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Experimental Investigation On Finned Tube Used In Air Cooled Heat Exchanger Under Variable Surrounding Air Condition

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Abstract:

Heat exchanger is a device which transfer the energy from hot fluid to the cold fluid with high rate and reasonable cost. The present study was Performed on the Finned tube Heat exchanger. The finned tube having dimension of of (40cm) overall length, which contains (32cm) copper tube of (16mm) outer diameter & inner diameter(13.5) with fin pitch (10 fin/in), fin outer diameter(34.5mm) and fins thickness (0.1mm).. and the tubes material ad braas. Fin type crimp root soldered. The objective of the present study was to evaluate the performance of the finned tube at ambient condition and the condition like in hot summer. Through this study found the performance of finned tube increases with increase the mass flow rate of air. The different plots obtained from the data collected at different conditions of mass flow rate of water and air at both ambient condition and hot condition.

1.Introduction

Heat exchanger is a device which transfer the energy from hot fluid to the cold fluid with high rate and reasonable cost. A heat exchanger is a piece of equipment built for efficient heat transfer from one medium to another. The media may be separated by a solid wall, so that they never mix, or they may be in direct contact.They are widely used in space heating, Refrigeration , Power plants, Oil and gas industries etc.Heat exchangers are devices used to transfer heat energy from one fluid to another. Typical heat exchangers experienced by us in our daily lives include condensers and evaporators used in air conditioning units and refrigerators. Boilers and condensers in thermal power plants are examples of large industrial heat exchangers. There are heat exchangers in our automobiles in the form of radiators and oil coolers.

Figure 1

An air cooled heat exchanger, or ACHE, is simply a pressure vessel which cools a circulating fluid within finned tubes by forcing ambient air over the exterior of the tubes. A common example of an Air cooled condenser Car radiator Air cooled heat exchangers are used for two primary reasons. They increase plant efficiency They are a good solution as compared to cooling towers and shell and tube heat exchangers because they do not require an auxiliary water supply (water lost due to drift and evaporation, plus no water treatment chemicals are required).

2.Experimental Set Up

This is the Photo of Experimental set up of Air cooled heat exchanger made by me under the Guidance of Dr. V.N. Bartaria sir. This set up consist of following component.

Figure 2

2.1.Fan

Fan is used to produce the forced convection. Forced convection is a mechanism, or type of transport in which fluid motion is generated by an external source (like a pump, fan, suction device, etc.).

Figure 3

2.2. Heating Coils

Heating coils are used to heat the atmospheric air which strike the exterior of the finned tube. With help of this coils the performance of the finned tube analysis at different temperature condition

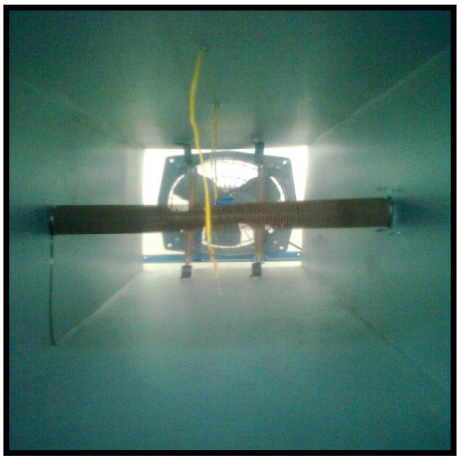

Figure 4

2.3.Thermocouple

A thermocouple consists of two conductors of different materials (usually metal alloys) that produce a voltage in the vicinity of the point where the two conductors are in contact. The voltage produced is dependent on, but not necessarily proportional to, the difference of temperature of the junction to other parts of those conductors. This is used to measure the temp. of air and water at both ambient and Heated condition.

2.4.Temperature Indicator

Temperature indicator is a device used to indicate the temperature measured by the thermocouple wire.Thermocouple wiring:When wiring a thermocouple input, the compensation wire should be qualified and directly connect to the corresponding terminals in correct direction.

Figure 5

2.5.Anemometer

It is a device for measuring wind speed, and is a common weather station instrument. The term is derived from the Greek word anemos, meaning wind, and is used to describe any airspeed measurement instrument used in meteorology or aerodynamics.Anemometers can be divided into two classes: those that measure the wind's speed, and those that measure the wind's pressure; but as there is a close connection between the pressure and the speed, an anemometer designed for one will give information about bot.

Figure 6

2.6.Crimped Fin Tube

Crimped fin made of copper or aluminum. It is brazed over the tube to increase the rate of heat transfer.The components that are available on the external surface of the bare tube to increase its surface area are called fins. Finned Tubes help better transfer of heat between the outside and inside of tube. With the usage of these tubes having surface area almost eight times of the outer tube, the length of the tube required to heat the viscous oil can be reduced by one sixth. Our Spiral Finned Tubes are popular because of their following advantages:

High efficiency

Excellent quality

Smooth functionality

Figure 7

2.7.Water Heater

Heater is used to heat the water. It has capacity 3000 Watt. It is instant type water heater. Water heating is a thermodynamic process using an energy source to heat water above its initial temperature.

Figure 8

3.Observation Table And Calculation

The test is conducted under both the ambient condition and heated condition like in summer.

3.1.For Mass Flow Rate Of Water Is Mw=0.03377 Kg/Sec. At Ambient Condition

Mass flow rate of air	**Temp. of air**		**Temp. of water**		**Heat taken by air**	**Heat rejected by water**
	In	out	In	out	qa= MaCp(T2 -T1)	qw=MwCp(T4-T3)
0.2227	30	31	44	32	0.2238	1.6932
0.2739	30	32	44	30	0.5505	1.9754
0.3226	30	32	44	30	0.6483	1.9754
0.3328	30	32	44	28	0.6689	2.2576
0.3456	30	33	44	27	1.0419	2.1165
0.361	30	33	44	26	1.0882	2.5398
0.3814	30	34	44	26	1.5333	2.5398

Table 1

3.1.1.Calculation

qa= MaCpa.(T2-T1)

= 0.2227x1.005x(31-30)

= 0.2238 kj/sec

qw= Mw.Cpw.(T4-T3)

=0.3377x4.187x(44-32)

= 1.6932 kj/sec

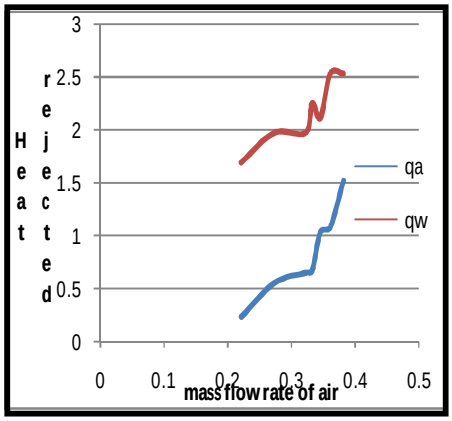

Figure 9

Figure shows as the mass flow rate of air increases the heat rejected by water and heat taken by air also rises but some heat loss by water is not taken by air due to un accountable losses.

3.2.For Mass Flow Rate Of Water Is Mw=0.03377 Kg/Sec. When Hot Air Flowing Over Tube

Mass flow rate of air	**Temp. of air**		**Temp. of water**		**Heat taken by air**	**Heat rejected by water**
	In	out	In	out	qa= MaCp(T2-T1)	qw=MwCp(T4-T3)
0.1454	36	37	44	35	0.1461	1.2699
0.1658	36	38	44	35	0.3332	1.2699
0.2273	36	38	44	33	0.4568	1.5521
0.2476	36	39	44	32	0.7471	1.6932
0.2682	36	39	44	31	0.8086	1.8343
0.2723	36	42	44	31	1.6419	1.8343
0.2846	36	42	44	30	1.7161	1.9754

Table 2

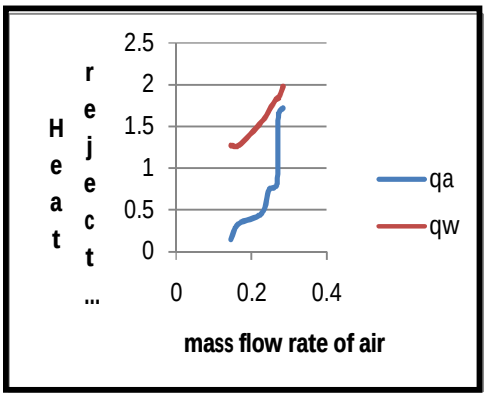

Figure 10

Figure shows as the mass flow rate of air increases the heat rejected by water and heat taken by air also rises but some heat loss by water is not taken by air due to unaccountable losses. In this condition performance of heat exchanger reduces because hot air flowing over tube.

3.3.For Mass Flow Rate Of Water Is Mw=0.01816 Kg/Sec. At Ambient Condition

Mass flow rate of air	**Temp. of air**		**Temp. of water**		**Heat taken by air**	**Heat rejected by water**
	In	out	In	out	qa= MaCp(T2-T1)	qw=MwCp(T4-T3)
0.2227	30	31	54	30	0.2238	1.8168
0.2739	30	32	54	30	0.5505	1.8168
0.3226	30	32	54	28	0.6483	1.9682
0.3328	30	33	54	27	1.0033	2.0439
0.3456	30	34	54	26	1.3893	2.1196
0.361	30	34	54	26	1.451	2.1196
0.3814	30	35	54	25	1.9167	2.1953

Table 3

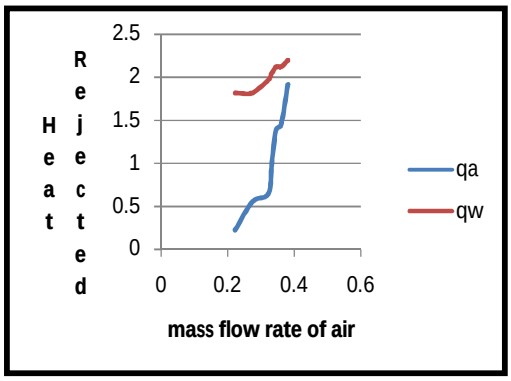

Figure 11

Figure shows as the mass flow rate of air increases the heat rejected by water and heat taken by air also rises but some heat loss by water is not taken by air due to unaccountable losses. As the discharge is reduced the heat rejected by water is also reduced but the unaccountable losses are reduced. thus heat taken by air increases.

3.4.For Mass Flow Rate Of Water Is Mw=0.01816 Kg/Sec. When Hot Air Flowing Over Tube

Mass flow rate of air	**Temp. of air**		**Temp. of water**		**Heat taken by air**	**Heat rejected by water**
	In	out	In	out	qa= MaCp(T2-T1)	qw=MwCp(T4-T3)
0.1454	38	39	54	37	0.1461	1.2869
0.1658	38	40	54	36	0.3332	1.3626
0.2273	38	40	54	36	0.4568	1.3628
0.2476	38	41	54	35	0.7471	1.4383
0.2682	38	42	54	34	1.0781	1.514
0.2723	38	43	54	34	1.3683	1.514
0.2846	38	44	54	33	1.7161	1.5897

Table 4

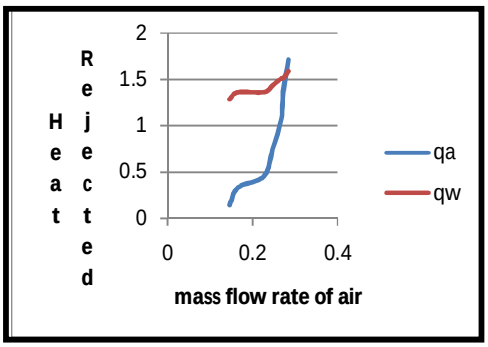

Figure 12

Figure shows as the mass flow rate of air increases the heat rejected by water and heat taken by air also rises but some heat loss by water is not taken by air due to unaccountable losses. As the discharge is reduced the heat rejected by water is also reduced but the unaccountable losses are reduced. thus heat taken by air increases.

4. Results

The result shows that as mass flow rate of air increases the heat taken by air and heat rejected by water also increases for both ambient and hot condition. But its found that when hot air flowing over tube the discharge should high for obtaining the best performance of heat exchanger.

5. Conclusion And Future Scope

In the present project work, a detailed experimental study was performed on a finned tube Air cooled heat exchanger under various outside air conditions The results obtained may be used in design of heat exchanger/condenser and optimisation of design of heat exchanger. Through this study found the performance of finned tube increases with increase the mass flow rate of air. The different plots obtained from the data collected at different conditions of mass flow rate of water and air at both ambient condition and hot condition. The present study may be further extended for analysis of the finned tube heat exchanger for other fluid in the tube. A study may also be performed for several tubes used.

6.Reference

1.Heat and mass transfer Book, By P.K. Nag.

2. Process heat transfer by Donald Q. Ken , Publisher TMH

3. Optimal Design of shell & tube Heat exchanger by Different strategies of Diffeential a. Evolution B.V. Babu and S.A. Munawar

4. The fundamentals of Heat exchanger, The industrial Physicist by Deon A. Batlett

5.Performanc analysis of & optimal Design of heat exchanger used in high temp. & High press. System by Yang-gu-kim , Byoung Ikchoi and Kuisoonkim.

6. WWW.thermotch-finnedtubes.com/finnd-tubes.htm

7. Larinoff, M.W., Moles, W.E. and Reichhelm, R., "Design and Specification of Air-Cooled Steam Condensers, Chemical Engineering, May 22, 1978

8.Kröger, Detlev G.,"Air Cooled Heat Exchangers and Cooling Towers", Penwell Corporation, Tulsa, OK, 2004.