A REVIEW PAPER OF TWISTED TAPE INSERTS

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ABSTRACT
This paper presents an intensive review of heat exchangers with twisted tape inserts. The main motive of this work to find out the best possible efficient heat exchanger configuration. Heat exchanger with wire coil inserts has highest heat exchanging capability. Double counter twist inserts outperformed other configuration when thermohydraulic performance is considered.

INTRODUCTION
In this era of industrialization and modernization, energy play vital role in the development of nation. Solar air heater[1-2], solar water heater[3-4] and heat exchanger are the main components of thermal energy systems. Heat exchangers are key components of refrigeration[5-7] and cryogenic systems[8]. Efficient heat exchangers are the need of today world, as the fossil fuels depleted with very fast rate[9].

A Review of Heat transfer features of diverse inserts.
Twisted Tape inserts
The Twisted Tape inserts fir introduced by Sir Whitham et al. There are many kinds of Twisted Tape inserts used for heat transfer enhancement factor.

Inserts are modified as per previous study in augmentation of thermo-hydraulic performance. Passive techniques are always in keen interest as these are economic. Inserts also give compactness to heat exchangers. The inserts the strips of metals with different geometrical configuration. The types of twisted tapes are as follows:
1. Tapes with twist ratio
2. Perforated Tapes
3. Cut Tapes
4. Doble twist tapes
5. Dimple tapes
6. Coupling
7. V-cut tapes
8. V-finned
9. Tappered
10. Clock wise twisted
11. NonUniform tapes
12. Continious spaced
13. Trapaziodial
14. Quadrapule cut
15. U cut
16. Multiple quadrapule
17. Double v-ribbed
18. Perforated and helical etc.

The description of tapes are presented in Table.1 given below.
<table>
<thead>
<tr>
<th>Type of Twisted Tapes</th>
<th>Re Range</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perforated [10]</td>
<td>5000-20,000</td>
<td><img src="image1" alt="Perforated Tape" /></td>
</tr>
<tr>
<td>Full length dual regularly spaced [11]</td>
<td>4000-19,000</td>
<td><img src="image2" alt="Full Length Tape" /></td>
</tr>
<tr>
<td>Alternate clockwise &amp; counter clockwise [12]</td>
<td>830-1990</td>
<td><img src="image3" alt="Alternate Tape" /></td>
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<tr>
<td>Delta winglet [13]</td>
<td>3000-27,000</td>
<td><img src="image4" alt="Delta Winglet" /></td>
</tr>
<tr>
<td>Coupling [14]</td>
<td>6000-15,000</td>
<td><img src="image5" alt="Coupling Tape" /></td>
</tr>
<tr>
<td>Multiple [15]</td>
<td>2700-9000</td>
<td><img src="image6" alt="Multiple Tape" /></td>
</tr>
<tr>
<td>Trapezoidal cut [16]</td>
<td>2000-12000</td>
<td><img src="image7" alt="Trapezoidal Tape" /></td>
</tr>
<tr>
<td>Type of Twisted Tapes</td>
<td>Re Range</td>
<td>Figure</td>
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<td>---------------------------------------------</td>
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<tr>
<td>Short length [17]</td>
<td>4000-20000</td>
<td><img src="image1" alt="Short length" /></td>
</tr>
<tr>
<td>V-Finned [18]</td>
<td>4000-30000</td>
<td><img src="image2" alt="V-Finned" /></td>
</tr>
<tr>
<td>Non uniform coil &amp; twisted tape[19]</td>
<td>4600-20000</td>
<td><img src="image3" alt="Non uniform" /></td>
</tr>
<tr>
<td>Tapered [20]</td>
<td>6000-20000</td>
<td><img src="image4" alt="Tapered" /></td>
</tr>
<tr>
<td>Non uniform [21]</td>
<td>4000-16000</td>
<td><img src="image5" alt="Non uniform" /></td>
</tr>
<tr>
<td>Dimple tube with a twisted tape[22]</td>
<td>12000-44000</td>
<td><img src="image6" alt="Dimple tube" /></td>
</tr>
<tr>
<td>Trapezoidal cut plain [23]</td>
<td>2000-12000</td>
<td><img src="image7" alt="Trapezoidal" /></td>
</tr>
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<tr>
<td>Multiple quadruple counter [24]</td>
<td>5000-30000</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>Wire coil inconjunction with twisted tape [25]</td>
<td>3000-18000</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>Double V-Ribbed [26]</td>
<td>5300-24000</td>
<td><img src="image3.png" alt="Image" /></td>
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<tr>
<td>U cut [27]</td>
<td>2000-12000</td>
<td><img src="image4.png" alt="Image" /></td>
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<tr>
<td>Perforated helical [28]</td>
<td>6000-20000</td>
<td><img src="image5.png" alt="Image" /></td>
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<tr>
<td>Twin Delta winglet [29]</td>
<td>5000-15000</td>
<td><img src="image6.png" alt="Image" /></td>
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<tr>
<td>Cross hollow [30]</td>
<td>5600-18000</td>
<td><img src="image7.png" alt="Image" /></td>
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<tr>
<td>Regularly spaced quadruple [31]</td>
<td>7000-25000</td>
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</table>

**GRAPHHS**

![Graph showing effect of Re on Nusselt number enhancement ratio](image)

**Fig. 1. Effect of Re on Nusselt number enhancement ratio**

- Sdtt – single dual twisted tape
- Cctt – co coupling twisted tape
- Coctt – counter coupling twisted tape
- Mtt – multiple twisted tape
- Sltt – short length twisted tape
- Vfctt – v finned counter twisted tape
- Dwct – Di wire coil with twisted tape
- Ttt – tapered twisted tape
- Dttt – dimpled tube twisted tape
- Tcct – trapezoidal cut twisted tape
- Mqtt – multiple quadruple twisted tape
- Wcctt – wire coil inconjunction with twisted tape
- Dvrtt – double v ribbed twisted tape
- Tdwwtt – twin delta winged twisted tape
- Chtt – cross hollow twisted tape
- Rqutt – regularly spaced quadruple twisted tape
- Dcctt – double counter twisted tape
- Coctt – counter coupling twisted tape

Fig. 2. Effect of Reynolds number on $\eta$ for air as fluid

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Coctt – counter coupling twisted tape
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Ttt – tapered twisted tape
Dttt – dimpled tube twisted tape
tctt – trapezoidal cut twisted tape
mqtt – multiple quadruple twisted tape
Wcctt – wire coil inconnection with twisted tape
dvtt – double v ribbed twisted tape
tdwt – twin delta winged twisted tape
Chtt – cross hollow twisted tape
Rqutt – regularly spaced quadruple twisted tape
dctt – double counter twisted tape
RESULT AND DISCUSSION

The Thermo hydraulic performance parameter ($\eta$) defined below by eq 1.

$$\eta = \frac{Nu}{Nu_s} \left( \frac{F_s}{F} \right)^{1/3}$$

S – Smooth tube

Fig 2: shows the graph of different geometries of inserts used for air. The graph of thermal performance factor for air tell that efficiency diminish with growing values of Reynold number in each case. The thermal performance factor of non uniform coil and twisted tape lies in the range of 2.5 – 2.7 and other are below this range so the better thermal performance factor is for non uniform coil and twisted tape.

Hence, thermo hydraulic efficiency for inserts used has better performance.

CONCLUSIONS

This review paper emphasize on different TT.

Thus we selected diverse TT layouts for two working fluids first is air and second is water, and we got different result of thermal performance factor, nusselt number, friction factor. We got thermal performance factor more than unity for maximum geometry of twisted tape inserts of air as a working fluid & got thermal performance factor more than unity for each geometry of twisted tape inserts of water as a working fluid. The maximum thermal performance factor for water is 2.3 for trapezoidal cut twisted tape (TCT) and for air maximum thermal performance factor is 2.7 for DI coil and twisted tape (DCTT).

REFERENCES


31 Y. He, L. Liu, P. Li, L. Ma, Experimental study on Heat transfer enhancement characteristics of tube with cross hollow twisted tape inserts, Applied Thermal Engineering (2017).