Design and Fabrication of 360 cooler cum Heater

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ABSTRACT: *This paper is based on innovation to conventional coolers. In conventional or normal cooler we get one directional air flow only. This cooler is designed in such a way that the people sitting in any area in the room will get equivalent cooled air. The cubical cooling chamber consist of four cooling pads. The exhaust fan in mounted above the chamber, below which the heating coil is mounted. Thus this cooler can be used as a heater in winter season and as a cooler in a summer season.*

Keywords—*Chamber, Exhaust fan, Heating coil, Khus-Grass, Pump.*

1. INTRODUCTION

The EVAPORATIVE cooling is one of the earliest methods employed by men for conditioning their houses. Only in recent years, it has been put on sound footing thermodynamically. It is a process of adiabatic saturation of air when a spray of water is made to 360 EVAPORATIVE into it without transfer of heat from or to the surroundings. The initial investment cost of such a system is low & the operation is simple & cheap.

Simple 360 EVAPORATIVE cooling is achieved by direct contact of water particles & a moving air stream. If the water is circulated without a source of heat & cooling, dry air will become more humid & will drop in temperature. In a complete contact process, the air would become saturated at WBT of the entering air.

The minimum outdoor temperature required for successful 360 EVAPORATIVE cooling is above 35^0 c & another requirement is a relatively low. Wet bulb temperature. The comfort given by the 360 EVAPORATIVE cooling always depends upon the outdoor temperature & R.H. High D.B.T & low W.B.T. always gives more comfort with 360 EVAPORATIVE cooling. Although the 360 EVAPORATIVE cooling does not perform all the function of true air-conditioning but it provides comfort by filtering & circulating the cooled air. This system does not dehumidify the air but on the contrary, further humidify air.

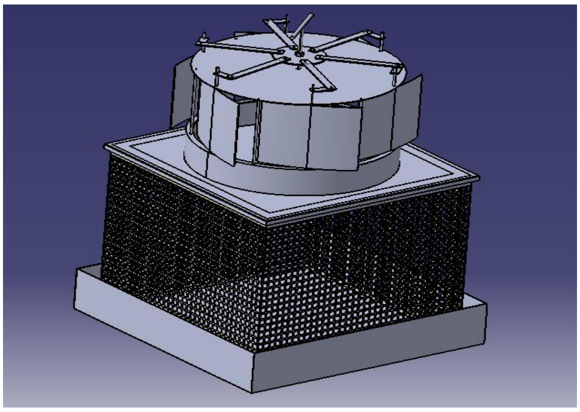


Fig a) 360 Evaporative cooler

Before the advent of residential air-conditioning it was the only mechanical means available to make home interiors livable in the hot, dry, desert summers. Hence different cooling pads helps to get cooling effect.as shown in fig b)



1) khus grass 2) cellelouse pads 3) coconut coir

These cooling systems are economical in terms of energy usage. During the energy crisis from last two decades, 360 EVAPORATIVE cooler use was promoted as to control household utility bills.

2. LITERATURE REVIEW

The history was categorized as primitive, modern, Eastern and Western judging from the Egyptian water jars of 2500BC manually fanned by slaves to cool water up tothe development of homemade drip coolers of 1935 when they became more popular (Watt et al, 1997).

Historically also the ancient Egyptians hung wet mats in their doors and windows while wind blowing through the mats cooled the air making this to be the first attempt air conditioning. The idea was refined through the centuries. Chronologically; mechanical fans to provide air movement came in the 16th century, cooling towers with fans that blew water-cooled air inside factories in the early19th Century and swamp coolers in the 20th Century.

Evaporative cooling have existed in different forms and using different materials for centuries ago. Examples include the fired clay porous ceramic jars "Botijos" of Spain and Southern Italy used to provide water for agricultural workers in the fields (Brian and Rosa, 2003). Other areas are Egypt and Sudan, (Ibrahim et al, 2003)

Similarly in Nigeria from centuries to the present days locally fired porous clay pots are very popular for cooling water in homes and farms. The most popular shapes are basically spherical differing in the openings at the top. The size of the opening depends on the nature and shapes of the item to be cooled or stored and the size of the ceramic pot as well. As warm dry air flows over the wet body of the water filled porous clay pot evaporation takes place on the surface. The air downstream becomes coo1.and humidified while the water in the pot becomes cool. The same materials are used for the preservation of some agricultural products such as kola nuts and vegetables(Elkahoji, 2004).

In India (Roy, 1989) drip evaporative cooling method was constructed with simple materials and used for the preservation of fruits and vegetables . It consists of a simple low cost cavity wall evaporative cooler constructed from bricks and termed as "Improved Zero-Energy Cool Chamber" in India, (Lisa and Kader, 2003). The sand filled cavity between the walls and the sand were kept saturated with water by simple dripping system.

3. PROBLEM STATEMENT

Now a days power crisis is much more. so importance should be given to power saving and energy conservation. Efforts being concentrated on finding resources or method of saving energy. In this project 360 EVAPORATIVE COOLER will be design, developed and fabricate to low operational and overall cost. It doesn't create any type of pollution so it is eco-friendly. This A.C. supplies air without increasing humidity compared with conventional air coolers.360 direction will allow to sit people any where.

4. OBJECTIVE

To develop the Energy efficient, environment friendly direct evaporative air conditioning system having low operating cost suitable for hot and dry regions.

5. WORKING PRINCIPLE

First start the pump which sucks water from bottom tank which was already filled with water. Water goes on stationery pad which are placed on backside of two side door, through delivery pipe.

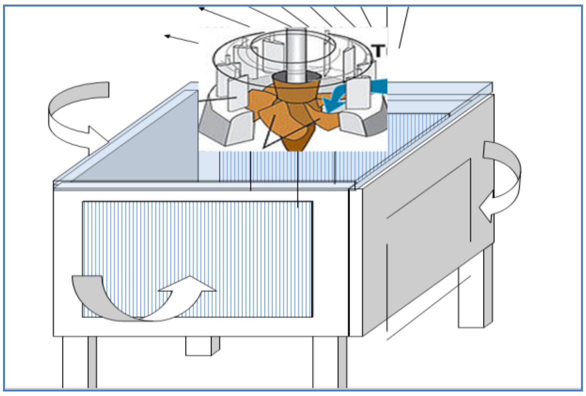


Fig c)Layout of model

After that, the exhaust fan starts & sucks the atmospheric air, which is passed through wet pad. In this process cooling is achieved by direct contact of water particles & moving air stream. In complete contact process the air would become saturated at WBT of entering air. In other words sensible heat of air is carried by water in the form of latent heat, when it is brought intimate contact with water.

After some time air may be sufficiently cooled by 360 EVAPORATIVE process, which results in considerable increase of humidity. For better effect add ice cube or chilled water in bottom tank.

6. Practice ,theory and methodology

Collecting data –

An 360 EVAPORATIVE cooler is a device in which air and water are contracted in adiabatic manner. The surface area for contracting may be supplied by water droplets as in the spray type or by a water film spread over a wetted matrix or pad as in the pad type, in either case the surface area can be maintained by a single pass or multiple passes of feed water and these are referred to as once through, and recirculation system respectively. The overall fed water rate must be in excess of the evaporation rate in order to prevent the build up of salts and solids in the water.

There is a separate motor for the pump and the fan, so they can use independently. The pump pumps the water from the bottom tank to the top and the water twinkles through the holes provided on the top tank and falls passing through the pads to the bottom tank. The air is sucked by the fans from all four sides and gets cooled passing through the pads. The fan in the horizontal plane discharges the cool air.

7. Design-

Design calculation:-

1)Design calculation of shaft:-

Mild steel C-45 is selected in our project.

1. Easily available in all sections.

2. Welding ability
3. Machinability
4. Cuttingablity

Cheapest in all other metals.

Material = C 45 (mild steel)

Take fos= 2

$\sigma_t = \sigma_b = 540/\text{fos} = 270\ N/mm^2$

$\sigma_s = 0.5\ \sigma_t$

$= 0.5 \times 270$

$= 135\ N/mm^2$

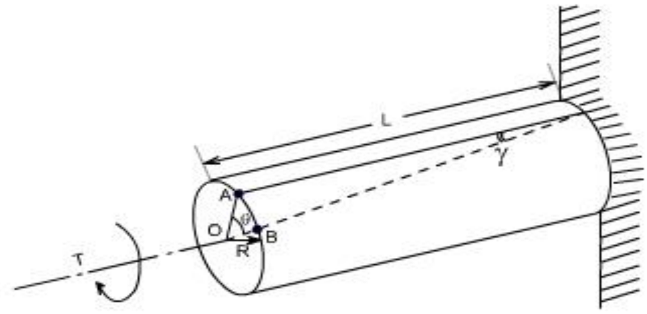


Fig d) Shaft

Torque transmitted by shaft,

$T = F \times L$

$= 100 \times 50$

$= 5000$ N-mm.

$T = \pi/16 \times \sigma_s \times d^3$

Therefore, $5000 = \pi/16 \times d^3 \times 80$

$d^3 = 5000 \times 16/3.142 \times 80$

$d = 6.82$ mm

But we are using 10 mm shaft so our design is safe.

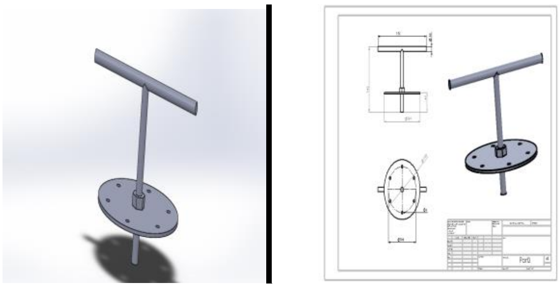


Fig e) Handle

2) Chamber stress calculation:

The whole body of water cooler is kept on 4 box pipe let the weight of whole flapper assembly including fans be 40Kg so load on each pipe is 10 kg, 100N

Take fos= 2 times so W =200 N

$M = W L / 4 = 200 \times 244 / 4 = 76616$ N/mm

$Z = B^3 - b^3 / 6 = 40^3 - 34^3 / 6 = 4116\ mm^3$

$\sigma_b = M / Z$

$\sigma_b = 76616 / 4116 = 18.61\ N/mm^2$

$\sigma_{b\ INDUCED} < \sigma_{b\ ALLOWED}$

$18.61\ N/mm^2 < 160\ N/mm^2$

Hence our design is safe.

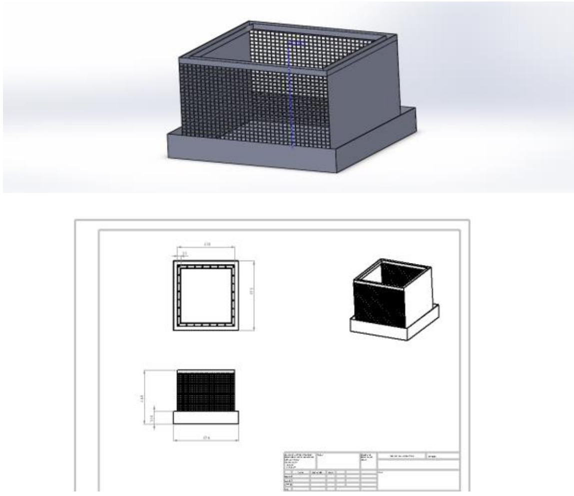
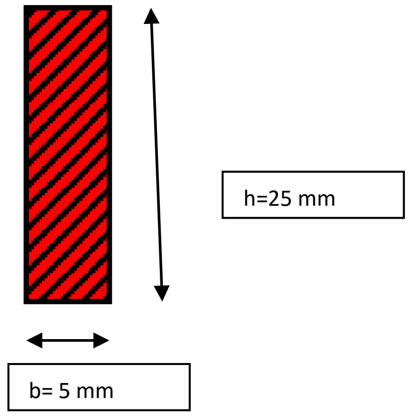


Fig f) Chamber

3)Flappers design calculation:-

The link which we are using for rotating flappers may fail under bending

F = maximum force applied = 100 N



For cantilever, $M = F \times L$

$M = 100 \times 160 = 117600$ N-mm

And section modulus

$Z = 1/6\ bh$

$Z = 1/6 \times 5 \times 25^2$

$Z = 1/6 \times 3125$

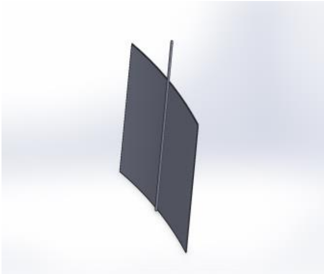
$Z = 520.8\ mm^3$.

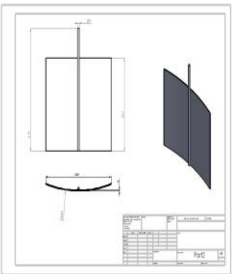
Now using the relation,

$Fb = M / Z$

$Fb = 117600 / 520.8 = 225.8\ N/mm^2$

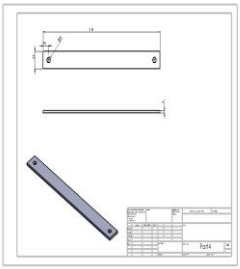
Induced stress is less then allowable 260 N/mm² so design is safe.





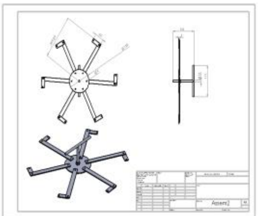
Cad model:-

Small rectangular steel plates forming part joint of flapper handle.



Cad Model :-

Handle of flapper mounted on top of cooler

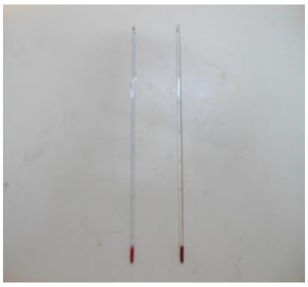


Actual project Image

This project can be used in room as well as in open areas such dabas, hotels, restaurant etc. This project is cheap compared to coolers available in market. If little advancement in is done in such cooler, then it can be operated on solar energy .Hence the problem of electricity crisis can be reduced more.

8. RESULT:-

Experimental Setup Instruments:



THERMOMETER **ANEMOMETER**

PSYCROMETER **ENERGY METER**

Trial on air cooler:

Initial room temperture (DBT) = 32 C.
Relative humidity=60
Area of room = 200 ft, height = 10 ft.

Observation number	Temperature in degree centigrade	Time interval in minutes
1	32.0	0
2	32.0	15
3	31.6	30
4	31.0	45
5	30.2	60
6	29.6	75
7	29.0	90
8	28.6	105
9	28.2	120

Net drop in temperature is 3.5 C as the trial is taken in Kankavli and Kankavli has coastal atmosphere. So water containing capacity of air is less. Cooler works on the principle of evaporation. So its performance is limited and less effective in Bombay and is widely used in dry areas like Madhya Pradesh, Delhi, which is far away from coastal areas.

8. CONCLUSIONS

From the present investigation it is evident that for drip type 360 EVAPORATIVE cooling the performance characteristics cooling the performance characteristics can be related to the variables like and thickness and the atmospheric conditions such as humidity control and comfort. It is also possible to determine the optimum value of these design parameters but location and one needs to optimize the design parameters for corresponding outdoor conditions.

The result also indicates that a considerable saving in power consumed is possible and at the same time the cooling effectiveness can be enhanced. The approach can be employed to analyze any piece of equipment and improve it's performance.

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