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CFD ANALYSIS OF HEAT EXACHANGER

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ABSTRACT

In this Paper, Computation fluid dynamics (CFD) is used to study shell and tube type of heat exchanger, using the ansys software to analysis. The quantities which are being studied are rate of heat transfer, exit temperature of hot and cold, mass transfer rate of hot and cold fluid. Hot fluid is water and cold fluid is air. It is found that the overall of heat transfer between cold and hot fluid is 12.13 kilowatts. The exit temperature of hot and cold fluids is 45.8°C and 26°C respectively and mass transfer rate of hot and cold fluid are 0.3028 kg/sec and 2.78 kg/sec.the obtained result satisfactory and useful to the research area of the fluid dynamics as well as fluid application.

Keywords: *CFD, Fluent, ansys, Mass transfer rate, heat transfer coefficient.*

INTRODUCTION

Heat exchanger is device in which heat is intercghange between the different fluid, the working fluid may be gas or liquid. Mostly there are use a shell type o tube type heat exchanger in the various industry and the thermpdynamics area like refineries applications. The construction and assembly of heat exchanger generally consisting several tubes set on the cyllinderical type shells and transferring the fluid by means of forces [1]. Tube material should have good thermal conductivity like the alluminium and alloys one of the most and good thermal conductive materials are used to make heat exchanger tube and baffles. Best of heat conductivity as shows the heat transfer rate is vary and an effectively work, according to the literature the various typs of heat exchanger use in our duly life[2][3].

LITERATURE REVIEW

In 2017, RosyidaPermatasari et al. study and concluded to selection parameter of the material that are use in fabrication of HE and studied three different material of tube for counter flow heat exchanger and find that copper has best heat transfer coefficient and less temperature drop along the length of the heat exchanger [4]. J S Jayasankarr find out the heat transfer in the three-coil helical type HE much and more then the simple and straight type heat exchanger, using the fluent CFD module software and

concluded based on the fluent methodology result has been satisfactory [5].They have also depicted the various condition teken affecting parameter that directectly affect the procedure and setup simply were fabricated. Ender Orzden and Liker Tari investigate a small HE is consisting the small diameter tube and supported by the baffle and find out the pressure drop inside the system using the simulation CFD methods. The result was ploted satisfactory and the parameter have affected by th diameter of the tube [6]. Some of other researcher given our work that has been tabulated given in below

OBJECTIVE OF THE STUDY

Based on research paper a very few researchers done the analysis of heat exchanger with consider simply types tubes and buffle, nut there a very less amount of research has don on the three types helical HE thus the main objective of this study calculation heat transfer rate between the fluid between the various temperature operated condition, considering the three type of assemble tube.

Meshing

Meshing is done using ANSYS fluent 16.2, procedure of making grids where we want to see the variation. Fine mesh results good solution less iteration and less time consumer

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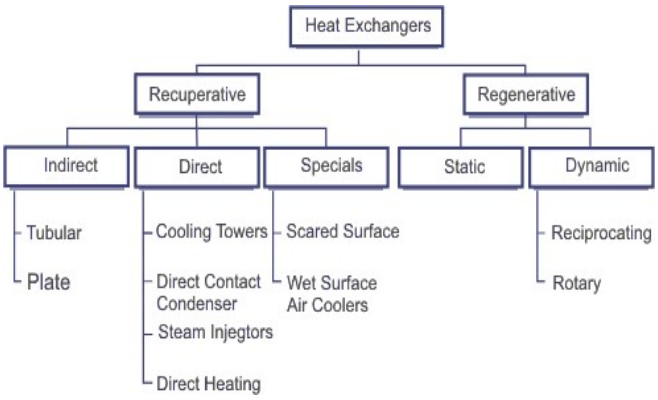

Figure:1 *Classification of heat exchanger*

Table 1: *state of art*

S. No	Name of Researcher	Year	Work Define
1	Kwasi Foli et al	2006	Established model and optimise the various parameter using the optimization techinique of CFD [7]
2	Rohit Mishra et al	2013	Investigate the climate of ajmer using experimental methods of CFD model[8]
3	Muhammad Mahmood et al	2012	A complete survey of the research underging on CFD application [1]
4	In Hum Kim et al	2009	Investigate the hydrp-thermal performance of using the KAIST test loop under the various condition, pressure, temperature and finding appropriate solution using the CFD simulation[9]
5	Vikas Bansal e al	2013	Developing a new concept for evaluating the performance of thermal of EATHE[8]
6	Seong Won et al	2012	Performance analysis of various type of heat exachanger tunnel and concluded that the high air velocity increases the heat rate transfer [10]

GEOMETRY DETAILS

Table: 2 *Geometry Details*

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Length of shell	22013 mm
Length of pipe	2000 mm
Number of pipes	3
Outer diameter of pipe D_o	800 mm
Inner diameter of pipe D_i	600 mm
Diameter of the shell D_s	6000 mm

MESHING

Meshing is done using ANSYS fluent 16.2, procedure of making grids where we want to see the variation. Fine mesh results good solution less iteration and less time consumption. And quality of mesh is checked by orthogonal quality that ranges from (0-1) closer to 1 means having higher quality of meshing. That can so in figure 2,3 respectevely.

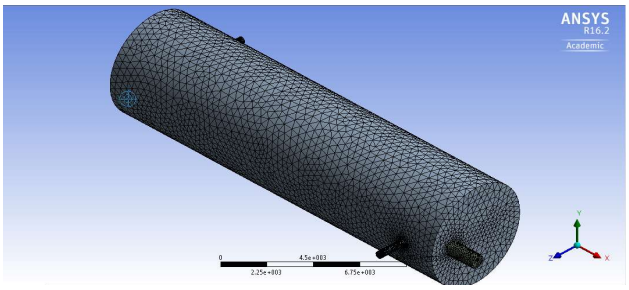

Figure: 2 *Isometric view of heat exchanger meshing*

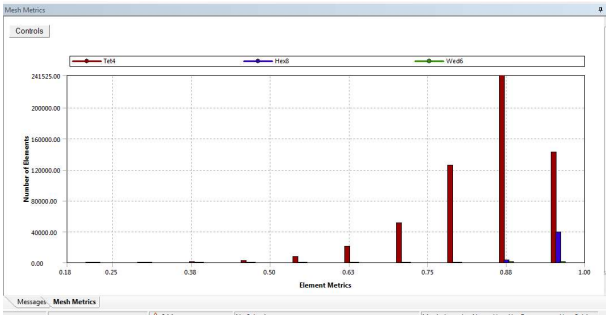

Figure:3*Orthogonalqualityplotsofmesh*

Table: 3 *Details of mesh*

Average orthogonal quality	.85
Number of elements	632395
Number of nodes	173597
Structure of element	Tetrahedral

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Type of meshing element	Unstructured

Table: 4 *Details of boundary condition*

Material	V_h (m/s)	V_c (m/s)	T_{hi} (°c)	T_{ci} (°c)	h_i (w/m^2°c)	h_t (w/m^2°c)
copper	2	1	90	26	23	23

Table: 5 *Output of simulation*

Material	T_{ho}(°c)	T_h (°c)	Q_{hi}(kw)	Q_{ho}(kw)	Q_{ci}(kw)	Q_{co}(kw)	m_c (kg/sec)	m_h (kg/sec)
Copper	45.237	26	19.8	7.61	1161	1173.5	2.78	0.3028

For shell heat transfer rate Q = -.954 kilowatts for copper.Results

The convergence of Simulation is required to get the parameters of the shell and tube heat exchanger in outlet. It also gives accurate value of parameters for the requirement of heat transfer rate. Continuity, X-Y-Z velocity, energy, epsilon is the part of scaled residual which must converge in a specific region. For the continuity, X-Y-Z velocity, epsilon should be less than 10^{-4} and the energy should be less than 10^{-7}. If these all values in same manner, then solution will be converged.

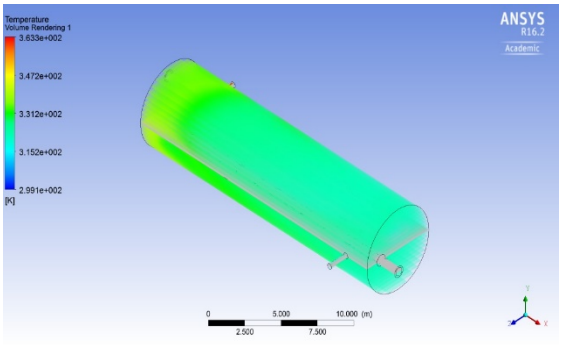

Figure: 4 *Isometric view of temperature distribution along the length of heat exchanger*

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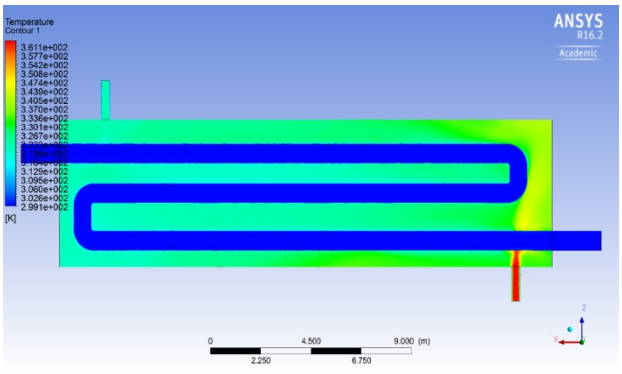

Figure:5 *Plane view of temperature distribution along the length of heat exchanger*

Convergence plot ***Figure:6*** *Residue plot for heat exchange*