"Study of a Pump Less Air Cooler"

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ABSTRACT

Cooler is also able to control humidity (water particle /vapor) with high cooling capacity. This cooler is filter the air two This is one of the evaporative air cooler working without water pump and save electric energy, and this times and another specialty of this cooler is consume very less water during running condition. Pump less cooler give temperature drop of 30 degree F within 15 minutes. It has been found may by not using pump electricity consumption reduces by 23.5%. It affected by atmospheric condition. The water consumption reduces by an average of 59.25%. But water consumption is increases with increase in atmosphere temperature where cooler is kept. From the performance tests on pump less air cooler it can be concluded that the efficiency of this cooler quite comparable high with conventional cooler in the market.

Key skills: *Energy Consumption, Humidity, Evaporative Cooling, Model Design, Etc.*

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1. Introduction: An evaporative cooler (also swamp cooler, desert cooler and wet air cooler) is a device that cools air through the simple evaporation of water. Now a day's thus evaporative coolers are renowned not only because it gives comfort in summer by humidifying air but also it is cheaper. Pump less air cooler was started as a project work with a view a make it cheaper than the coolers available in the market with the comparable high humidifying efficiency in less power consumption. It is an entirely a new design, different from the conventional types and has a very little attribute to get up.

1.1 History of Evaporative Cooling: The evaporative cooling is one of the earliest methods employed by men for conditioning their house. Simple evaporative cooling is achieved by direct contact of water particles and a moving air stream. If the water becomes more humid temperature will drop in. In a complete contact process the air would become saturated at wet of the entering air. The air may be sufficiently cooled by evaporating process to result in considerable degree of summer comfort of high dry bulb temperature associated with low relative humidity. Although the relative cooling does not perform all the function of true air. Practical use of evaporating cooling was made by the citizenry of India during the past century with the help of wetted grass. With development of science modified developed and manufactured to utilize evaporative cooling in the air stream.

2.0 Design Criteria:

2.1 Fan motor:-Single phase A.C. motor
Volts - 220/230V, Power -130W (1/16 B.H.K.), Speed -1400 RPM

2.2 Fan:-The fan used was semi-exhaust fan specifications of fan are as follows:
Blade sweep-16",Supply-220/230, Volts A.C.-50 c/s, Speed-1400 R.P.M, Air displacement-90 m^3/m. The fan and its motor were supported on the front sheet with the help of foundation of 1/2" M.S. angles to have rigid support. The foundation was attached to the front sheet with the help of nut and bolts. Here the motor was used which is having extended shaft so to coupled with gear box input shaft.

2.3 Rotating drum:-The screen drum will be mounted on the shaft coming from the gear box. The fan sweep is 16" so drum diameter should be greater than the fan sweep. Below the fan water tank will be kept the height of water tank is 8 inches at latest of a screen drum should be dipped into water. Hence minimum drum diameter should be convenient, we choose our drum diameter as specification: Outer drum-26*20*12, Inner drum-20*15*8, Tank Capacity-50 Liter.

2.4 Water tank:-In order to humidity the air the drum must rotate through water i.e. considerable portion of drum must be always dipped in water to cool the air sucked by fan keeping all these points in view the size of tank was selected as 27*25*8.The material used for water tank was G.I. sheet of 22 gauge, with the help of folding machine the sheet was folded to have a shape as shown in figure. The shape of tank was so selected that it will reduce the amount of waste water in the tank all corners were soldered with heated mixture of lead and zinc further pasted with putties to make it stronger and to prevent from the danger of water leakage.

2.5 Cooler box:- A 22 gauge G.I. sheet was used to fabricate the cooler box with following specifications Front sheet-29″x22″, Side sheet-25″x22″, Back sheet-29″x22″,Top sheet-29″x25″.

2.6 Gear Box:-It consists of following parts (a).Worm No. 1 (b). Worm Wheel No. 1 (c). Worm No. 2 (d.) Worm Wheel No. 2. For worms, suitable rod of cast iron steel was taken and turned to required diameter of worms suitable change gear set for cutting required pitch was selected and threads were cut after adjusting the required speed. For worm wheels the plastic material was selected because of the plastic worm wheel there was silent operation of gear box beside this it was having following advantages (a) Less in weight (b) Reduced friction worm wheel no.1 was having 24 teeth while the worm wheel no.2 was having 42 teeth. For proper meshing worms and wheels, four steel plates welded together to have a box of proper dimension. Two vertical places were drilled and hearings were fitted in it to support the worms, the worm no.1 is coupled with shaft of the drum.

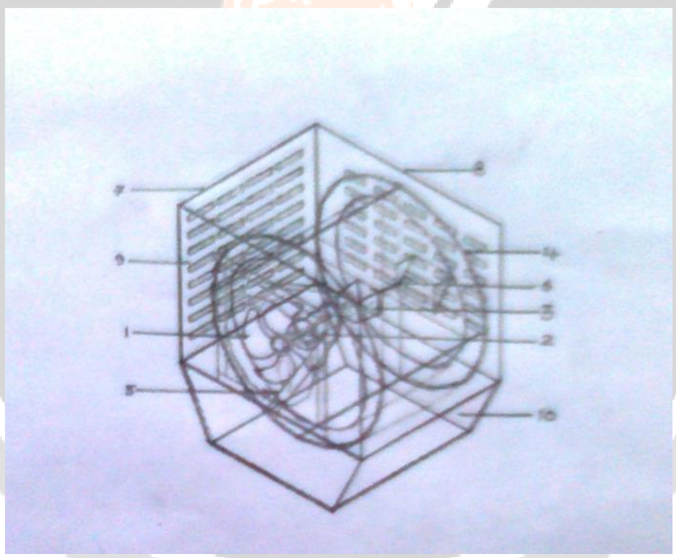

Figure 2.1 Line Diagram of Pump Less Air Cooler (Description:1.Fan, 2.Motor, 3.Speed Reduction Gear Box, 4.Outer Drum, 5.Inner Drum,6.Bearing,7.Side Panel, 8.Back Sheet, 9.Front Sheet,10.Tank)

3.0 Working Of Pump Less Air Cooler: In pump less air cooler instead of circulating the water thought the screen for humidifying air it was developed, with an idea to rotate the screen through water that is water is kept stationary and the screen is rotated continuously through water so that each part of screen becomes wetted to humidify the air sucked by the fan. As the screen is of rotating types its shape must be properly aligned so that each and every part is wetted while passing through the water. The most suitable shape of the screen is drum type with the rear end closed with the same type of screen. Again, the drum must be rotated in such a way that only air passing through the drum will be sucked by fan.

4.0 Thermal Analysis and Observation: Observations are done in summer season at Indore, M.P. India. Indore has a humid subtropical climate with mild, dry winters, a hot summer and a humid monsoon season. Summers start in late March and go on till mid-June, the average temperature being around 30 °C (86 °F), with the peak of summer in May, when the highs regularly exceed 40 °C (104 °F). Outdoor DBT 30.8 at 12:00 pmAt the room area of 450 Square meters

Table 4.1 Observation of temperature at 40 °C

Outdoor DBT 30.8 at 12:00 pm at the room area of 450 Square meters

TIME	Dry Bulb Temp.(°C) After cooling	Wet Bulb Temp.(°C) After cooling	Relative Humidity (%) After cooling
12:10	28	20.5	52
12:40	26	19.1	55
1:10	25	19	59
1:40	24	18.9	61

1. Air temperature $t1=30.8$
2. Air temperature after cooling $t2=28.5$
3. Actual cooling temperature $t3=20.62$
4. Now efficiency of the cooler at 12:00 pm

$\eta = (t2-t3/t1-t3)*100\%$

$\eta = (28.5-20.62/30.8-20.62)*100\%$

$\eta = 77.2\%$

Where

t1 = inlet air dry blub temperature.

t2 = air dry bulb temperature after cooling.

t3 = ideal cooling temperature.

w = Relative humidity.

Energy Consumption

P =130 Watt

So that unit consume is =1Unit/8 hours

If price of 1 unit is = 3.5 Rs. Means 3.5 Rs/8 hour

So = 0.4375Rs/hours

If cooler is run 10 hours in one day

Running cost of cooler in one day = 4.3Rs/day

And one month ru. Cost = 129Rs/month

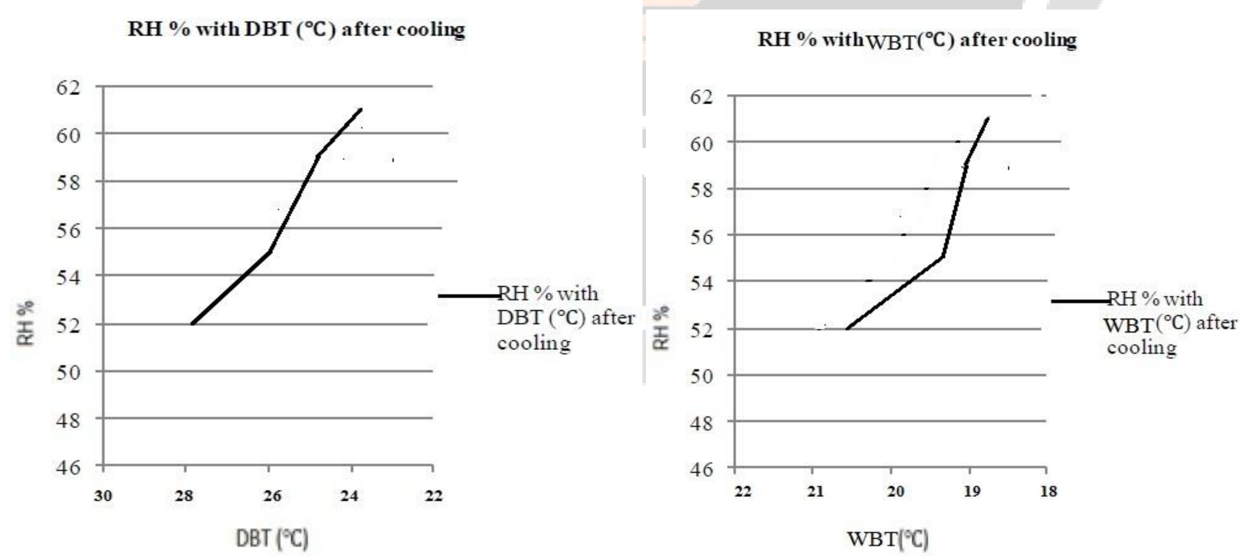

Figure 4.1: Graph between RH, DBT & WBT.

4.1 **Observation for Energy Saving:**

Parameters	WITH PUMP PUMP	WITHOUT PUMP	% OF SEVING ENERGY (A-B)/A*100A*100
Electricity Consumption per Hours	170 watt	130 watt	23.5%
Water Consumption per Hours	5.65 Litres/hours	2.5-3 Litres/hours	59.29% (avg)
Leaving Temperature in (°C)	26	24.5	5.76(increase)

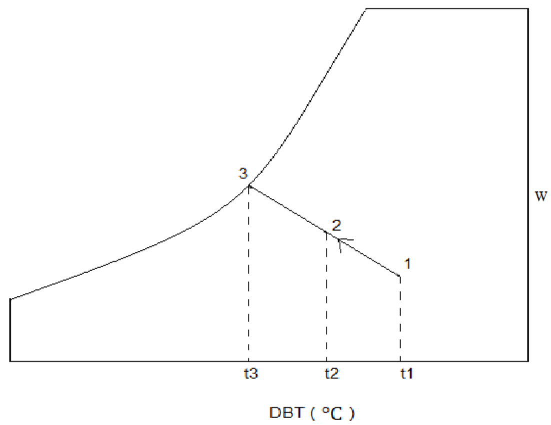

Figure: 4.2 Psychometric line Diagram.

5.0 Conclusion:

1. From the performance tests on pump less air cooler it can be concluded that the efficiency of this cooler quite comparable high with conventional cooler in the market.
2. It can be batter designed by keeping the motor at a considerable distance from the rotating drums so that there no chance of any water particles coming out.
3. It has been found may by not using pump electricity consumption reduces by 23.5%. It affected by atmospheric condition.
4. The water consumption reduces by an average of 59.25%. But water consumption is increases with increase in atmosphere temperature where cooler is kept.

6.0 References:

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