Experimental Investigation of Heat Transfer Enhancement by Using Varying Width Twisted Tape Insert with Circular Holes-A Review

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***Abstract*- Tubular heat exchanger is a device that enables exchange of heat between two fluids which are at different temperatures and separated by a solid wall occurs in many engineering applications. The one way to enhance the performance of Tubular heat exchanger is to improve tube side heat transfer rate. Twisted tape insert is one of the passive heat transfer enhancement techniques, which are extensively used in various heat transfer applications such as, air conditioning and refrigeration systems, heat recovery processes, food and dairy processes, chemical process plants.**
A small scale experimental setup was done to enhance the heat transfer rate of tubular heat exchanger.
The turbulent flow was created by inserting the twisted tape inserts into the test pipe creating high rate of turbulence in pipe, which results in increasing heat transfer enhancement and pressure drop.

***Index Terms*- Heat Exchanger, Twisted tape Inserts, Twisted tape inserts with different twisted ratio, Pressure Drop, Reynolds number, Nusselt number.**

INTRODUCTION

Heat exchanger is a device facilitating heat transfer between two or more fluids. Heat exchangers are widely used in various industrial processes for heating and cooling applications such as air conditioning and refrigeration systems, thermal power plants, heat recovery processes, food and dairy processes, chemical process plants etc. The major challenge in designing a heat exchanger is to make the equipment compact and achieve a high heat transfer rate using minimum pumping power. Techniques for heat transfer augmentation are relevant to several engineering applications. In recent years, the high cost of energy and material has resulted in an increased effort aimed at producing more efficient heat exchange equipment. Furthermore, sometimes there is a need for miniaturization of a heat exchanger in specific applications, such as space application, through an augmentation of heat transfer. The heat transfer rate can be improved by introducing a disturbance in the fluid flow thereby breaking the viscous and thermal boundary layer. However, in the process pumping power may increase significantly and ultimately the pumping cost becomes high. Therefore, to achieve a desired heat transfer rate in an existing heat exchanger at an economic pumping power, several techniques have been proposed in recent years. They are broadly classified into three different categories:

1. Passive Techniques 2. Active Techniques 3. Compound Techniques.
1. Passive Techniques: These techniques do not require any direct input of external power; rather they use it from the system itself which ultimately leads to an increase in fluid pressure drop. They generally use surface or geometrical modifications to the flow channel by incorporating inserts or additional devices like twisted tapes, twisted wires, circular rings, mesh inserts, helical screw inserts ribs etc. They promote higher heat transfer coefficients by disturbing or altering the existing flow behavior except for extended surfaces.
2. Active Techniques: This method involves some external power input for the enhancement of heat transfer; some examples of active methods include induced pulsation using reciprocating plungers, electrostatic fields, surface vibrations etc.
3. Compound Techniques: When any two or more of these techniques are employed simultaneously to obtain enhancement in heat transfer that is greater

than that produced by either of them when used individually, is termed as compound enhancement. This technique involves complex design and hence has limited applications. In this project, I will use passive technique for heat transfer enhancement by using varying width twisted tape with circular holes.

Research Methodology to be Employed: The water in the bath is heated to the desired temperature. Each set of reading is taken at 60°C, 65°C, 70°C and 75°C. The cold water from the storage is pumped through the tube which is present inside the heated water bath and the flow is controlled using a rotameter. Heat transfer from the bath to the water in the tube takes place due to natural convection since the water flowing through the tube cools the bath slightly and due to this the density of the water at the outside surface of the tube changes, generating natural convection currents. This heat is then transferred to the water flowing inside the tube via forced convection. Temperature of water at the inlet and the outlet of the copper tube are measured. This is repeated for different water bath temperatures and flow rates of the water. All the joints are sealed with the help of a sealant to prevent any leakage. For the experiment, water bath is fixed as the hot fluid as it is easier to maintain the water bath at higher temperatures with the help of heaters. The cool fluid (water in this case) is the tube side fluid, which is pumped from storage.

Benefits of modified Design

- Heat transfer rate is increase by using twisted type inserts.
- It reduces the pressure drop and fouling factor.

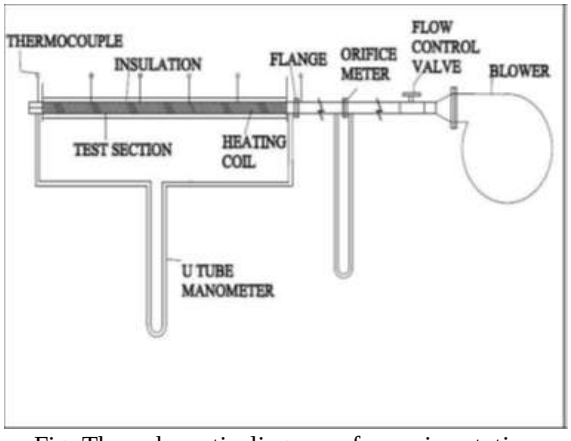

Fig. The schematic diagram of experimentation

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