COMBINED COPPER ALUMINIUM HEAT EXCHANGER

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Abstract- *Heat exchanger is one which is used to transfer the heat from to cold one. Traditionally copper is the material which is used as heat transferring medium because of its high conductivity. Whereas gold and silver has more conductivity but they are more expensive. While next to the Copper Aluminium is consider as the heat transferring material. Here both Copper and Aluminium is introduced in heat exchanger and finding their heat transfer rates. Then it is compared to the existing model of Copper heat exchanger and Aluminium heat exchanger. The Heat exchanger is to fabricate is Single shell pass and two tube pass. The Heat transfer rates and effectiveness is been determined by NTU (Number of Transfer Units) method. Whereas LMTD (Logarithmetic Mean Temperature Difference) method is also used. Mass flow rates of Hot fluid and cold fluid is kept same also hot fluid and cold fluids are been same.*

Keywords—NTU; LMTD; Effectivness

1. INTRODUCTION

Heat exchanger is one in which is used to transfer the heat from hot source to cold source by means of direct or indirect contact. There are several types of heat exchanger among the types shell and tube heat exchanger is consider efficient design among traditional designed heat exchanger. Copper and Aluminum where the most commonly used heat transfer materials. Copper has the higher conductivity among all the materials except silver metal and it has 60% more heat conductivity than aluminium [1]. Whereas next to copper aluminium has grater thermal conductivity and it can be used as a superconductor of critical temperature 1.2kelvin [2]. In today copper is used as in steam evaporator and condensing coils [3]. Aluminium tubes is not suitable for portable and cause corrodes at ph<7 with release in hydrogen gas [4].

Here going to fabricate and test combined copper aluminium heat exchanger and comparing its heat transfer rates separately with the traditional copper and aluminium heat exchanger. The design we use is shell and tube arrangements where it can be used for high pressure and temperature purpose (pressure and temperature say 30 bar and 260°c)[5]. Here we can use Logrithmetic Mean Temperature Difference method and Number of Transfer Units for calculating the heat transfer rates. LMTD method is used when four of the three temperature is known while NTU method is mostly used in complex cases and it involves in effectiveness, maximum heat transfer, capacity of coil e.t.c., The tubes used in heat exchanger is must be used in smaller diameter because it can be easy to clean and fouling can be easily reduced.

2. METHODS AND CALCUATIONS

A. Abbreviations and Acronyms

LMT - Logarithmetic Mean Temperature Differences
NTU - Number of Transfer Units
Ph - Percentage of Hydrogen
C - Capacity of coil
Q_{max} - Maximum heat transferred
Q - Heat transfer rate

B. Testing Considerations

Here going to test on single shell two tube heat exchanger where one of the tube is copper and another one is aluminium. Which is to compared with the two shelled copper and aluminium heat exchanger. Specifications of heat exchanger are,
Dimensions of Heat exchanger fabricated,
Shell Dimensions

- Diameter = 3 inch
- Length = 1 meter
- Thickness = 0.30 milli meter

Tube Dimensions(for single tube)

- Diameter =0.5 inch
- Length = 1.25 meter
- Thickness =0.049 milli meter

Some considered facts of heat exchanger taken are,

- All fluids taken is water.
- Heat exchanger designed is single shell pass and two tube pass.
- Mass flow rates of all fluids are same (0.067 kg/s).
- Specific Heat of the Fluid is 4186 J/kg.k
- All Cold fluid is taken as a room temperature.
- All Hot fluids are taken as 40°c.
- Pressure is maintained in atmospheric level
- Thermal conductivity of copper and aluminium is taken as 340 W/M2 and 204 W/M2.
- Type of the flow used in the experimented heat exchanger is counter flow.
- No of transfer units (NTU) method of calculation is used to determine the heat transfer and effectiveness.
- Shell material is made of chlorinated poly vinyl chloride (CPVC), which is a insulator which withstands the temperature upto 70°C and is also act as a insulator.
- Area of heat exchange is taken as,

D=0.5 inch=0.0125m

AREA = π*D*L

= π*0.0125*2.5

- AREA = 0.0981 mm2

C. Figures and Tables

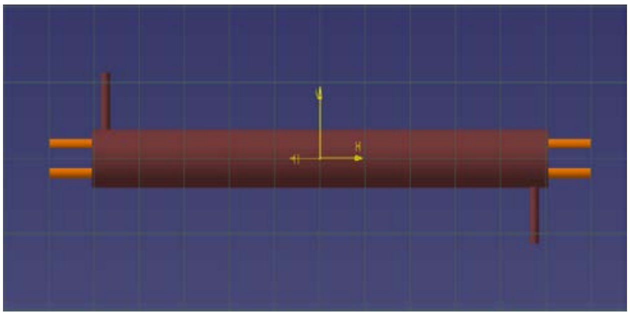

fig.1 Double shelled copper heat exchanger

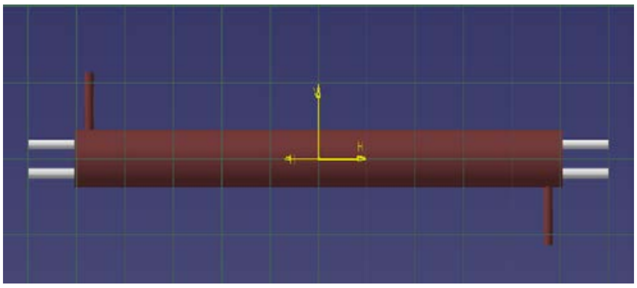

fig.2 Double shelled Aluminium heat exchanger

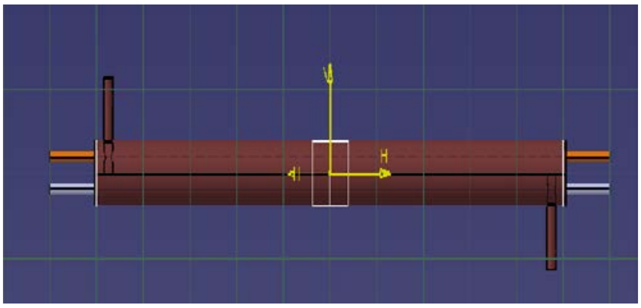

fig.3 Combined copper aluminium heat exchanger

TABLE I. HEAT EXCHANGER OBTAINED VALUES

Heat exchangers	**Hot Inlet (T1)**	**Cold Inlet(t1)**	**Hot Outlet(T2)**	**Cold Outlet (t2)**
Copper heat exchanger	40°C	28°C	34°C	33°C
Aluminium heat exchanger	40°C	28°C	37°C	30°C
Copper Aluminium combined heat exchanger	40°	28°	36°	31°C

TABLE II. COMPARISATION BETWEEN HEAT EXCHANGER

Characteristics	**Double shelled copper heat exchanger**	**Double shelled copper heat exchanger**	**Combined Copper Aluminium Heat exchanger**
Heat transfer amount	1682.7 Watts	841.32 Watts	1142.23 Watts
Effectiveness	0.5	0.25	0.34
NTU	1.2	0.34	0.5

D. Calculation Of Heat Exchange

NTU METHOD OF CALCULATION ,

C = Specific heat *Mass flow rate

Qmax = C * (T1-t1)

Q = ἐ * Qmax

ἐ = (T1-T2) / (T1-t2)

By applying the formulas,

C = 0.067*4186

C=280.462 W/K

Qmax=280.462*(40-28)

Qmax=3365.54 Watts

1) Double shelled copper Heat exchanger:

ἐ = (40-34)/(40-28)

ἐ=0.5

Q=0.5*3365.54

NTU=1.2[6]

Heat transfer = 1682.77 Watts

2) Double shelled Aluminium Heat exchanger:

ἐ = (40-37)/(40-28)

ἐ=0.25

Q=0.25*3365.54

NTU=0.34[6]

Heat transfer = 841.38 Watts

3) Combined Copper Aluminium Heat exchanger:

ἐ = (40-36)/(40-28)

ἐ=0.34

Q=0.34*3365.54

NTU=0.5 [6]

HEAT TRANSFER = 1144.23 WATTS

3. CONCLUSION

By Executing the heat exchangers here we obtain the comparisation the parameters

By above Table - II comparisation Combined copper aluminium heat exchanger has better transfer rates than aluminium it can be replaced by aluminium heat exchanging application because of the problems facing by the aluminium het exchanger also in economy wise it is consider as lesser then copper heat exchanger where the heat transfer is somewhat lesser than copper heat exchanger.

REFERENCES

[1] Cochran, J. F, Mapother, D. E. “Super- conducting Transition in Aluminum,” Physical Review 111 (1):132–142.Bibcode:1958PhRv..111..132C.

[2] Chung, DDL, Applied Thermal Engineering, 21, 1593-1605

[3] Saunders, E. A. (1988). Heat Exchanges: Selection, De- sign and Construction. New York: Longman Scientific and Technical.

[4] CP Kothandaraman , S Subramanyan, HMT Databook,Effectiveness-1 shell pass and 2,4,6 tube pass graph, New Age International,(2005).