CFD Analysis and Performance Evaluation of Concentric Tube in Tube Heat Exchanger

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Abstract
An objective of the present dissertation work is to design and develop a CAD model of Tube in tube type counter flow Heat exchanger. The Dissertation is about preparing the CAD model as well modifying an experimental setup of tube in tube heat exchanger and use of different type of inner tube configuration for the estimation of heat transfer, pressure drop and change in velocity gradient. The experimental results are compared with the CFD results using CFD package, ANSYS CFX 14.0. A design has been made taking into consideration all the above mentioned Parameters and other Real life circumstances which is also a part of this report.

Keywords: Helical Coil, Shell and Mandrel, Coil Pitch, Reynolds Number, Heat Transfer, Mass Flow Rate, CFD Simulation

I. INTRODUCTION

The concentric tube heat exchanger consists of two tubes that are concentrically arranged. One of the fluid (either hot or cold fluid) flows through the tube and the other through the annulus. For a CTHX, two types of flow arrangements are possible - co-current and counter-current flow. In the parallel or co-current arrangement, the flow direction of the hot fluid will be the same as that of the cold fluid. In the counter-current arrangement, the flow directions of the hot and the cold fluids are opposite to each other.

General Heat Transfer Concepts
Heat is a form of energy that flows due to difference in temperature between two points that are located within a medium or in two different media. The transfer of heat occurs via one or any combination of the three modes of heat transfer - conduction, convection and radiation. Generally, the radiation heat transfer is of little importance for heat exchangers operating at low temperatures and will not be considered here. Thus, the discussion here will be limited to convective and conductive heat transfers.

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II. GEOMETRY

The first task to accomplish in a numerical flow simulation is the definition of the geometry followed by the grid generation.
A. **Outlet Temperature:**

The maximum outlet temperature of Inner tube side is 320 K and for outer tube side is 303K are obtained from the result generated by CFD post as shown in below Fig.
B. Pressure Contour of Inner Copper Tube:

The maximum outlet temperature at Inner tube side is 321K and for outer tube side is 309.8K are obtained from the result generated by CFD post as shown in below fig

C. Dimple Tube with 60 Mm Pitch:
The maximum outlet temperature at Inner tube side is 321K and for outer tube side is 309.8K are obtained from the result generated by CFD post as shown in below fig
Fig. 7: (B) Temperature Profile of Outer side tube (Pitch = 60 mm)

### Table – 1

<table>
<thead>
<tr>
<th>Temperature (K)</th>
<th>Results obtained by Ansys CFX(40mm)</th>
<th>Results obtained by Ansys CFX(50mm)</th>
<th>Results obtained by Ansys CFX(60mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner tube side outlet</td>
<td>319</td>
<td>318</td>
<td>321</td>
</tr>
<tr>
<td>Outer tube side outlet</td>
<td>313</td>
<td>311</td>
<td>309</td>
</tr>
</tbody>
</table>

![Diagram showing inlet and outlet boundary condition for tube in tube type heat exchange](image)

Fig. 3: Inlet and Outlet Boundary Condition for Tube in Tube Type Heat Exchange

### III. CONCLUSION

1) The Temperature difference between outlet temperature of simple inner tube and dimpled inner tube is 3K. So from the result we concluded that the dimpled inner tube having higher heat transfer rate than the simple one.
2) There is no deviation in pressure loss for both the cases. (i.e. pressure drop in both case = 3 Pa).
3) When pitch is increased the outer tube side outlet temperature is decreased and inner tube side outlet temperature is increased so heat transfer rate is increased.

### REFERENCES


