

ENHANCEMENT OF HEAT TRANSFER IN DOUBLE PIPE HEAT EXCHANGER USING TWISTED TAPES

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ABSTRACT

To improve the performance of heat exchanging devices for reducing material cost and surface area and decreasing then difference for heat transfer thereby for reducing external irreversibility, lot of techniques have been used. Among different passive means to increase heat transfer coefficient, twisted tape inserts are promising. The secondary flow (swirl flow) generated by twisted tape effects fluid flow across the tape-partitioned tube, promotes greater mixing and higher heat transfer coefficients [1]. Experimental investigation of heat transfer and friction factor characteristics in a double pipe heat exchanger fitted with regularly spaced twisted tape elements were studied by Eiamsa-ard et al.,. So our start from these research paper as reference with addition of enhancing dimension of tape to increase heat transfer rate.

Keywords: Heat exchanger, twisted tapes

INTRODUCTION

A heat exchanger is a device used to transfer heat between a solid object and a fluid, or between two or more fluids. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact. They are widely used in space heating, refrigeration, air conditioning, power stations, chemical plants, petrochemical plants, petroleum refineries, natural-gas processing, and sewage treatment.



Figure 1 Actual view of heat exchanger[6]

1.1 Types of heat exchanger:-

Double pipe heat exchangers are the simplest exchangers used in industries. On one hand, these heat exchangers are cheap for both design and maintenance, making them a good choice for small industries. On the other hand, their low efficiency coupled with the high space occupied in large scales, has led modern industries to use more efficient heat exchangers like shell and tube or plate. However, since double pipe heat exchangers are simple, they are used to teach heat exchanger design basics to students as the fundamental rules for all heat exchangers are the same.

1.1.1 Shell and tube heat exchanger:-

Shell and tube heat exchangers consist of series of tubes. One set of these tubes contains the fluid that must be either heated or cooled. The second fluid runs over the tubes that are being heated or cooled so that it can either provide the heat or absorb the heat required. A set of tubes is called the tube bundle and can be made up of several types of tubes: plain, longitudinally finned, etc. Shell and tube heat exchangers are typically used for high-pressure applications (with pressures greater than 30 bar and temperatures greater than 260 °C). This is because the shell and tube heat exchangers are robust due to their shape.

Several thermal design features must be considered when designing the tubes in the shell and tube heat exchangers: There can be many variations on the shell and tube design. Typically, the ends of each tube are connected to plenums (sometimes called water boxes) through holes in tube sheets. The tubes may be straight or bent in the shape of a U, called U-tubes.

1.1.2 Plate heat exchangers:-

Another type of heat exchanger is the plate heat exchanger. These exchangers are composed of many thin, slightly separated plates that have very large surface areas and small fluid flow passages for heat transfer. Advances in gasket and brazing technology have made the plate-type heat exchanger increasingly practical. In HVAC applications, large heat exchangers of this type are called plate-and-frame; when used in open loops, these heat exchangers are normally of the gasket type to allow periodic disassembly, cleaning, and inspection. There are many types of permanently bonded plate heat exchangers, such as dip-brazed, vacuum-brazed, and welded plate varieties, and they are often specified for closed-loop applications such as refrigeration. Plate heat exchangers also differ in

the types of plates that are used, and in the configurations of those plates. Some plates may be stamped with "chevron", dimpled, or other patterns, where others may have machined fins and/or grooves.

1.1.3 Plate and shell heat exchanger:-

A third type of heat exchanger is a plate and shell heat exchanger, which combines plate heat exchanger with shell and tube heat exchanger technologies. The heart of the heat exchanger contains a fully welded circular plate pack made by pressing and cutting round plates and welding them together. Nozzles carry flow in and out of the plate pack (the 'Plate side' flow path). Plate and shell technology offers high heat transfer, high pressure, high operating temperature, uling and close approach temperature. In particular, it does completely without gaskets, which provides security against leakage at high pressures and temperatures.

PROBLEM STATEMENT AND PROPOSED EXPERIMENTAL WORK

Here we enhance the heat transfer rate of shell and tube heat exchanger by using twisted tip.

3.1 Shell and tube boiler:-

Shell and tube heat exchangers consist of series of tubes. One set of these tubes contains the fluid that must be either heated or cooled. The second fluid runs over the tubes that are being heated or cooled so that it can either provide the heat or absorb the heat required. A set of tubes is called the tube bundle and can be made up of several types of tubes: plain, longitudinally finned, etc. Shell and tube heat exchangers are typically used for high-pressure applications (with pressures greater than 30 bar and temperatures greater than 260 °C). This is because the shell and tube heat exchangers are robust due to their shape. The shell and tube boiler is as shown in figure 3.1.1

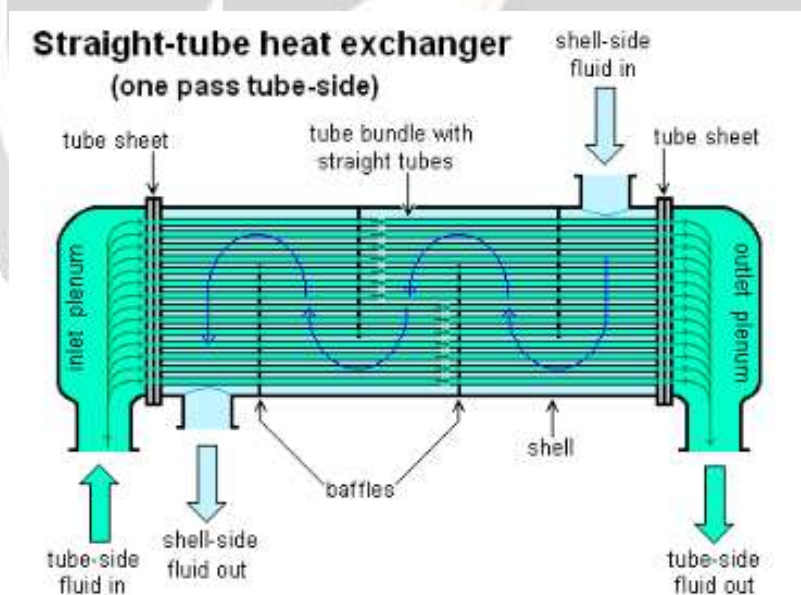


Figure 2 Shell and tube type heat exchanger[6]

Several thermal design features must be considered when designing the tubes in the shell and tube heat exchangers: There can be many variations on the shell and tube design. Typically, the ends of each tube are connected to plenums (sometimes called water boxes) through holes in tube sheets. The tubes may be straight or bent in the shape of a U, called U-tubes.

Tube diameter: Using a small tube diameter makes the heat exchanger both economical and compact. However, it is more likely for the heat exchanger to foul up faster and the small size makes mechanical cleaning of the fouling difficult. To prevail over the fouling and cleaning problems, larger tube diameters can be used. Thus to determine the tube diameter, the available space, cost and fouling nature of the fluids must be considered.

Tube thickness: The thickness of the wall of the tubes is usually determined to ensure:

1. There is enough room for corrosion That flow-induced vibration has resistance Axial strength
2. Availability of spare parts
3. Hoop strength (to withstand internal tube pressure)
4. Buckling strength (to withstand overpressure in the shell)

Tube length: heat exchangers are usually cheaper when they have a smaller shell diameter and a long tube length. Thus, typically there is an aim to make the heat exchanger as long as physically possible whilst not exceeding production capabilities. However, there are many limitations for this, including space available at the installation site and the need to ensure tubes are available in lengths that are twice the required length (so they can be withdrawn and replaced). Also, long, thin tubes are difficult to take out and replace.

Tube pitch: when designing the tubes, it is practical to ensure that the tube pitch (i.e., the centre-centre distance of adjoining tubes) is not less than 1.25 times the tubes' outside diameter. A larger tube pitch leads to a larger overall shell diameter, which leads to a more expensive heat exchanger.

Tube corrugation: this type of tubes, mainly used for the inner tubes, increases the turbulence of the fluids and the effect is very important in the heat transfer giving a better performance.

Tube Layout: refers to how tubes are positioned within the shell. There are four main types of tube layout, which are, triangular (30°), rotated triangular (60°), square (90°) and rotated square (45°). The triangular patterns are employed to give greater heat transfer as they force the fluid to flow in a more turbulent fashion around the piping. Square patterns are employed where high fouling is experienced and cleaning is more regular.

Baffle Design: baffles are used in shell and tube heat exchangers to direct fluid across the tube bundle. They run perpendicularly to the shell and hold the bundle, preventing the tubes from sagging over a long length. They can also prevent the tubes from vibrating. The most common type of baffle is the segmental baffle. The semicircular segmental baffles are oriented at 180 degrees to the adjacent baffles forcing the fluid to flow upward and downwards between the tube bundles. Baffle spacing is of large thermodynamic concern when designing shell and tube heat exchangers. Baffles must be spaced with consideration for the conversion of pressure drop and heat transfer. For thermo economic optimization it is suggested that the baffles be spaced no closer than 20% of the shell's inner diameter. Having baffles spaced too closely causes a greater pressure drop because of flow redirection. Consequently, having the baffles spaced too far apart means that there may be cooler spots in the corners between baffles. It is also important to ensure the baffles are spaced close enough that the tubes do not sag. The other main type of baffle is the disc and doughnut baffle, which consists of two concentric baffles. An outer, wider baffle looks like a doughnut, whilst the inner baffle is shaped like a disk. This type of baffle forces the fluid to pass around each side of the disk then through the doughnut baffle generating a different type of fluid flow.

Experimental set in project stage II:-

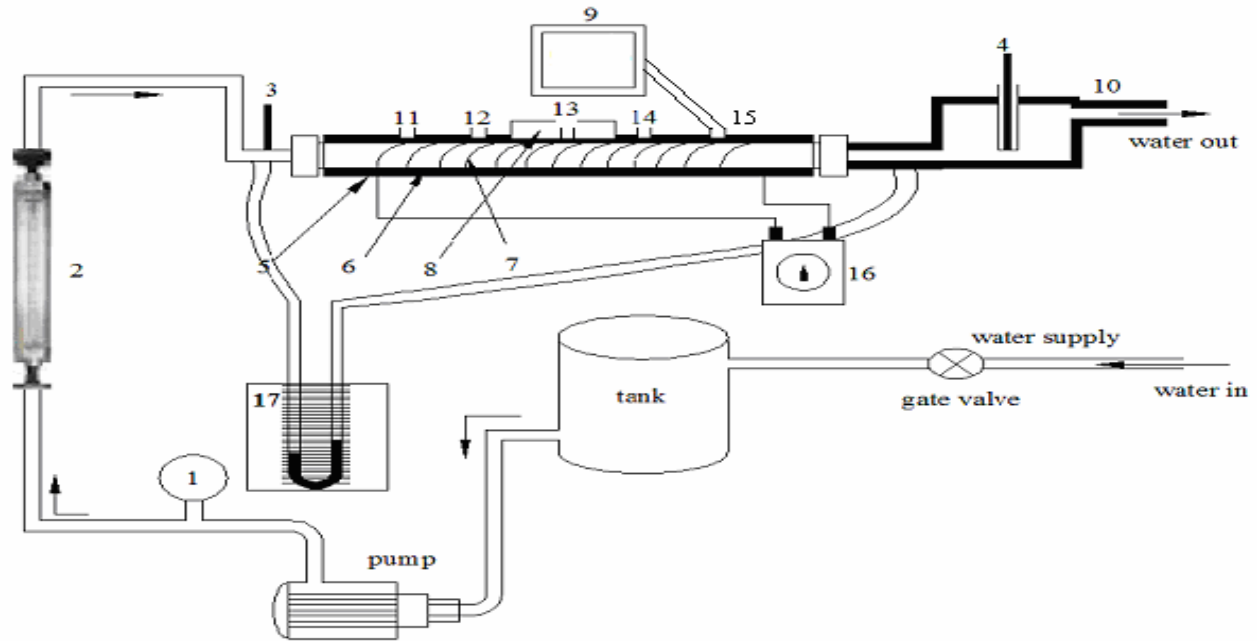


Figure 3 Experimental set up [1]

The probable schematic diagram of the experimental set up for project stage II is as shown in fig 3.2.1. Initially, water was taken in the tank and pumped to the test section through the rotameter. The flow rate of water was varied by the gate valve for different data and kept constant during the experiment. Following twisted tip that going to be used to enhanced heat transfer rate in shell and tube type heat exchanger as shown below in fig 3.2.2.

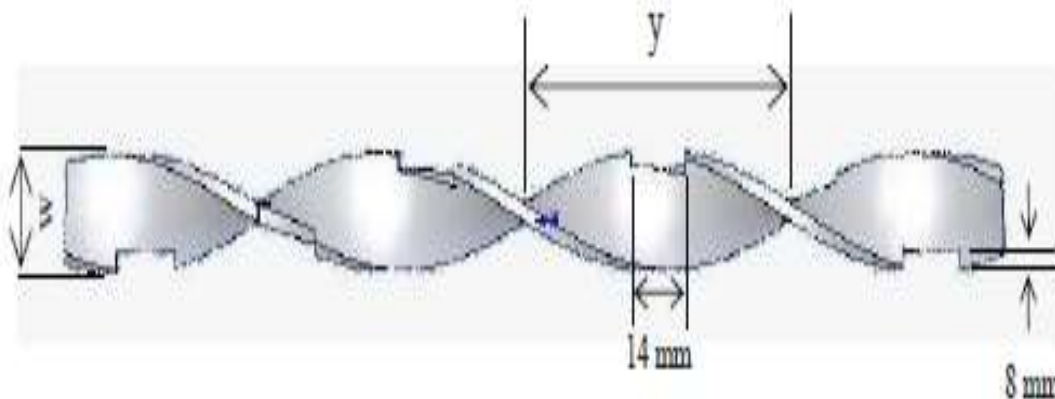


Figure 4 Twisted tip [1]

Work to be done in Stage II:-Following path is followed for the proceeding project work for project stage II

Table 1 Project stage II work



Sr. No.	Month	Task to be done
1	November 2017	Review research paper proceeding and paper publication on project stage I
2	December 2017	Design calculation and manufacturing of twisted tip.
3	January 2018	Experimental set up
4	February 2018	Experimental set up and calculating results.
5	March 2018	Final research paper proceeding for project stage II and paper publication on project stage II.
6	April 2017	Report writing with guidance from project guide and final presentation preparation.

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8.BIOGRAPHY

	<p>Mr. Bhusare Dipak, student of the Snd Collage of Engineering & Research Center Yeola, Nashik-423401, Maharashtra, India.in the year 2017-2018 in the mechanical Engineering. Work on the project “ENHANCEMENT OF HEAT EXCHANGER USING TWISTED TAPE”.</p>
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	<p>Prof. Sawant S.G.,Assistant Professor, of the Snd Collage of Engineering & Research Center Yeola, Nashik-423401, Maharashtra, India.in the year 2017-2018. In the mechanical Engineering. Work on the project “ENHANCEMENT OF HEAT EXCHANGER USING HELICAL RIB”.</p>

