JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

DESIGN OF EVAPORATIVE AIR COOLER

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Abstract : It is desirable to deliver cool air in hot summer seasons in order to boost human comfort level. Various sorts of air-cooling technologies have emerged over time to suit this requirement, including fans, air conditioning systems, and air cooling systems, to mention a few. Common people cannot afford ACs. But in air coolers the cooling capacity is less. This project aims at designing the air cooler with increased cooling capacity. Air cooling system works on basic principle called as Evaporative cooling. Water stored in a higher tank is allowed to drain down through a fibrous screen with high air permeability in air coolers using a similar process. Air is drawn through the Terracotta tubes, made of clay. The low pressure created by the high velocity air stream flowing past the tubes aids in lowering the pressure and, as a result, the temperature of the air. In the similar way the evaporative pads are used. The performance parameters are noted in two cases separately and combinedly too. It is observed that the terracotta tubes more cooling effect than pads. In combined case it is giving even more cooling effect. In the present work evaporative air cooler was modelled by using CREO 9.0.0 version.

***IndexTerms*: Air cooling technologies, Air cooling techniques, Evaporative cooling, Terracotta tubes, Clay, Evaporative pads, Cooling effect.**

I. INTRODUCTION

The purpose of an air cooler is to deliver cool air. An air cooler works on Evaporative air cooling. Evaporative cooling is being used from ancient times for cooling of water in earthen pots. In the similar way the air will be cooled. Air cooler components are designed in CREO software. The assembly model of Evaporative Air Cooler is designed.

Literature:

Ibrahim et al. (1) theoretically analyzed the performance of direct evaporative cooler in hot and dry climate with kano being the study area. The performance of cooler was determined at different air velocities at saturation effectiveness of 50% to 90%. These results shows that leaving air temperature of 21.9 and relative humidity of 82% were obtained with pad material of 90% saturation effectiveness. The cooling capacity and water consumption rate are found to vary linearly with the saturation effectiveness.

Abdulrahman Th. Mohammad, et al. (2) done experimental investigation on direct evaporative cooler in hot and humid region, experimental study is based on weather data Kuala Lumpur ,Malaysia, the performance of evaporative cooler is evaluated using output temperature ,saturation efficiency, and cooling capacity .During experimentation ,the inlet air conditions were as follows, the dry bulb temperature 29.6 ˚ to 36 ˚. The air relative humidity 42.5 to 81.1 % and the solar radiations 307.4 to 903.7 W/m^2 .the average velocity during the experiment was 5.5 m/s and water flow rate 10 lit/min. Experiment indicated that DBT decrease up to 7.6 ˚ is obtainable by using direct evaporative cooling unit in hot and humid region, saturation efficiency varies from 77.3% to 63.5% and cooling capacity ranges from 1.384 KW to 5.358 KW.

J.k. Jain, et al. (3) developed regenerative evaporative cooler, they have been modified conventional direct evaporative cooler by adding water to air, heat exchanger in the path of outgoing air stream and heat exchanger cools the air further by using cooled water available in the cooling tank. They have been found that efficiency and COP of regenerative system is increased by 20-25%, they have conducted experiment and found that regenerative evaporative cooler is advantageous for providing more cooling compare to an ordinary direct evaporative cooler which can make cooler more useful for providing thermal comfort in residential and commercial building. They have plotted graphs for DEC and regenerative DEC.

Rajesh Maurya, et al. (4) studied three types of cooling pad made of cellulose ,aspen fiber, coconut coir, this study is performed in summer and best on weather conditions of Bhopal having maximum DBT and calculated saturation efficiency and cooling capacity ,result shows that saturation efficiency at air velocity 0.5 m/s is highest for aspen material at 80.99% compare to 69.58% for cellulose pad.

Dr. Punjabrao Deshmukh Krushi Vidhyapeeth, et al. (5) developed centralized air cooling system for college auditorium. The present building of college auditorium posed the problem of ill-ventilated atmosphere and suffocation in most of its part during the programs. Major part of the building exposed to the sun the roof being heated throughout the day. The object of air cooling is to establish a stable thermal environment which satisfies the majority of occupants with respect to comfort under all the climatic conditions to which the building is subjected. Hence it was decided to provide the false ceiling and design air cooling system for college Auditorium for better comforts to the occupants during longer program. For the cooling system of auditorium requires two coolers with water requirement is estimated as 8 lit/sec and power requirement is 120 Watts. Solar and transmission heat gain through walls and roofs etc. Solar and transmission heat gain through doors, windows or wall glasses. Transmission gain through partition wall ceiling floor etc. Infiltration of direct air from some inlets like doors or windows. Internal heat gain from occupants, light appliances etc. Additional heat gains not accounted above, safety factors etc. Return duct heat gains, supply duct leakage, heat gain from door, fan and pump.

1.1 Objective

The major objective of this project is to design an evaporative air cooler.

2. Proposed Model

In this proposed model, An Evaporative air cooler is designed. Initially the area to be cooled is selected, accordingly all the required components are designed. All the components are arranged together and assembled with the help of bolts and nuts.

2.1 BLOCK DIAGRAM

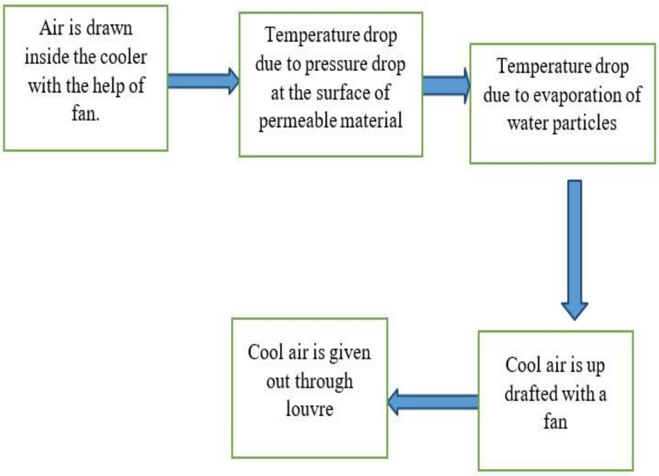

Fig 1 Block diagram of working

2.2 WORKING:

From the block diagram, it is observed that the atmosphere air, which is having high temperatures, is drawn inside the cooler. Our concept is based on evaporative cooling, a centuries-old technology that uses water and porous materials like terracotta to reduce ambient temperatures. Evaporative cooling occurs when water seeps through the porous layers of terracotta and evaporates at the outer surface, cooling the inner surface. Whenever the atmospheric air with high temperature passes through the tubes the temperature of the air gets dropped. Due to evaporation of water particles the temperature drops even more. Finally the cool air is delivered to the area to be cooled with the help of the fan. This happens in case of clay tubes. Clay terracotta is chosen for its porous, flexible, and durable properties.

2.3 DESIGN OF COMPONENTS

a) Frame

It is the main of the air cooler. It is made up of steel allow. All the three side frames are made as mesh. So that evaporative pads can be accommodated here. Front frame is made as a sheet with a circular opening for accommodation of fan to deliver cool air. The design of frame is made based on the area to be cooled.

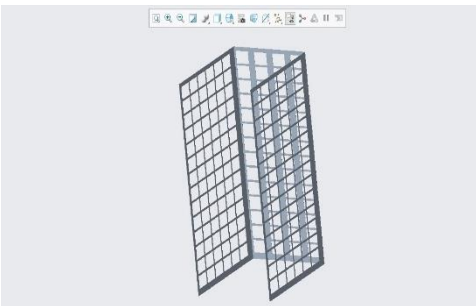

Fig 2 Frame

b) Storage Tank

There are two storage tanks in this air cooler. One is placed at the bottom for storing of water and the other tank is placed at the top with small holes through which the water will be sprinkled. The storage tanks are also made up of steel alloy.

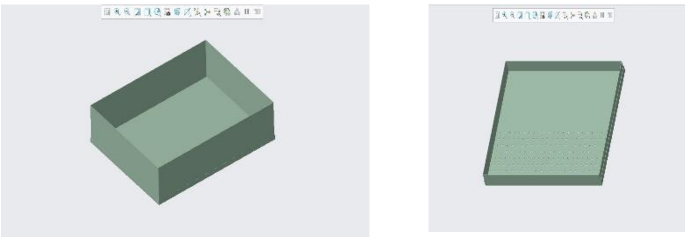

Fig 3 Storage tank

c) Pump:

A pump is a device that moves fluids, or sometimes slurries, by mechanical action, typically converted from electrical energy into hydraulic energy. Compact, submersible water pumps are mostly used on air coolers. The pump runs out of water and continues to operate.

Fig 4 Pump

d) Fan with motor:

The pump will run the water through the cooling pads, allowing them to soak the water beforehand. You can run the fan after the tank is full. This helps the cooler to cool the air, as soon as you turn it on. Fan will help to deliver the cool air with different speeds and velocities.

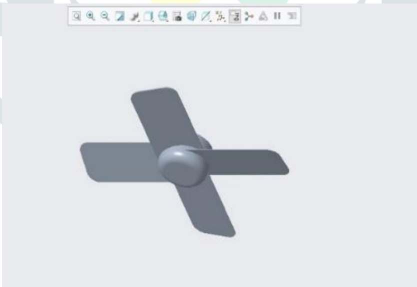

Fig 5 Fan with motor

e) Metal frame:

Metal frame is made of rod to accommodate terracotta tubes. It is made up of steel rods. This metal frame is made through welding. Metal frame is designed. This metal frame is accommodated inside of the air cooler.

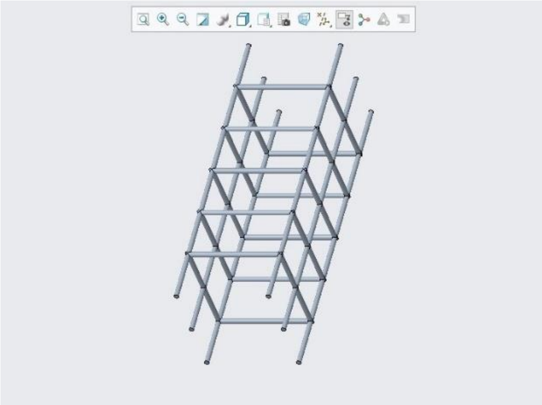

Fig 6 Metal frame

f) Evaporative pads:

The Evaporative cooling pad is a pad that is used to evaporate hot air to reduce the air temperature. Evaporative cooling uses evaporation to help cool the air. Based on the principles of evaporation, hot and dry outside air is drawn through water-soaked cooling pads. As the air is pushed through these pads, the water evaporates and the heat in the air is absorbed, which lowers the air temperature.

Fig 7 Pads

g) Terracotta tubes:

Terracotta tubes are made up of clay. Later on they will be heated treated in order to increase its porosity property. Water passes through the terracotta tubes, facilitating evaporative cooling. Air is cooled when it passes through the terracotta tubes and comes out and stays cool like water in an earthen pot. This installation also gives a beautiful cascade effect when drenched in water.

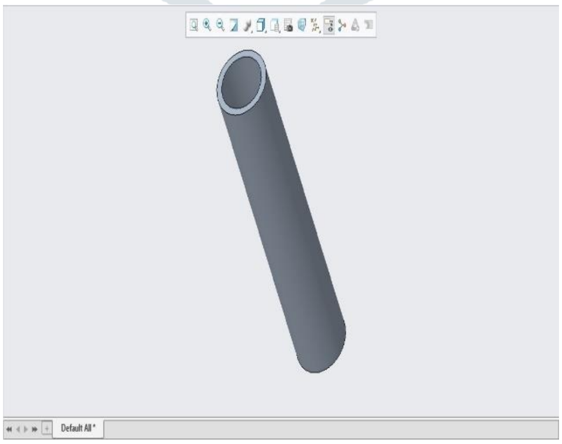

Fig 8 Terracotta tubes

h) Thermocouple:

A thermocouple is a sensor that measures temperature. It consists of two different types of metals, joined together at one end. When the junction of the two metals is heated or cooled, a voltage is created that can be correlated back to the temperature. Thermocouple is used to measure the inlet and outlet temperatures of the air.

Fig 9 Thermocouple

3 EXPERIMENTAL SET UP

Belo figure shows the final assembly of the air cooler was design in CREO software.

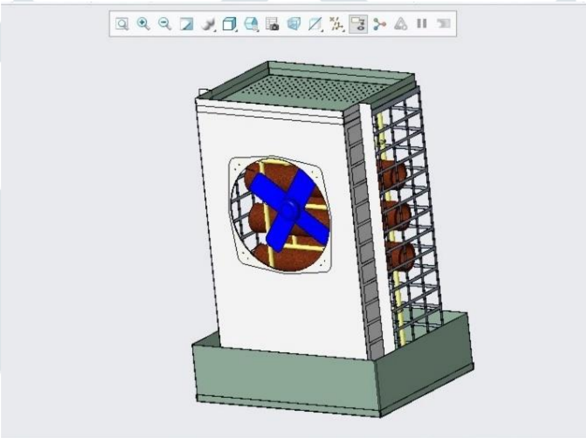

Fig 10 Evaporative Air cooler

4 CONCLUSION

Evaporative air cooler was modeled by using CREO 9.0.0. In short, this project is about design of evaporative air cooler. In this, firstly the required components were designed for the air cooler. Terracotta tubes are modelled as per the dimensions of our project. All the components were arranged together and assembled to form an air cooler.

ACKNOWLEDGEMENT

It is with immense pleasure that we would like to express our indebted gratitude to our guide **Dr. D. Sai Chaitanya Kishore, Professor of Mechanical Engineering** who has guided us a lot and encouraged us in every step of the project work. We thank him for the stimulating guidance, constant encouragement and constructive criticism which have made possible to bring out this project work.

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