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Note on RECENT TECHNOLOGIES

Experimental investigation on Copper cooled specialized direct contact Heat Exchanger (cooling tower)

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Abstract: Cooling tower operate on the principle of removing heat from water by evaporating a small portion of water passed through the copper U-tubes in the unit. The heat that is removed is called the latent heat of vaporization. When air is blown from the air blowing chamber it passes through the solid balls and comes in direct contact with the water droplets which in turn takes away heat from the water to the exhaust. We have also introduced some innovative methods to lower the temperature of water at a faster rate which are discussed here. Baffle plates at the outlet, pressed plate at the sides of the containing chamber, solid balls, and water inlet through the copper U-tubes are our new innovations which significantly reduces the temperature of water and increases the efficiency upto 93% with better performance of bringing down the temperature of water upto room temperature of 27°C than normal cooling towers.

Keywords: *Heat Exchanger, Latent heat, Cooling Tower*.

I. INTRODUCTION

A heat exchanger is any device used for affecting the process of heat exchange between two fluids that are at different temperatures. Heat exchangers are useful in many engineering processes like those in refrigerating and air-conditioning systems, power systems, food processing systems, chemical reactors and space or aeronautical applications. A heat exchanger in which two fluids exchange heat by coming into direct contact is called a direct contact heat exchanger. Examples of this type are open feed water heaters, desuperheaters and jet condensers. The special type of heat exchanger that we have used is the copper cooled specialised direct contact heat exchanger in which two mediums air and water comes in direct contact and heat exchanging process takes place by various processes. A periodic flow type of heat exchanger is called a regenerator. In this type of heat exchanger, the same space is alternately occupied by the hot and cold mediums between which heat is exchanged. The heat exchange process in heat exchangers can be described by the principles of conduction, convection, radiation and evaporation or condensation. A comprehensive treatment of heat exchanger design would involve many factors besides the heat transfer analysis like size, weight, structural strength, pressure drop and cost, which is beyond our scope. The main aspects also include thermal analysis, simulation (mathematical modeling) and cost optimization of the more common types of heat exchangers.

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2. PRIMARY OBJECTIVE

The primary objectives of this project are:

- To make an alternate design and to introduce the all new method of rapid cooling in the direct contact heat exchanger (cooling tower).
- To fabricate the materials used and to run the heat exchanger at a better performance with inlet water at higher temperature.

3. PICTORIAL REPRESENTATION OF COOLING TOWER

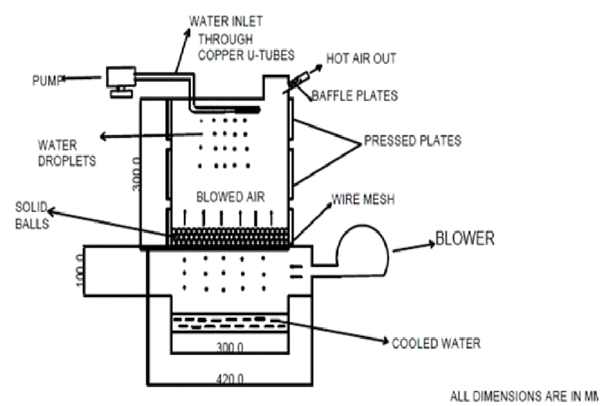

Fig. 1 Pictorial representation of the copper cooled specialized direct contact heat exchanger

4. MATERIAL OF CONSTRUCTION

We constructed this cooling tower on the basis of material properties and behavior. Since copper is highly thermal resistant we wanted that our heat exchanger should contain most of this metal. But the problem, copper is costly metal. So we wanted to involve copper alloys in which common brass was best suited since it has high level of copper content in it (63% Cu and 37% Zn) and almost 90% of the brass can be recycled. It also have a relatively low melting point of 900 to 940°C, 1652 to 1724°F depending on composition. We made the air blowing chamber and the exhaust chamber with steel alloy which is stainless steel since it is corrosive resistant, 100% recyclable and also has high strength and durability even if the water is at any temperature. The list of materials used is tabulated below.

TABLE 1
LIST OF MATERIALS USED

S.no	PARTS	MATERIALS USED
1	Heat exchanging chamber	Copper alloy (Brass – 63% Cu and 37% Zn)
2	Air Blowing Chamber	Stainless steel
3	Exhaust Chamber	Stainless steel
4	Wire mesh	Steel
5	Moisture separator	Stainless steel
6	Velocity stopper for water	Solid balls and pebbles

Fig. 2. Actual view of the specialized direct contact heat exchanger

5. PERFORMANCE OF HEAT EXCHANGER

We have implemented several parameters to test the actual performance of the heat exchanger. In order to achieve this, we tested the cooling performance by supplying the hot water into the inlet circuit with different temperatures. In normal heat exchangers the inlet water supply will be mostly of spray type, but we are introducing the inlet water as droplets in the copper circuit unit and since copper can dissipate heat easily, around 40% of the heat is removed in the copper circuit itself. The water when reaching the heat exchanging chamber loses most of its heat because of the heat dissipation property of the copper alloy material. When it comes in direct contact with the solid balls, high velocity air will be passed through the air blowing chamber with air blower at the rate of 16000 rpm. When the water and the high velocity air comes in direct contact the solid bed particles will increase the heat exchanging time between the water and the air, this allows the air to take away the complete heat from the water to the exhaust chamber as hot air outlet. The cooled water will be collected under the heat exchanger into the collecting tank. The results was surprising that even at the different inlet temperatures of water, the collecting tank temperature gave nearly the room temperature with high performance and with the help of cooling tower efficiency formula we achieved 93% of cooling tower efficiency.

6. CONCLUSION

Direct contact heat exchangers use the heat exchanging process between two mediums such as air and water. We have a cooling tower in our lab and we found the efficiency of the cooling tower is lower. So we decided to make an alternate design and fabricate with a better efficiency and performance of the heat exchanger. Since copper is too costly for large scale fabrication we decided to make it using copper alloy i.e.,Brass as a heat exchanging chamber material which gave us good results and significantly reduces the temperature of water. As per our design and plan the heat exchanger was completed successfully.