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Experimental Analysis of Shell and Tube Heat Exchanger with Circular Fin by Using Compatible Liquids

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ABSTRACT

The scope of our project is to increase the effectiveness of the shell and tube heat exchanger by attaching circular fin. Hence by using circular fin contact area is increased which leads to more heat transfer. Fins are attached to retain the heat for a certain period of time. We use both shell and tube fluid as water, Ethylene Glycol and propylene Glycol Shell carries cold water and tube carries hot water.

Baffles are arranged inside shell for structural rigidity and to divert the flow across the bundle to get high heat transfer coefficient. Tube bundle is arranged in triangle pitch pattern to get high effectiveness. After the fabrication process the equipment has been tested for different temperature and different mass flow rate. Mass flow rate of both hot water and cold water is varied to get optimum effectiveness of heat exchanger.

Keywords : Heat Transfer, Shell and Tube Exchanger, Compatible Liquids, Miscible Liquids

I. INTRODUCTION

Heat exchangers are device whose primary responsibility is the transfer (exchange) of heat, typically from one fluid to another. However, they are not only used in heating applications, such as space heater but are also used in cooling applications, such as refrigerators and air conditioners. Many types of heat exchangers can be distinguished from on another based on the direction the liquids flow. In such applications, the heat exchangers can be and be parallel-flow, cross-flow, or counter current. In parallel-flow heat exchangers, both fluid involved move in the same direction, entering and exiting the exchanger side by side. In cross-flow heat exchangers, the fluid paths run perpendicular to one another. In counter current heat exchangers, the fluid paths flow in opposite directions, with each exiting where the other enters. Counter current heat exchangers tend to be more effective than other types of exchanger.

Aside from classifying heat exchangers based on fluid direction, there are types that vary mainly in their composition. Some heat exchangers are comprised of multiple tubes, whereas others consist of hot plates with room for fluid to flow between them. It's important to keep in mind that not all heat exchangers depend on the transfer of heat from liquid to liquid, but in certain cases use other mediums instead.

II. METHODS AND MATERIAL

The shell and tube heat exchanger consist of shell, tube, baffles, fins and plates. The outer shell is made up of steel and inner tube is made of copper. Baffles and plates are made up of steel. Plates are used to support the copper tubes which are very small in size and baffles are used to control the flow of water. The outer shell is 150mm in diameter and 500mm length. The inner tubes are 10mm in diameter and 500mm in length. Multiple numbers of tubes are inserted inside the shell. As per calculation we use sixteen numbers of tubes so sixteen numbers of holes of 10mm diameter are drilled in the two plates. Baffles are cut to certain to increase the heat transfer by retaining the fluid for period of time. Baffle height is generally cut to 20-40% of shell diameter. Aluminium fins are used to increase the heat transfer area by attaching the fins at copper tubes.

Fabrication of shell

M.s steel tube of 500mm length and 150mm diameter is brought from store. Then the tube is drilled to make holes for cold water inlet and outlet. Now pipes are attached for the flow of water.

Fabrication of fin

Aluminium fin are used in the heat exchanger because next to copper aluminium has very high thermal conductivity. Aluminium is brought as per specification and numbers of fins are calculated. Fin has 10mm internal diameter and 20mm external diameter and it has 2mm thickness.

Fabrication of baffle plate

To support the tubes for structural rigidity, preventing the tube vibration and sagging. To divert the flow across the tube bundle to obtain a higher heat transfer coefficient. The total height of the baffle plate is 150mm; to obtain high heat transfer coefficient height is reduced to 20-35% .In our project baffle is cut to 42.5mm. Baffle is made with M.s steel.

Experimental setup

III. RESULTS AND DISCUSSION

Test 1

Hot water inlet temperature = 80°C

Mass flow rate of cold water = 3 lit/min
Mass flow rate of hot water = 2 lit/min
Cold water inlet temperature = 24°C
Cold water outlet temperature = 33°C

S.NO	Hot water inlet temperature(°C)	Cold water outlet temperature(°C)
1	60	32
2	70	35
3	80	40

Hot water outlet temperature = 64°C

In test 1 the Hot water inlet temperature is set at 80°C and mass flow rate is kept at 2lit/min. cold water inlet temperature is measured using digital indicator as 24°C. Now the cold water mass flow rate is set at 3lit/min. after particular period of time hot water outlet temperature and cold water outlet temperature is measured using digital indicator.

Test 2

In test 2 the Hot water inlet temperature is set at 80°C a cold water inlet temperature is measured using digital indicator as 24°C. Now the cold water mass flow rate is set at 3lit/min. now the hot water mass flow rate is varied for different values and their values are noted using digital indicator.

Hot water inlet temperature = 80°C
Cold water inlet temperature = 24 °C
Cold water mass flow rate = 3 lit/min

S.No	Mass flow rate of hot water(lit/min)	Cold water outlet temperature (°C)	Hot water outlet temperature(°C)
1	1.5	42	58
2	2.0	35	64
3	2.5	34	67

Table (i) Experimental Results of Test 2

Test 3

In test 3 the Hot water inlet temperature is set at 80°C a cold water inlet temperature is measured using digital indicator as 24°C. Now the hot water mass flow rate is set at 2lit/min. now the cold water mass flow rate is varied for different values and their values are noted using digital indicator

Hot water inlet temperature = 80°C
Cold water inlet temperature = 24°C
Cold water mass flow rate = 2 lit/min

Table (ii) Experimental Results of Test 3

Test 4

Now the mass flow rate of cold water and hot water is set to 2lit/min and hot water inlet temperature is varied and cold water outlet temperature is noted for different values using digital indicator

Mass flow rate of hot water = Mass flow rate of cold water

Mass flow rate = 2 lit /min
Cold water inlet temperature = 24°C

S.No	Mass Flow rate of cold water (lit/min)	Cold water outlet temperatur e (°C)	Hot water outlet temperature (°C)
1	1.5	45	63
2	2.0	40	65
3	2.5	36	69

Table (iii) Experimental Results of Test 4

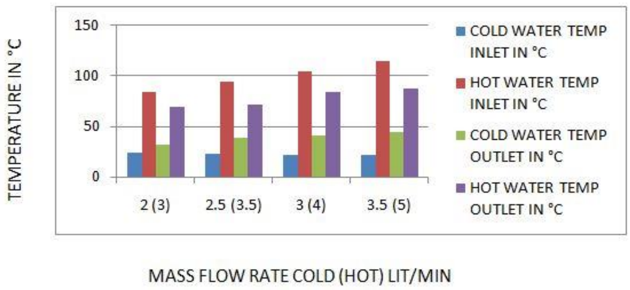
Test 5 (Water and Ethylene Glycol Ratio 50:50)

Hot water inlet temperature = 85°C
Mass flow rate of cold water = 2 lit/min
Mass flow rate of hot water = 3 lit/min

Cold water with inlet temperature = 25°C
Cold water outlet temperature = 33°C
Hot water outlet temperature = 70°C

S. no	Cold water mfr	Hot water mfr	Cold water temp inlet in °c	Hot water temp inlet in °c	Cold water temp outlet in °c	Hot water temp outlet in °c
1	2	3	25	85	33	70
2	2.5	3.5	24	95	39	72
3	3	4	23	105	42	85
4	3.5	5	22	115	45	88

Table iv) Experimental Results of Test 5

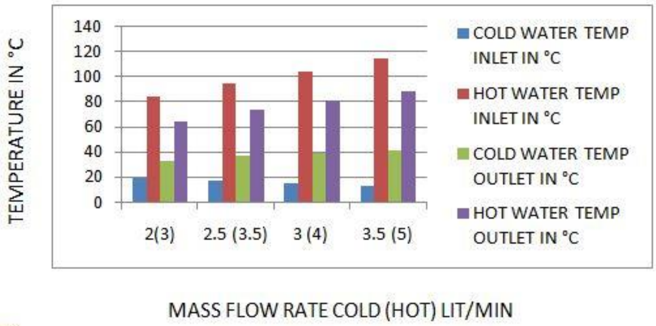


Graph (i) Performance of Test 5

Test 6 (Water and Ethylene Glycol Ratio 60:40)

S.no	Cold water mfr	Hot water mfr	Cold water temp inlet in °c	Hot water temp inlet in °c	Cold water temp outlet in °c	Hot water temp outlet in °c
1	2	3	20	85	33	65
2	2.5	3.5	18	95	38	74
3	3	4	16	105	40	82
4	3.5	5	14	115	42	89

Table (v) Experimental Results of Test 6

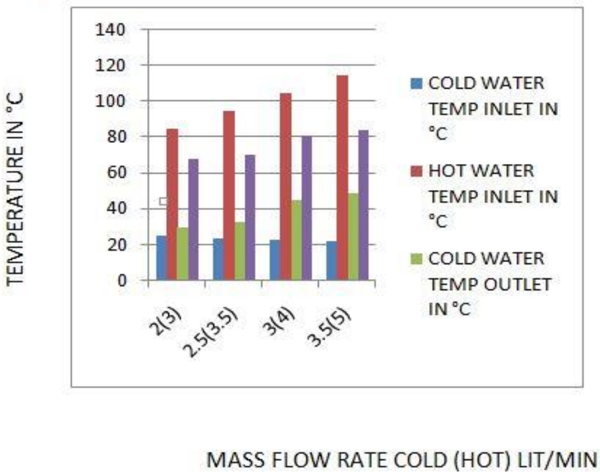


Graph (ii) Performance of Test 6

Test 7 (Water and propylene Glycol Ratio 50:50)

S.no	Cold water mfr	Hot water mfr	Cold water temp inlet in °c	Hot water temp inlet in °c	Cold water temp outlet in °c	Hot water temp outlet in °c
1	2	3	25	85	30	68
2	2.5	3.5	24	95	33	70
3	3	4	23	105	45	81
4	3.5	5	22	115	49	84

Table (vi) Experimental Results of Test 7



Graph (iii) Performance of Test 7

IV. CONCLUSION

The theoretical and experimental analysis of shell and tube heat exchanger with circular fin is conducted successfully. The results are compared with various mass flow rates of hot water and cold water, from this results it is clear that the temperature of hot water can be decreased by decreasing the mass flow rate of cold and hot water.

The effectiveness of heat exchanger can be increased by reducing the mass flow rate.

V. REFERENCES

[1] Bipan Bansal, Hans Müller-Steinhagen, Xiao Dong Chen. (2000). 'Performance of plate heat exchangers during calcium sulphate fouling investigation with anin-line filter'. Chemical Engineering and Processing, Vol. 39, pp 507-519

[2] Garcıa-Cascales J.R, Vera-Garcıa F., Corberan-Salvador J.M., J.Gonzalvez-Macia. (2007). 'Assessment of boiling and condensation heat transfer correlationsin the modelling of plate heat exchangers'. International Journal of Refrigeration.Vol.30, pp 1029 – 1041.

[3] Jameel Ur Rehman Khan ; Syed M. Zubair. , (2004) 'A Risk-Based Performance Analysis of Plate-andFrame Heat Exchangers Subject to Fouling: Economics of Heat Exchanger Cleaning'. Heat transfer engineering. Volume 25 , pages 87 - 100

[4] Jorge A. W. Gut, José M. Pinto. (2003). 'Modeling of plate heat exchangers with Generalized configurations'. International Journal of Heat and Mass Transfer, Vol.46, Pages 2571-2585

[5] Jorge A.W. Gut, Jose M. Pinto. (2004) . 'Optimal configuration design for plate heat exchangers'. International Journal of Heat and Mass Transfer. Vol.47, pp 4833–4848.

[6] Kevin M. Lunsford,(1996). "Advantages of Brazed Heat Exchangers in the Gas Processing Industry". Proceedings of the Seventy-Fifth GPA Annual Convention.Tulsa, OK: Gas Processors Association, pp 218-226.

[7] Lamb B. R..(1982). 'Plate Heat Exchangers - A Low-Cost Route To HeatRecovery'. Heat Recovery Systems Vol. 2. pp. 247-255,

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