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Review on triple tube heat exchanger with dimple on internal tube & internal threaded middle tube using CFD and Experimental analysis for heat transfer

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ABSTRACT:
This study will investigates the heat transfer characteristics of a horizontal triple tube heat exchanger having internal threaded pipe in the middle & dimples on inner tube. This research work will lead to findings on the effect of triple tube on heat transfer. It is expected from this research work that the applications of CFD and experimental results are nearly equal to same in triple tube heat exchanger by providing turbulence in inner tube and spiral movement of fluid in the intermediate tube of the triple heat exchanger.

KEY WORDS: *HTC, Surface roughness, Dimple, Internal threading*

1. INTRODUCTION

The technique of improving the performance of heat transfer system is referred to as heat transfer augmentation or intensification. This leads to reduce the size and cost of the heat exchanger. Heat transfer enhancement technology has been developed and widely applied to heat exchanger applications; for example, refrigeration, automotive, process industry, chemical industry etc. Many techniques of active and passive techniques are available for augmentation. Some common examples include steam generation, condensation in power & cogeneration plants, sensible heating and cooling in thermal processing of chemical pharmaceutical & agricultural products, fluid heating in manufacturing and waste heat recovery etc. Some Projects focuses on reviewing the passive methods in tube in tube heat exchanger. The passive heat transfer augmentations do not need any external power input.. For the convective heat transfer, one of the ways to enhance heat transfer rate is to increase the effective surface area & residence time of heat transfer fluids. The passive method are based on this principle, by employing several techniques to generate swirl in the bulk of the fluids and disturb the actual boundary layer so as to improve effective surface area, residence time & consequently heat transfer coefficient in existing system.

2. SCOPE OF WORK:

Many heat transfer enhanced techniques have simultaneously been developed for the improvement of energy consumption, material saving, size reduction and pumping power reduction. Triple tube heat exchanger are a typical technique that offers a higher heat transfer increase and at the same time, only a mild pressure drop penalty. This study will investigates the heat transfer characteristics of a horizontal triple tube heat exchanger having internal threaded pipe in the middle & dimples on inner tube. Heat transfer characteristics of triple tube heat exchanger using water working fluid will be investigated experimentally and compared to CFD analysis.

3 LITERATURE REVIEW:

Babar et al [1] studied enhancement in heat exchangers finds much industrial importance because it gives an opportunity to reduce heat transfer surface area required for a given application and thus reduce the heat exchanger size and cost. Commonly used heat transfer enhancement methods are Active, Passive & Compound. In most of applications and key areas like power plants, process & chemical industries uses surface enhancement methods which are the type of passive method. Twisted tape inserts, coil wire, dimpled and extended surfaces are the most effective heat transfer enhancement techniques used due to their easy manufacturing & installation at lower cost, but these methods are only effective in

laminar regions. Active & compound methods are rarely used because of their complexity & cost.

Apet et al. [2] had concluded experimental investigation was carried out on four types of dimpled tube in comparison with plain tube. The effect of dimple structure on heat transfer coefficient and Nusselt number is experimentally investigated. The heat input to band air heater is kept constant and cold air stream flow rate varied in such way that its orifice manometer shows difference of water column 10 mm to 40 mm. The dimples are created on tube are in two pattern, inline and staggered.

Banekar et al. [3] studied an effective method of heat transfer enhancement is required to not only improve the heat transfer, but also minimize the flow resistance as much as possible. Accordingly much research has been carried out on various heat transfer augmentations such as pin fins, louvered fins, off set strip fins, slit fins, ribs, protrusions, and dimples in order to improve the thermal efficiency of heat exchangers. Among various heat transfer enhancers, a dimpled surface shows a high heat transfer capacity with relatively low pressure loss penalty compared to other types of heat transfer enhancers that are available. Therefore, many studies have been conducted in order to determine the heat-transfer characteristics that are induced by the dimpled surface. The present review covers the heat transfer enhancement characteristics in dimple tubes.

Parthasarathy et al [4] had studied heat exchanger consist of triple tube in various diameter. Triple tubes are located to concentric method with U tube arrangement. Hot fluid enters to one end and leave the cold fluids another end. The coolant fluid flow to middle of the tube. The hot fluid flow to remaining two tube with laminar flow of inside of the tubes. This flow is increase the effectiveness of heat transfer rating with U shape. The experimental setup is calculate the convective heat transfer with conduction on the tube heat transfer and effectiveness of heat exchanger. This arrangement is especially reduce the distance of tube length and to increase heat transfer area and reduce the cooling time with U shape.

Behera et al [5] had found in his paper resembles a numerical approach for a new type of thermal energy exchange unit which is a triple concentric tube heat exchanger (TCTHE) .The performance of TCTHE for both parallel and counter flow type arrangements are investigated. Also temperature variation for different flow of the three fluid cold-hot-normal (C-H-N) and normal-hot-cold (N-H-C) along the length of triple tube are done using ANSYS 14. The fluid used is water, hot fluid always flows in the intermediate tube and hot and cold fluid in outer tube and inner tube respectively that may be interchanged. The results obtained shows better result in counter flow type with cold fluid in outer tube and normal fluid in inner tube (NHC arrangement).

Ghiwala et al [6] studied most of the previous study on the heat exchanger is confined to two fluids and few of many possible flow arrangements. The present study involves the sizing of triple concentric pipes heat exchanger where in two cold water streams flow through the central tube and outer annular space at same mass flow rates and same inlet temperatures in co-current direction while hot water flows through inner annular space in counter-current direction. This paper proposes a basic procedure for calculating overall heat transfer coefficients and length of triple concentric pipes heat exchanger. Length of triple pipe heat exchanger is computed for a required temperature drop of hot water with available dimensions of three pipes by LMTD method. Overall heat transfer coefficient and length of the equivalent double pipe heat exchanger are compared with that of the triple pipe heat exchanger. The theoretical analysis shows that introducing an intermediate pipe to the double pipe heat exchanger reduces effective length of heat exchanger, which results in savings in material and space. The triple concentric pipes heat exchanger provides large heat transfer area per unit heat exchanger length and better heat transfer efficiencies compared to double pipe heat exchanger.

4 CONCLUDING REMARK:

- Researchers have worked on triple tube heat exchanger Dimples & threading on the tube is more effective if, no pressure drop penalty is considered.
- Better heat transfer rate is observed as turbulence increases, increase in friction factor is observed.
- The heat transfer coefficient enhancement in triple tube is higher than that of double tube heat exchanger.

5 CONCLUSION:

In this study we will lead to findings on the effect of triple tube on heat transfer. It is expected from this

research work that the applications of CFD and experimental results are nearly equal to same in triple tube heat exchanger by providing turbulence in inner tube and spiral movement of fluid in the intermediate tube of the triple heat exchanger.

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