchanger, consists of bundle of tubes. One fluid flows through the tubes while the second fluid flows space between the tubes and shell. Tubes plays an important role while exchanging heat from hot fluid to cold fluid. Although they are not specially compact, their robustness and shape make them well suited for high pressure operations. They have larger heat transfer surface area to volume ratio than the most of common types of heat exchangers, and they are manufactured easily for a large variety of sizes and flow configurations. The main design objectives here are to accommodate thermal expansion, to furnish ease of cleaning, or to provide the least expensive construction.

To get robust, least expensive and technically sound design, we will be dealing with four different designs viz. "Circular Tube", "Elliptical type(Oval)", "Twisted type" and "Coil type" Along with construction issue we too come across the difficulties in improving heat transfer rates, which means to have high effectiveness, we were in flow to compromise the design and robustness. In order to achieve the maximum heat transfer rate an analysis is made on single tube for Author ? : Mechanical Engineering Department, MIT, Aurangabad (M.S), India. e-mail: roshan.marode@gmail.com Author ? : Associate Professor, Mechanical Engineering Department, MIT, Aurangabad (M.S), India. e-mail: ashokkeche@gmail.com different designs with two different fluids (Water and Al₂O₃-water based Nano fluid) in a shell and tube heat exchanger. This paper shows how maximum heat transfer rate has been achieved by comparing four different designs and getting optimal design solutions using computational techniques. To measure the performance of different designs, its model is suitably designed and fabricated so as to perform experimental tests. Thermal analysis has been carried out for four different designs with two fluids and on the basis of comparative results is made which one give the best heat transfer rates. After the modification of design an experimental validation is carried out to validate the results from analysis.

2 II.

3 Literature Review

Ala Hasan [1] experimentally investigated five oval tubes and compared with that for a circular tube in a cross-flow way and concluded that oval tube gives higher heat transfer results. The outcome was taken for comparing results of oval and circular tubes which helped for optimized design. Abdul Kareem Abbas et al [2] shows heat transfer augmentation due to twisting parameter was investigated in a twisted tube of rectangular/square cross sectional area. Also swirling increases internal mixing process which enhances internal thermal equilibrium. The heat transfer coefficient also increases as Reynolds number increased as velocity components are increased. This

relation shown was used as function and one of the parameter in design. Su Thet Mon Than et al [3]In this paper data is evaluated for heat transfer rate having spiral tubes and pressure drop and checking whether the assumed design satisfies all requirement or not by using computational techniques. Satisfied design found was used for coil type tubes for analysing the heat transfer rate. Jay J. Bhavsare et al [4]objective of this paper is to design and analyze of spiral tube heat exchanger. In this newly proposed design hot fluid flows in axial path while the cold fluid flows in a spiral path. The presented work was used in spiral tube design and has high heat transfer rate compared with helical coil heat exchanger and spiral plate heat exchanger. P. M. Deshpande et al [5]They studied horizontal spiral coil tube (HSTC) for various forces (viscous, buoyancy and centrifugal force) acting on fluid element in coil; of which the centrifugal force is predominant and results in secondary flow. This phenomenon also depends on the physical properties of fluid at a given temperature. They also concluded that as the coil diameter reduces the curvature ratio increase that increases the pressure drop. Relation was used for designing coil type tubes.

4 Experimental Work

We achieved temperature range by placing thermocouple at 250 mm apart for four design tubes.

5 Thermal Analysis of Tubes with two different Media

Thermal Analysis is made by using Computational Fluid Dynamics. In this a compromise between the computer time and accuracy of the analysis We have focused only on twisted type tube as in above sequence of calculations we are getting high heat transfer rate and high effectiveness by calculation.

In above colourful diagram, if we compare the twisted tube temperature contours with water as base fluid, an CFD analyst may observe that for 4th and 5th plane we are getting blue colour contours as compared to case 1, which directly shows the temperature gradient in above case is high along with effectiveness.

6 VII.

7 Conclusion

This study shows the design and thermal analysis of different tubes. Experimentally, same designs are made and results are evaluated. With relate to same design tubes are thermally analysed in ANSYS comparing the result for both water-water (Case-I) and water-Al₂O₃ (Case-II) for four different tubes we are in conclusion that twisted type of tube is giving high heat transfer coefficient as compared to other i.e 1.14 more. Along with effectiveness, twisted tube is at higher side by 1.17. So according to my research one should go for twisted tube.

However, a good understanding of the underlying principles of exchanger design is needed to use this software effectively. The possibility to increase in these characteristics using the latest technology and various methods has raised application range of these designs. Modified design tubes are having great applications due to their large heat transfer area and high heat transfer coefficients. They are used in many industrial processes like waste water treatment, refrigeration, wine and beer making, petroleum refining^{1 2 3}

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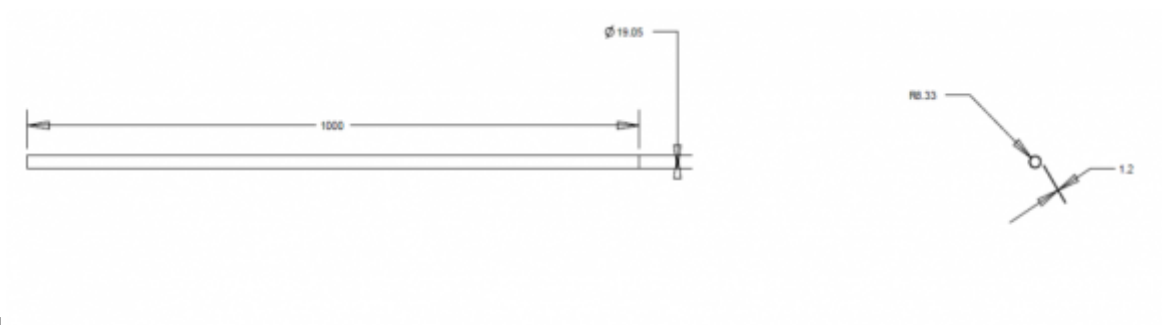
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Figure 1: 6 =??



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Figure 2: T 1 =



Figure 3:

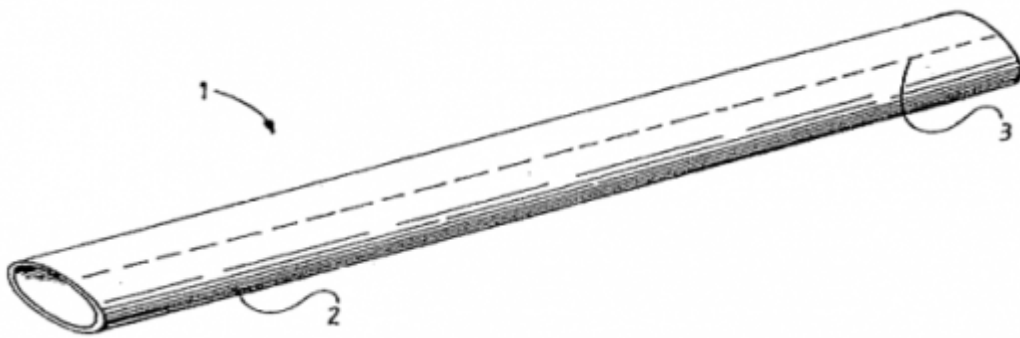


Figure 4: ?

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