CFD (Computational Fluid Dynamics) of Heat Exchanger using Twisted GI Wire with and without Baffles

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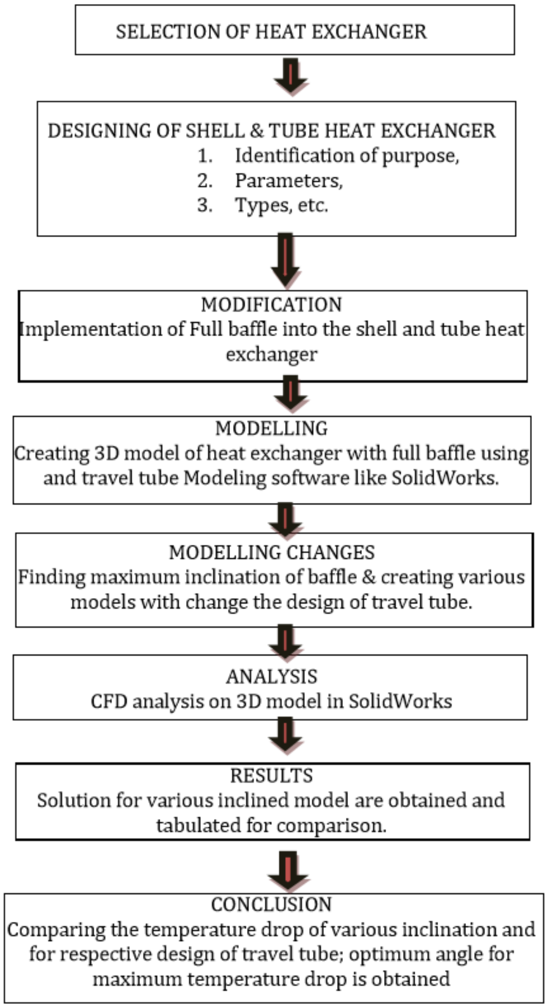
***Abstract*- This study deals with the use of GI wires as passive heat transfer augmentation device. Effect of twisted GI wire with and without baffles with varying baffle spacing is studied experimentally in a double pipe heat exchanger. The effect of turbulence created by twisted wires & baffles on Nusselt number is compared with that of the theoretical one.**

***Index Terms*- Heat transfer augmentation, CFD, Nusselt number, Twisted GI WireI.**

INTRODUCTION

The conversion, utilization, and recovery of energy in industrial, commercial, and domestic application sometimes involve a heat transfer method. Improved heat exchange, over and above that in the usual or standard practice, can significantly improve the thermal efficiency in such applications as well as the economics of their design and operation. The requirement to extend the thermal performance of warmth primarily based equipment (for instance, heat exchangers), thereby effecting energy, material, and value savings furthermore as an important mitigation of environmental degradation has LED to the event and use of the many heat transfer improvement techniques. These ways square measure cited as augmentation or intensification techniques. Enhancement techniques primarily cut back, for instance, the thermal resistance during a conventional device by promoting higher convective heat transfer constant with or without expanse will increase (as diagrammatic by fins or extended surfaces). As a result, the size of a device is reduced, or the warmth duty of Associate in nursing existing money dealer is magnified, or the exchanger's in operation approach temperature distinction is faded. The latter is particularly helpful in thermal process of organic chemistry, food, plastic, and pharmaceutical media, to avoid thermal degradation of the tip product. On the opposite hand, heat exchange systems in artificial satellite, electronic devices, and medical applications, for instance, may rely primarily on increased thermal performance for his or her in operation. In the gift work, heat transfer improvement for fluid flowing through a pipe with wire coil inserts is to be analyzedvictimization machine Fluid Dynamics (CFD). The spectacular enhancements in pc performance, matched by developments in numerical methods, have resulted during a growing confidence within the ability of CFD to model advanced fluid flows. CFD techniques are applied on a broad scale within the method business to realize insight into varied flow phenomena, examine totally different instrumentality styles or compare performance under totally different in operation conditions. The twisted GI wires are used as passive heat transfer augmentation device. Effect of twisted GI wires without baffles and with baffles, with varying baffle spacing are studied in this project with help of CFD (Computational Fluid Dynamics) Analysis. The Baffle spacing is of 3 cm, 6 cm and 12 cm. When the water flow through the pipe containing baffles, it create an obstruction to the flow and create a turbulence. The effect of turbulence created by twisted wires and baffles on Nusselt number is compared with that of smooth tube using CFD analysis.

METHODOLOGY

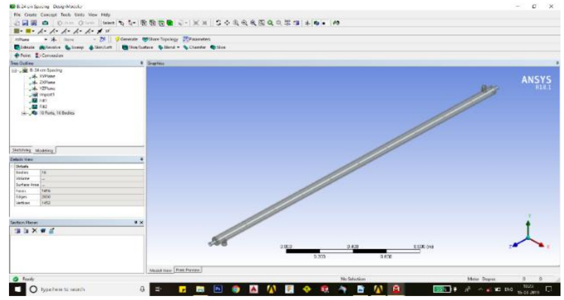


HELPFUL HINTS

Dimensions

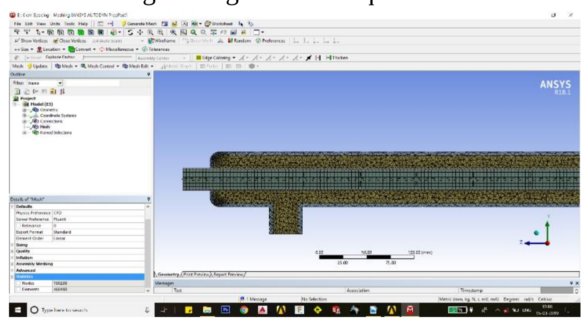
Sr.no	Parameter	Dimension
1	Type of Heat Exchanger	1-1 pass shell and tube 2
2	Shell diameter	61mm
3	Shell length	2000mm
4	Shell thickness	4mm
5	Tube diameter	25mm
6	Tube length	2430mm
7	Tube thickness	1.5mm
8	Baffle spacing	60mm,120mm & 240mm

GEOMETRY MODELING: First the geometry of the model is created in SOLIDWORKS. The model is saved in Para solid type file i.e. (.xt). The external geometry file is imported in the design modeller of the ansys fluent



MESHING:

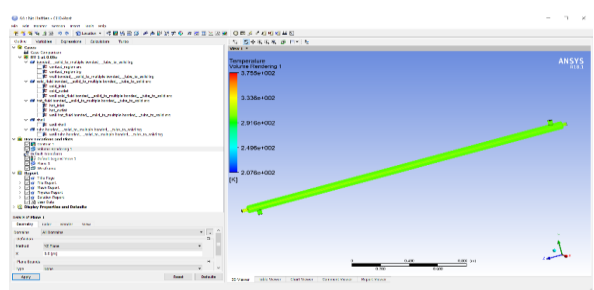
In free meshing a relatively coarse mesh is generated. It contains both tetrahedral and hexahedral cells having triangular and quadrilateral at the



boundaries. Later, a fine mesh is generated using edge sizing. In this, the edges and regions of high pressure and temperature gradients are finely meshed.

SOLUTION INITIALIZATION:

Pressure Velocity coupling selected as SIMPLEC. Skewness correction was set at 0. In Spatial Discretization zone Gradient was set as “Least square cell based” .Pressure was “standard” .Momentum was “First order Upwind”. Turbulent Kinetic energy was set as “First order Upwind”. Energy was also set as “First order Upwind”. Solution initialization was “standard method” and solution was initialize from inlet with 300k temperature. Under the Above boundary condition and solution initialize condition simulation was set for 100 iteration.



Working Principle

Heat exchangers work because heat naturally flows from higher temperature to lower temperatures. Therefore if a hot fluid and a cold fluid are separated by a heat conducting surface heat can be transferred from the hot fluid to the cold fluid.
There are two types of heat exchange
1. Parallel flow
2. Counter flow.

1.Parallel Flow: - In parallel flow heat exchangers, the two fluids enter the exchanger at the same end, and travel in parallel to one another to the other side

2.Counter flow: - In counter flow heat exchangers the fluids enter the exchanger from opposite ends.
The counter current design is the most efficient, in that it can transfer the most heat from the heat (transfer) medium per unit mass due to the fact that the average temperature difference along any unit length is higher.
For efficiency, heat exchangers are designed to maximize the surface area of the wall between the two fluids, while minimizing resistance to fluid flow through the exchanger

DATA COLLECTION

Properties:-
Galvanized Iron (GI) - a) Syt -80-110 MPa
b) Density- 7850 kg/m3
c) Melting Point- 1510 deg C
Copper (Cu)- a) Thermal Conductivity- 386 W/m
b) Density- 8920 kg/m3
c) Melting Point- 1085o C

Aluminium (Al)-a) Thermal Conductivity-0.57 Cal/cms.oC
b) Density- 2689.8 kg/m3
Galvanized iron has a good resistance to corrosion.
Copper and Aluminium have good thermal conductivity

RESULT

In 6cm baffles the hot water temperature comes out to be 380C

CONCLUSION

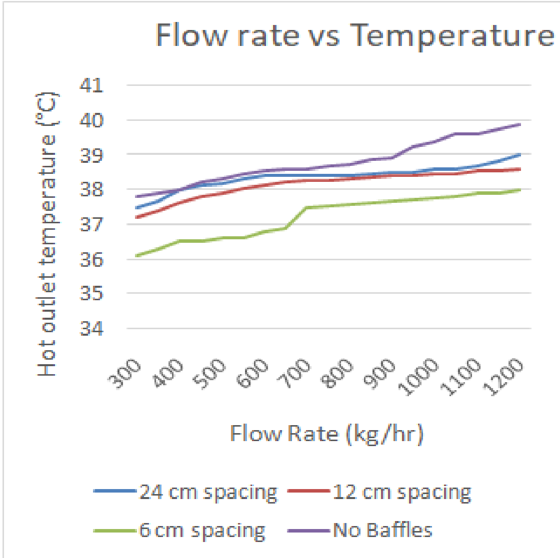


Fig: Flow rate vs Temprature for different baffle Spacing

In this paper, the effect of turbulence created by twisted wires and baffles on Nusselt number is compared with that of smooth tube using CFD analysis. The CFD analysis result shows that the flow rate for 24cm spacing is merely compatible in comparison with, no baffles. It is also concluded that baffles decrease the flow rate and increases the heat transfer and so the performance of heat exchanger

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