International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 07 | July 2021 www.irjet.net p-ISSN: 2395-0072

"Testing And Performance of Honeycomb Packing Based Counter Flow cooling Tower"

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Abstract - The Objective of this study is to investigate experimentally performance of cooling tower having honeycomb structure packing. Air and Water used as fluids. The study is carried out by Tower characteristics, outlet temperature of water, water and air flow rate ratio and efficiency of cooling tower. The Range of inlet water temperature is between 35° c to 55° c.

Key Words: Cooling Tower, Tower Effectiveness, Honeycomb Packing, Air and Water Flow Rate, Heat Transfer.

1.INTRODUCTION

Cooling towers are widely used to remove heat from industrial processes and from refrigeration and air-conditioning systems. Simultaneous heat- and mass-transport processes at every section of the cooling tower give rise to complicated design equations. Experimental investigations of cooling towers should lead to better designs.

In counter-flow cooling towers, hot water is sprayed into an air stream. Heat and mass are transferred and the water enthalpy decreases while that of air increases. In order to increase the cooling rate, the interface area between air and water is increased by providing packed and fluidized beds. There are three types of packings in used, namely, film, splash and film-grid packing. In the present studies, film packings were used. In counter-flow cooling towers, hot water is sprayed into an air stream.

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1.1 Review OF Existing Cooling Tower

A cooling tower is a heat rejection device that rejects waste heat to the atmosphere through the cooling of the water stream to a lower temperature. Cooling towers may either use the evaporation of water to remove process heat and cool the working fluid to near the wet bulb air temperature or, in the case of closed dry cooling towers, on air cool the working fluid to near the dry bulb air temperature.

Common application include cooling the circulating water used in oil refineries, petrochemical and other chemical plants, thermal power stations, nuclear power stations and HVAC systems for cooling buildings. The classification is based on the types of air induction into the tower: the main types of cooling towers are natural draft and induced draft cooling towers.

1.2 Objective

The main objective of cooling tower is to cool the hot water in minimum time, to measure the total time taken to cool the temperature of hot water, to minimise and reduce the wastage of water and to increase the efficiency of joint plant.

2. Literature Review

1..Mr.Hindren Ali Saber and Assist Prof.Dr.IydEqqabMaree(2019). They investigate the performance characteristics of counter flow wet cooling towers experimentally by varying air and water temperatures, fins angle, rate of air flow, rate of water flow as well as the evaporation heat transfer, along the height of the tower. during the investigation it is observed that the cooling range is decreased with increasing water mass flow rate and increased with increasing air mass flow rate, due to as the amount of heat transfer depends on the two mass flow rates, in case of larger quantity of air that in contact with less quantity of water the results are larger degree of water cooling then cooling range increased, but in case of larger quantity of water that in contact with less quantity of air the results are lesser degree of water cooling then cooling range decreased, for both cases the cooling range increased with increasing fins angles, and the best cooling range was obtained for 70 degree fins angles.

2.Kevin J. Albrecht and Clifford K. Ho (2017). They investigate the heat transfer models of moving packed-bed particle-to-sCO2 heat exchangers. After investigation they presented. A predictive model for the design and evaluation of a moving packed-bed heat exchanger. The model is based on the single-component continuum approach previously documented in the literature. Analytical solutions of constant temperature and heat flux boundary conditions displayed Nusselt numbers, which asymptote to constant values at high residence times when solved in a bounded domain. This result is in contrast to the typical thought that the heat transfer coefficient is significantly diminished at high residence times, which is obtained from the analytical solution on a semi-infinite domain. The single-component continuum model was extended to a counter-flow particle/sCO2 heat exchanger. The simulation results indicate that high overall heat transfer coefficients (~144 W m-2K-1) and effectiveness (>90%) are attainable in moving packed-bed heat exchangers. For the particle/sCO2 temperatures simulated here, approximately 5.86 kW of heat can be transfer per square meter of heat transfer area. Finally, the modeling results were used to design a moving packed-bed heat exchanger experiment, which is a much smaller scale than the simulated heat exchanger, but still has the same non-dimensional characteristics. The experiment should allow for model validation and confidence in the simulated heat transfer coefficient values.

3.Dileep KJ, Dileep Kumar Baniya, Anoop Chandran Kurup and Arun Varghese (2017). They studied the Design and Fabrication of Cooling Tower, and conducted Experiments on a fluidized bed cooling tower. Performance of the cooling tower was analyzed with fluidized bed. The experiments show the effects of the water and air on the tower characteristic, the air to water contact is more in fluidized bed cooling tower, so better heat transfer has been occurred and the cooling water outlet temperature is reduced. The range of cooling tower can be increased by using fluidized bed. The increase in inlet temperature of water decreases the effectiveness as same quantity of air is available for cooling for all operating temperatures of cooling tower. As L/G ratio decreases the cooling rate increases. For optimum utilization of fluidized bed the flow rate of cooling air should be increased
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4.Rajarajeshwari S and Ramana AS (2017). They studied the Experimental investigation on packed bed cooling tower. After the investigation they found that Performance enhancement of cooling towers is essential for overall improvement in system efficiency for power generation and process applications. The performance of cooling tower using spherical shaped elements packing was analysed and tower efficiency increased with higher mass flow rates of air and water at the considered operating limits. However, at 200 LPH water flow rate, optimized mass flow rates of air is required to obtain maximum range and efficiency of cooling tower.

5.**Syed Amjad Ahmad, Anas Ahmad, Ahmed Butt and TaimoorWaqas (2014).**They studied the Performance Improvement of Mechanical Induced Draft Cooling Tower by Using Aluminium as Fill Medium. From the experiments various conclusions are postulated in which the most important was the effect of aluminium fills in performance of cooling tower aluminium being an elemental solid is corrosion free and has a reasonable good heat carrying capacity. The Specific Heat of aluminium is 900 J/kg °C which allows air to remove heat from water when they get contact over aluminium plates. The experimental was performed on small prototype design of cooling tower and it is proved to be an efficient one. In future it should be used on large scale in industry and more it is considered for more research study it will be founded to be a good method. Another fact is concluded that in win-ter the cooling tower performs more efficiently than summer because in winter the relative humidity of air is considerably low, the air will absorb large amount of water droplets which means air can take more heat from water, so more the relative humidity of air low will be efficient the cooling tower will perform.

2.1 Material

The assembly of the honeycomb packing based counter flow cooling tower is shown in fig. The tower consist of following component namely, Base (wooden), Tank (Acrylic fiber material), Pressure gauge, Flow meter, CPVC pipes, cooling tower filled with honeycomb packing, Induced fan, Basin and Temperature sensors. Acrylic fiber material are used to make tank, cooling tower, basin following are the dimensions of the component.

1.Packing Material

2.pressure Gauge

3.Thermometer

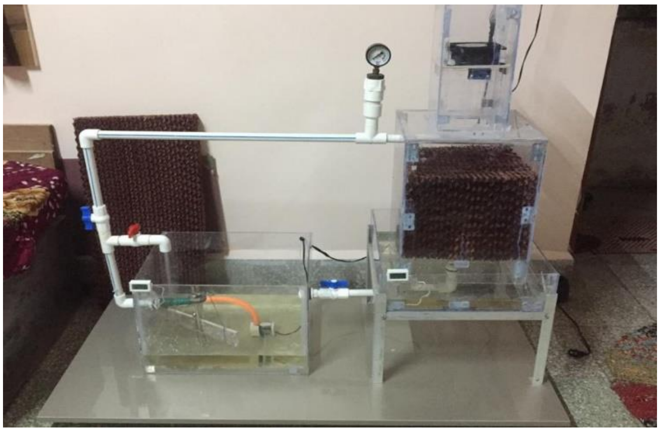
4.Induced Fan

Table -1:

Component	Dimension
1. Base	1200*580 mm
2. Tank	412*322*300 mm

3.	Pipe	15 mm dia.
4.	Cooling Tower	290*290*460 mm
5.	Packing	290*290*230 mm
6.	Basin	400*395*115 mm
7.	Thickness of basin & tower	3.5 mm

2.2 Construction And Working principe



The system includes a basin tank, packing and drift water arrangement, as well as motor and induced fan section. The hot water is pump to the cooling tower and the flow is, mentioned at.

The top section of the cooling tower consist of motor and induced-draft fan, guide vanes to control the air-flow rate, drift eliminator, a psychrometer and a rubber bellow to control vibrations. The air and water flow rates are measured with an orifice meter and a control valve. The inlet and outlet temperature measured using thermometer.

Working

In counter flow cooling tower, the water is heating for use of heating coil. The hot water is flows into the pipe and then attached to control valve is controlling the flow rate of water. The hot is sprays in cooling tower with help of spray and this hot water sprays in downward directions in packing materials. The induced fan assemble in upward direction on cooling tower suck out all the atmospheric air of the cooling tower.

Due to this cool air coming in contact with hot water, which flowing through packing material cools down this hot water. This water is used in the further process of power plant. In order to increase the cooling rate, interface area between air and water is increased by providing packed and fluidized beds.

3. CONCLUSIONS

As determined by the experiments carried out, it has been verified that experimental statements that the outlet temperature can never be less that the ambient temperature is validated, it has also been validated that the best cooling towers can give is a temperature difference between the outlet temperature and the ambient temperature

ACKNOWLEDGEMENT

We would like to express special thanks of gratitude to our guide Asst. Prof. Rahul Dahekar as well as other professor of mechanical department for their assistance who helped us to do a lot of research and we came to know about so many new things. We are really thankful to them.

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