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# HEAT TRANSFER ENHANCEMENT IN SHELL AND TUBE HEAT EXCHANGERS USING TWISTED TAPES

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**ABSTRACT**

*Heat exchangers are widely used in thermal applications. The effective performance of heat exchangers depend on their heat transfer rate. In this work an attempt is made to study the effect of twisted tape inserts in increasing the heat transfer rate. The water to water system is considered with hot water on shell side and cold water on tube side. It was found that the heat transfer rate increases with usage of twisted tapes.*

**Key words:** Heat exchangers, Heat transfer rate, Twisted tapes.

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## 1. INTRODUCTION

The heat exchangers have found wide applications in industries. Of late, the emphasis is on improving the heat transfer rate of heat exchangers. From published literatures it was evident that usage of inserts increases the overall heat transfer rate of heat exchangers. [1-4]

A twisted tape is a metal strip twisted about its longitudinal axis, the width being equal to the internal diameter of the tube in which it is inserted. The tape has a sliding fit in the tube and produces two identical ,interwinned channels of the semi-circular cross section. Thus the tape causes a helical type flow with a strong secondary motion which leads to an enhancement of heat transfer. An additional factor leading to enhancement is that the tape itself acts as a fin and provides additional heat transfer surface.[5-9]

The objective of this work is to study the influence of twisted tape inserts in enhancing the heat transfer rate in a heat exchanger.

## 2. EXPERIMENTAL METHOD

The hot water which was heated by the heating coil fitted in the tank is pumped through the shell side of the heat exchanger using centrifugal pump of 0.5 HP capacity. Hot water flow is controlled by a valve.

A bypass is provided in the discharge line of pumps to avoid damages caused to the pump by the variation in flow rates of fluids.

For efficient heating the shell side fluid is recirculated. Cold water is pumped through the tube side of the heat exchangers using a centrifugal pump. Cold water flow rate is controlled by a valve fitted in the inlet side. Hot water inlet and outlet temperatures are noted at steady states. This procedure is done for without packing condition initially. The same procedure was repeated after usage of twisted tape packing.[10-16]

## 3. RESULTS AND DISCUSSION

The table 1, depicts the experimental results without using twisted tape.

It is inferred from table 1 that the heat transfer rate is minimum.

The table 2 represents the experimental results after using the twisted tapes.

It is evident that the overall heat transfer coefficient increases after usage of the twisted tape inserts.[17-20]

**Table 1** Results of without packing condition

| **Mass flow rate (kg/s)** | | **Shell Side (°C)** | | **Tube side (°C)** | | **Overall heat transfer coefficient w/m$^2$K** |
|---|---|---|---|---|---|---|
| **Shell side** | **Tube side** | **Thi** | **Tho** | **Tci** | **Tco** | |
| 0.016 | 0.033 | 75 | 72 | 25 | 31 | 194 |
| 0.02 | | 75 | 67 | 25 | 33 | 199 |
| 0.025 | | 75 | 65 | 25 | 35 | 210 |
| 0.033 | | 75 | 60 | 25 | 39 | 217 |
| 0.05 | | 75 | 58 | 25 | 41 | 225 |

**Table 2** Results of twisted tape inserts

| **Mass flow rate (kg/s)** | | **Shell Side (°C)** | | **Tube side (°C)** | | **Overall heat transfer coefficient w/m$^2$K** |
|---|---|---|---|---|---|---|
| **Shell side** | **Tube side** | **Thi** | **Tho** | **Tci** | **Tco** | |
| 0.016 | 0.033 | 75 | 67 | 25 | 35 | 201 |
| 0.02 | | 75 | 64 | 25 | 38 | 210 |
| 0.025 | | 75 | 59 | 25 | 42 | 220 |
| 0.033 | | 75 | 51 | 25 | 45 | 225 |
| 0.05 | | 75 | 45 | 25 | 47 | 229 |

The increment in heat transfer due to usage of twisted tape is due to creation of turbulence inside the heat exchangers. The twisted tapes continuously interchange the fluid elements between the wall and center of conduit, thereby providing enhanced heat transfer. Additional power is not required for the twisted tape as they utilize the power of the fluid as such and diverts them to the walls. The twisted tape successfully divide and recombine the portions of the fluid stream. Due to the above mentioned reasons the twisted tape inserts enhances the heat transfer rate.

## 4. CONCLUSIONS

The effect of usage of twisted tape inserts in enhancing the overall heat transfer rate has been studied in a shell and tube heat exchanger. It is possible to increase the overall heat transfer rate by usage of twisted tapes.

The twisted tapes increases the heat transfer rate by increasing the turbulence.

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