IMPROVE THE EFFICIENCY OF HEAT EXCHANGER IN OIL COOLER.

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INTERNAL GUIDE:- DIXIT M PATEL

ABSTRACT

- For shell-and-tube oil cooler with water cooling, the heat transfer resistance on the shell side is 80% of the total heat transfer resistance of the cooler ,so oil heat transfer resistance is controlling .It is a key factor to increase heat transfer coefficient of oil on the shell side for making high performance oil cooler. Two measures to be taken to increase heat transfer coefficient of oil, are first to use highly effective enhanced tube ,and second to use novel shell side baffle geometry or flow rate of fluid.

INTRODUCTION

- A heat exchanger is A device that is used to transfer thermal energy (enthalpy) between two or more fluids, between A solid surface and A fluid, or between solid particulates and A fluid, at different temperatures and in thermal contact. In heat exchangers, there are usually no external heat and work interactions. Typical applications involve heating or cooling of A fluid stream of concern and evaporation or condensation of single- or multi component fluid streams.
- In A few heat exchangers, the fluids exchanging heat are in direct contact. In most heat exchangers, heat transfer between fluids takes place through A separating wall or into and out of A wall in A transient manner.

SCOPE OF PROJECT

- Heat exchanger used for heat transfer take place for cooling or heating purpose. Shell and tube type heat exchanger is mostly found in industrial application.
- Heat exchange between two substance is always depend upon medium surrounding it and also its part’s dimensions.
- Shell and tube type heat exchanger manufacture based on its design and its operating conditions like injection molding machine . If design modification as well as new accessories joint with heat exchanger, give better performance as well as give better heat transfer. Project aim that improve performance and heat transfer coefficient by using buffels for increase area of heat transfer and also applied different material tube with different diameter of tube for analyze profomance of heat exchanger

Methodology

Project selection

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Concept develop

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Selection of working procedure

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Selection of working area

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[Design]

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Implementation

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Result

↓

End

TYPE OF HEAT EXCHANGER

- Shell And Tube Heat Exchanger
- Plate Heat Exchanger
- Plate And Shell Heat Exchanger
- Adiabatic Wheel Heat Exchanger
- Plate Fin Heat Exchanger
- Pillow Plate Heat Exchanger
- Fluid Heat Exchangers
- Waste Heat Recovery Units
- Dynamic Scraped Surface Heat Exchanger
- Phase-change Heat Exchangers

SHELL AND TUBE HEAT EXCHANGER.

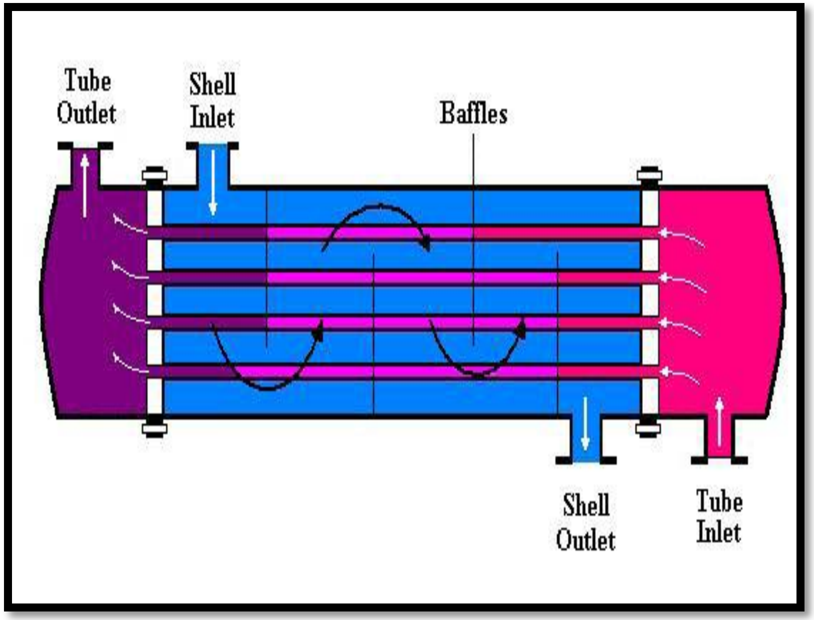


PLATE HEAT EXCHANGER

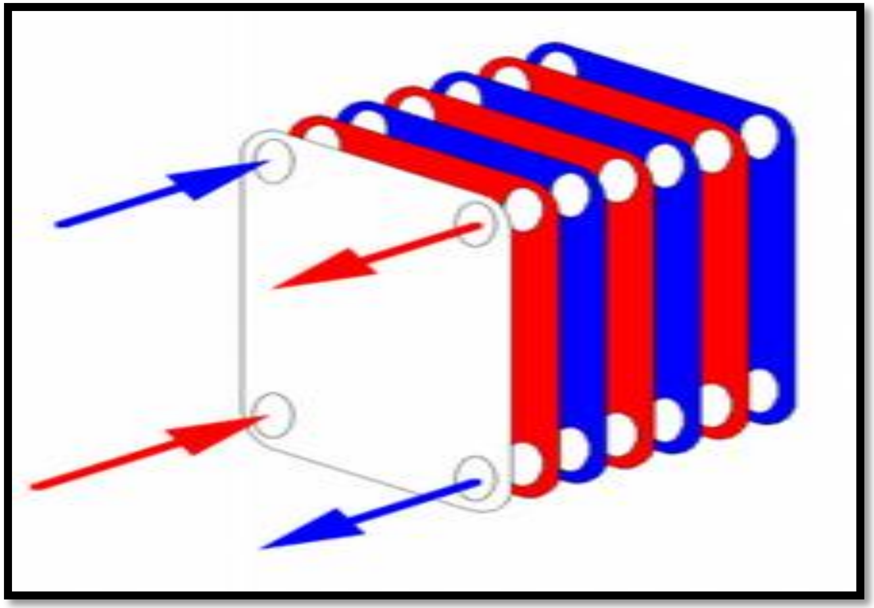
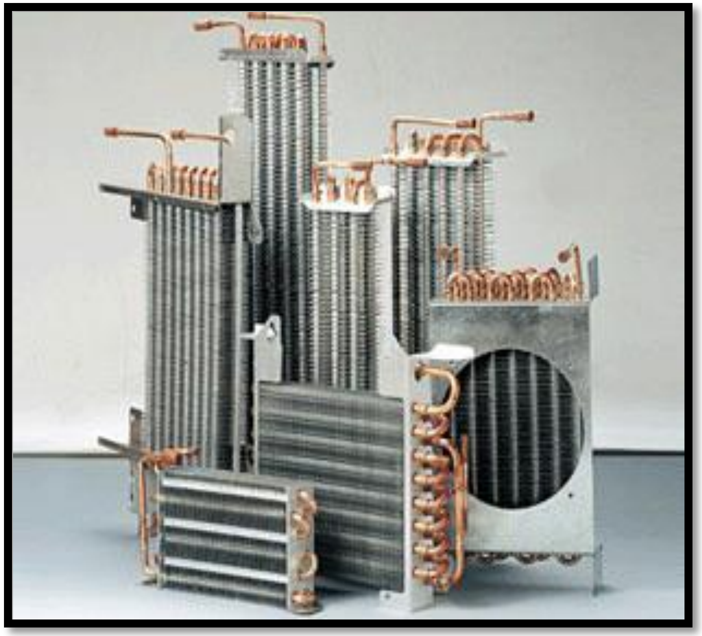
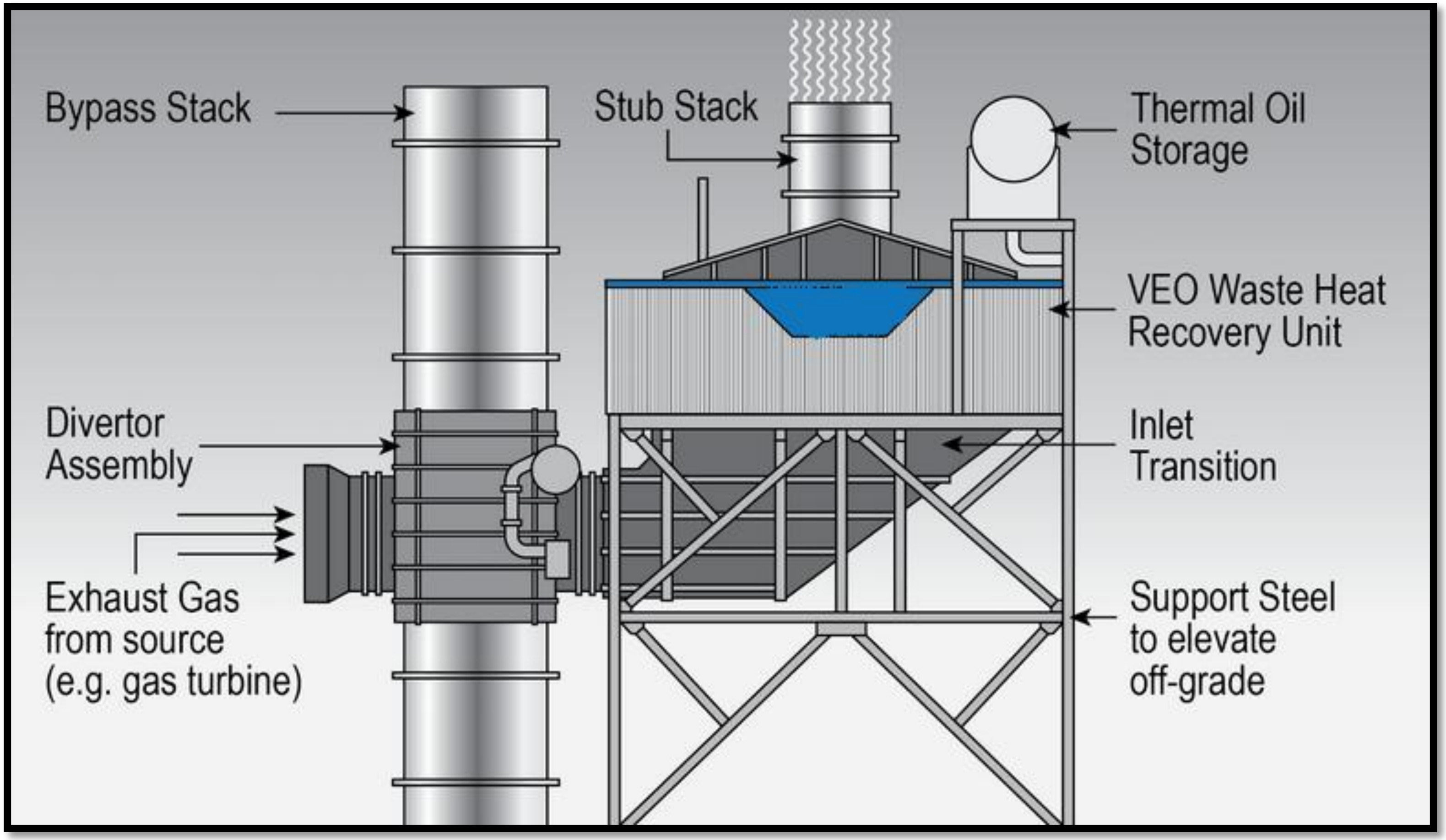


PLATE &SHELL HEAT EXCHANGER

PLATE FIN HEAT EXCHANGER



WASTE HEAT RECOVERY UNITS



LITERATURE SURVEY

- [1] **CFD AND EXPERIMENTAL STUDIES ON HEAT TRANSFER ENHANCEMENT IN AN AIR COOLER EQUIPPED WITH DIFFERENT TUBE INSERTS.**
- **Author:** S.R. Shabanian , M. Rahimi M. Shahhosseini , A.A. Alsairafi
- **Journal:** Science Direct
- **Work:**
- This paper reports the experimental and Computational Fluid Dynamics (CFD) modeling studies on heat transfer, friction factor and thermal performance of an air cooled heat exchanger equipped with three types of tube insert including butterfly, classic and jagged twisted tape. In the studied range of Reynolds number the maximum thermal performance factor was obtained by the butterfly insert with an inclined angle of 90°. The results have also revealed that the difference between the heat transfer rates obtained from employing the classic and jagged inserts reduces by decreasing the twist ratio. The CFD predicted results were used to explain the observed results in terms of turbulence intensity. In addition, good agreements between the predicted and measured Nu number as well as friction factor values were obtained.

- [2] **SHELL SIDE NUMERICAL ANALYSIS OF A SHELL AND TUBE HEAT EXCHANGER CONSIDERING THE EFFECTS OF BAFFLE INCLINATION ANGLE ON FLUID FLOW USING CFD**
- **Author:** Thundil Karuppa Raj, Srikanth Ganne
- **Journal:** ScienceDirect
- **Work:**
- In this present study, attempts were made to investigate the impacts of various baffle inclination angles on fluid flow and the heat transfer characteristics of a shell-and-tube heat exchanger for three different baffle inclination angles namely 0°, 10° and 20°. The simulation results for various shell and tube heat exchangers, one with segmental baffles perpendicular to fluid flow and two with segmental baffles inclined to the direction of fluid flow are compared for their performance. The shell side design has been investigated numerically by modeling a small shell-and-tube heat exchanger.

- [3] **MODELLING AND OPTIMIZATION OF HEAT TRANSFER IN SMOOTH CIRCULAR TUBE USED IN THE SHELL AND TUBE**

- **ABSTRACT**

An optimization of heat transfer for smooth circular tube used in the ammonia-water absorption cooling system has been carried out to estimate minimum outlet water temperature and maximum heat flux. The tube diameter ranges from 7 to 13 mm and length ranges from 0.5 to 1.2 M, has been varied to study the effects. The numerical analysis was performed by using the finite elements commercial code. The optimization result has shown that 7 mm diameter and 1.2 M length has given the minimum water temperature of 8.3 ‘c at the outlet with maximum heat flux of 16193 W/M2.

- **CONCLUSION**

- Numerical analysis and optimization of heat and fluid flow for circular smooth tube has been investigated. As well, the effects of tube diameters and lengths were studied. Results demonstrated that the maximum heat flux occurs within the smallest tube diameter and shortest length at constant wall temperature and flow rate. The temperature outlet from the tube has been presented, and the lowest value founded within the smallest tube diameter 7 mm and the longest length of the tube 1.2 m. The present study can be reported to monitor and evaluate the performance of difference kinds of shell and tube and to optimize the design by using the benefit of optimum heat flux from the individual pipe's wall.

- *Reference:-* RANJ SIRWAN 1, YUSOFF ALI 1, LIM CHIN HAW2, SOHIF MAT2, A.ZAHARIM2 and K. SOPIAN 2 1Department of Mechanical and Materials Engineering 2 Solar Energy Research Institute Faculty of Engineering, Universiti Kebangsaan Malaysia 43600 Bangi, Selangor MALAYSIA.

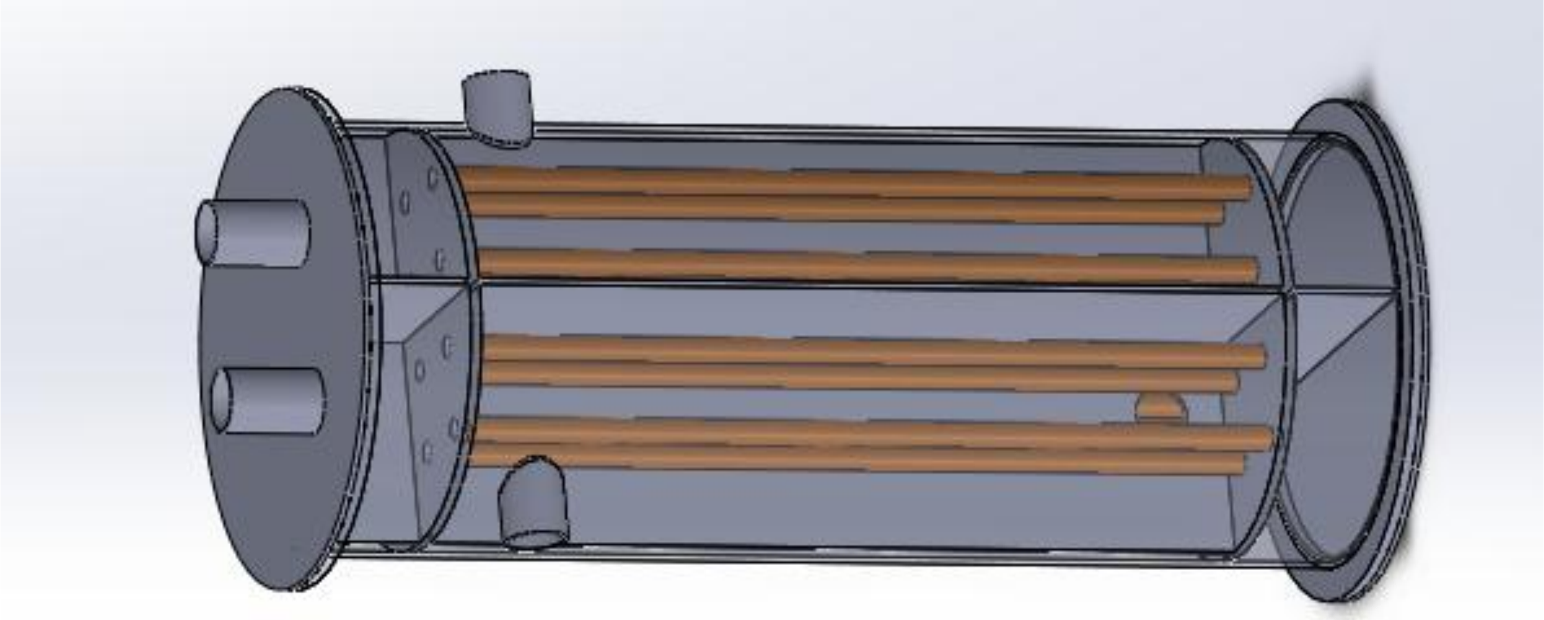
PROBLEM STATEMENT

- In modern day shell and tube heat exchanger is widely used in industries as a chillers plant for transfer waste heat from the injection molding machine to the cooling water for improve the efficiency of the injection molding machine. The transformations of the waste heat from injection molding machine to the cooling water is dependent on the heat exchange capacity of heat exchangers. So in now a day the industries are facing the problem for improving the heat exchange capacity of the heat exchanger by improving the heat exchanger's efficiency for increase production capacity and efficiency of injection molding machine. For shell-and-tube oil cooler with water cooling, the heat transfer resistance on the shell side is 80% of the total heat transfer resistance of the cooler ,so oil heat transfer resistance is controlling .it is a key factor to increase heat transfer coefficient of oil on the shell side for making high performance oil cooler. Two measures to be taken to increase heat transfer coefficient of oil, are first to use highly effective enhanced tube ,and second to use novel shell side baffle geometry.

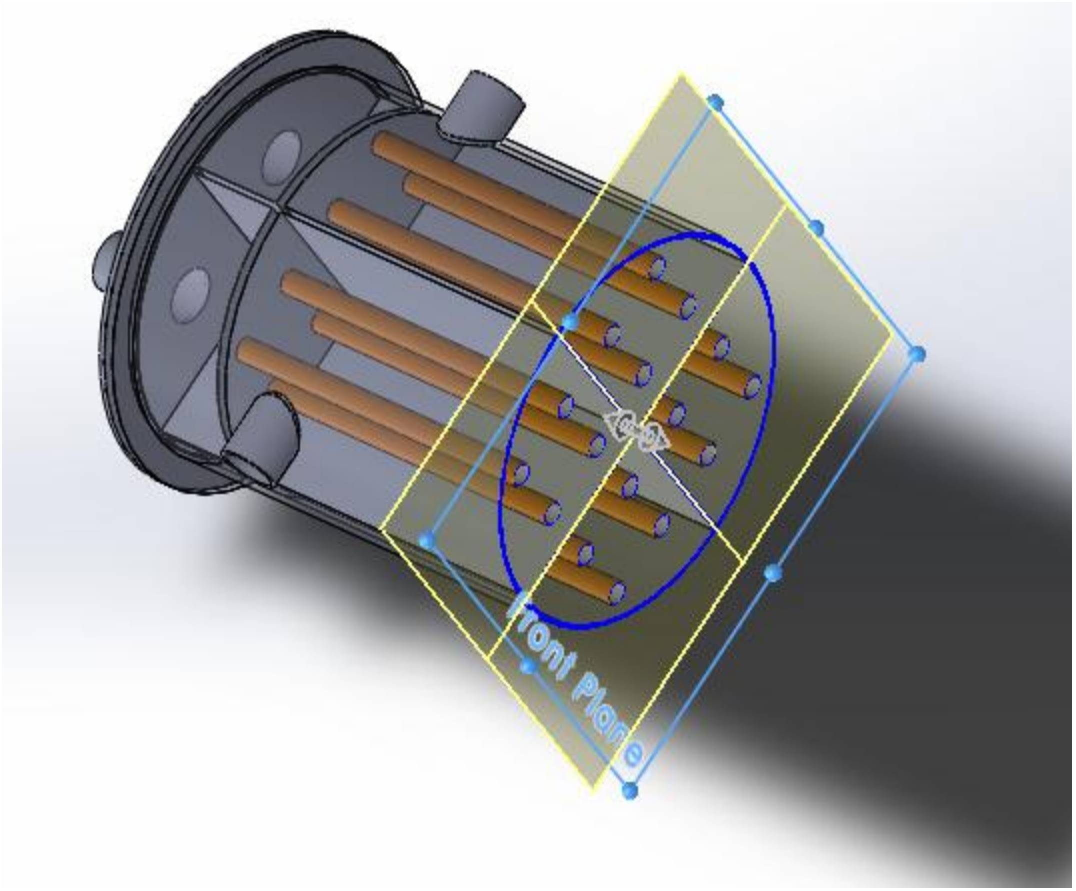
OBJECTIVES

- From problem statement the objective of work is to increase the efficiency of the shell and tube heat exchanger. The efficiency of the heat exchanger is basically depends on the geometric parameters tube diameter as well as process parameters (mass flow rate, inlet and outlet temperature of the cooling water etc.) of heat exchangers. So the objective is to optimize some of these parameters tube diameter and flow rate for improve the efficiency of the heat exchanger.

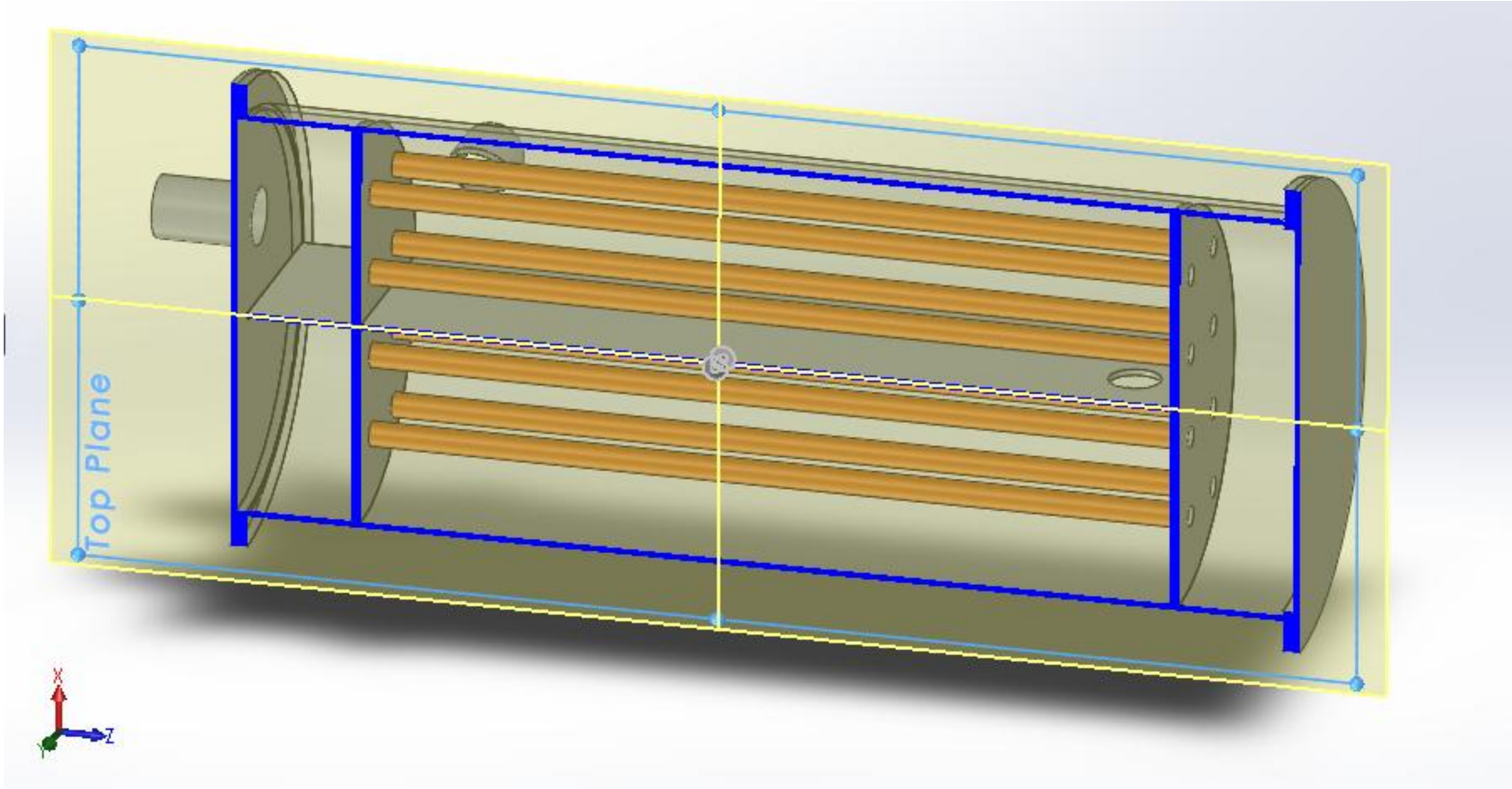
MODEL



CUT SECTION OF SHELL AND PIPE



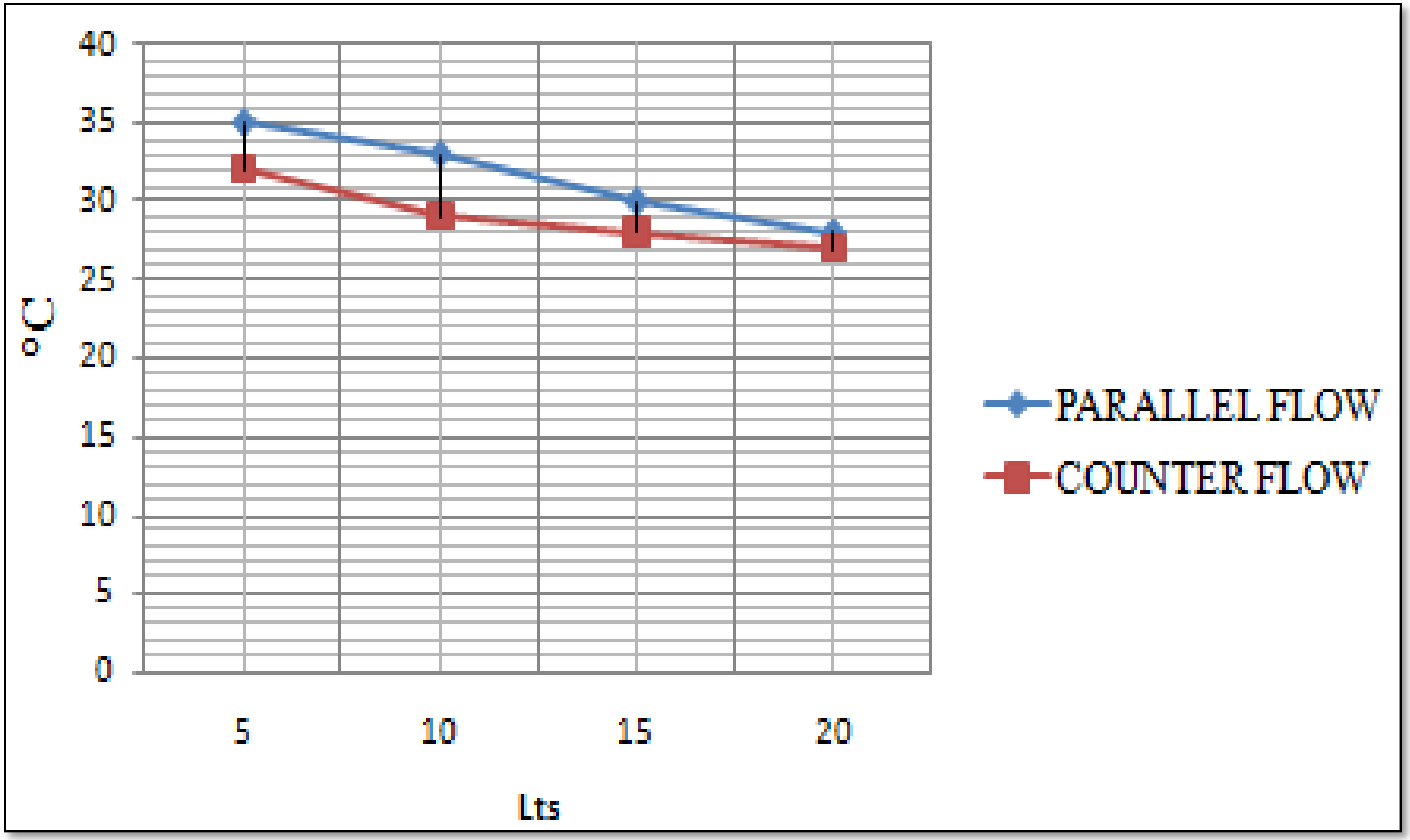
CUT SECTION OF ½ SHELL



COUNTER FLOW (CHANGING FLOW RATE OF HOT FLUID)		
Flow Rate Lts Per S	**Cold Inlet Temperature**	**Cold Outlet Temperature**
0.0833	23	32
0.1666	23	29
0.2500	23	28
0.3333	23	27

PARALLEL FLOW (CHANGING FLOW RATE OF HOT FLUID)		
Flow Rate Lts Per S	**Cold Inlet Temperature**	**Cold Outlet Temperature**
0.0833	23	35
0.1666	23	33
0.2500	23	30
0.3333	23	28

Graph Based On Reading



calculation

- **DATA:-**
- 1.Specific heat of water ,C_{pw} = 4.2 KJKg K
- 2.Inside area of tubes, $A_I = 4.5 \times 10^{-3} \times \pi \times 0.75 \times 32$
- $= 0.34\ m^2$
- 3.Outside area of tubes $A_0 = 6.35 \times 10^{-3} \times \pi \times 0.75 \times 32$
- $= 0.48\ m^2$
- 4.Density of water, $\rho_w = 1000\ Kgm^3$

(1) Temperature

- 1 Hot water inlet temp. T_{hi} = 60 °C
- 2Hot water outlet temp. T_{ho} = 55 °C
- 3Cold water inlet temp. T_{ci} = 23 °C
- 4Cold water outlet temp. $T\text{-}_{co}$ = 35 °C
- 5 Flow Rate of hot water mh = 0.0833 Lt /S
- 6 Flow rate of cold water mc = 0.225 l Lt/S
- **(2) Heat Lost by Hot Water**
- Qh = Mh x Ch (Thi – Tho)
- Here it may be noted that hot and cold both side water is there so,
- Specific heat Cpw = Ch = Cc = 4200 JKg °k
- Qh = 0.0833 x 4200 (60-55)
- = 1749.3 J/s
-

(3) Heat Collected by Cold Water

- $Qc = Mc \times Cc(Tco - Tci)$
- Here it may be noted that hot and cold both side water is there so,
- Specific heat $Cpw = Ch = Cc = 4200$ JKg °k
- $Qc = 0.225 \times 4200\ (35\text{-}23)$
- $Qc = 7560$ J/s
-
- **(4) Specific Heat Capacities of hot and cold water**
- Specific heat Capacity of Hot fluid $Ch = Mh \times Ch$
- $= 0.0833 \times 4200$
- $= 349.86$ W°k
- Specific heat Capacity of Cold fluid $Cc = Mc \times Cc$
- $= 0.225 \times 4200$
- $= 945$ W/ °k

- Here Cmin. = 349.86 W °k and Cmax. = 945 W °k
- So, Specific Heat capacity Ratio C= Cmin /Cmax
- = 349.86/ 945
- C = 0.37
- **(5) The value of Effectiveness**
- If Mc < Mh, then the value of effectiveness
- = (Tco – Tci) (Thi – Tci)
- = (35 – 23) (60 – 23)
- = 0.3243
- **= 32.43%**




COPPER FOR TUBE MATERIAL

COPPER

Advantages –

- Copper Is A Good Conductor,
- Malleable And Ductile So Make It Good For Bending Copper Pipes Into Shapes.
- It Has Very Durable.

Disadvantages –

- The Only Real Disadvantage Of Copper Is It Is Expensive To Buy.
- Alloys Don't Have The Strengths Levels Of Steel Alloys.

CALCULATION OF PERFORMANCE OF CROSS COUNTER FLOW HEAT EXCHANGER BY CHANGING THE VARIOUS PARAMETERS

- By Increasing The Cold Fluid Flow Rate By 10% To 90%
- By Decreasing The Cold Fluid Flow Rate By 10% To 90%
- By Changing The Direction Of Fluid Flow (Parallel Instead On Counter Flow)
- By Increasing The Hot Fluid Flow Rate By 10% To 90%
- By Decreasing The Hot Fluid Flow Rate By 10% To 90%
- By Changing The Pressure Drop.
- By Decreasing The Tube Diameter

CONCLUSION

- From expriment and research paper and conclude that if tube diameter of tube as well as material of tube changes then, may be increase effectiveness of heat exchanger.
- Baffles serve two important functions. They support the tubes during assembly and operation and help prevent vibration from flow induced eddies and direct the shell side fluid back and forth across the tube bundle to provide effective velocity and Heat Transfer rates.
- If no of baffles are attach to heat exchanger give better effectiveness of heat exchanger.
- If material as well as dimensions of tube changes then it will give improvement in effectiveness of heat exchanger.

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Thank you