Experimental Investigation of Cooling without Humidification on Evaporative Air-Conditioner by Using Water as a Coolant.

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ABSTRACT:

*The objectives of this paper are to increase the effectiveness of the ordinary table fan by using simple mechanism. It is easy to choose a size of HOME MADE AIR CONDENSING UNIT according to the room size. A general room temperature will be 34 degree Celsius; if the room size is 14*7 feet then a unit of 3000rpm fan speed will be used. If the room size is 10*8 feet then a unit of 2500rpm fan speed is used, if the entering air is dry enough. This report quantifies the performance and characteristics of the homemade air conditioner. Analysis includes quantification and modeling of the heat removal capacity and efficiency of the system under varying conditions, and net present worth analysis of the unit considering all recurring costs. Attention has been paid to the areas that have received the most frequent questions from those interested in the design.*

It was found that the heat removal capacity of the homemade air conditioning system ranged from approximately 500 BTU/h to 750 BTU/h as flow rate through the system ranged from 0.25 L/min to 2.1 L/min. A mathematical model was created to describe the response of heat removal capacity to changing flow rate. The efficiency of the system was measured in terms of BTUs removed per liter of water used. Efficiency varied from approximately 35 BTU/L to 15 BTU/L as flow rate through the system ranged from 0.25 L/min to 2.00 L/min. Based on the model for variation of heat removal capacity with flow rate, a model was constructed to describe the variation of efficiency with flow rate. The performance of homemade air condenser test rig analyze by the using psychometric chart with the help of dry bulb and wet bulb temperature and to determine the various properties of moist air like relative humidity, sp. humidity, dew point temperature, amount of heat removal and amount of moisture removal.

Kew Words- Homemade Evaporative air- conditioner, water, cooling, and dehumidification.

1. INTRODUCTION

Air-conditioning is the process of controlling properties of air .it is the process of controlling the air temperature, humidity, dust particles, air velocity and noise of the system. Merely lowering or raising the temperature does not provide comfort in general to the machines or its components and living beings in particular. In case of the

machine components, along with temperature, humidity (moisture content in the air) also has to be controlled and for the comfort of human beings along with these two important parameters, air motion and cleanliness also play a vital role.

1.1 Evaporative Air-conditioning system

Summer air conditioning systems capable of maintaining exactly the required conditions in the conditioned space are expensive to own and operate. Sometimes, partially effective systems may yield the best results in terms of comfort and cost. Evaporative air conditioning systems are inexpensive and offer an attractive alternative to the conventional summer air conditioning systems in places, which are hot and dry. Evaporative air conditioning systems also find applications in hot industrial environments where the use of conventional air conditioning systems becomes prohibitively expensive.

Evaporative cooling has been in use for many centuries in countries such as India for cooling water and for providing thermal comfort in hot and dry regions. This system is based on the principle that when moist but unsaturated air comes in contact with a wetted surface whose temperature is higher than the dew point temperature of air, some water from the wetted surface evaporates into air. The latent heat of evaporation is taken from water, air or both of them. In this process, the air loses sensible heat but gains latent heat due to transfer of water vapour. Thus the air gets cooled and humidified. The cooled and humidified air can be used for providing thermal comfort.

1.2 Classification of Evaporative Cooling Systems:

The principle of evaporative cooling can be used in several ways. Cooling can be provided by:

1. Direct evaporation process.
2. Indirect evaporation process.

1.2.1 Direct Evaporative Cooling Systems:

In direct evaporative cooling, the process or conditioned air comes in direct contact with the wetted surface, and gets cooled and humidified. The schematic of an elementary direct evaporative cooling system processed on a psychometric chart. As Hot and dry outdoor air is first filtered and then is brought in contact with the wetted surface or spray of water droplets in the air washer. [1]

1.2.2 Indirect Evaporative Cooling System

Figure1 shows the schematic of a basic, indirect evaporative cooling system and the process on a psychometric chart. As shown in the figure, in an indirect evaporative cooling process, two streams of air - primary and secondary are used. [2]

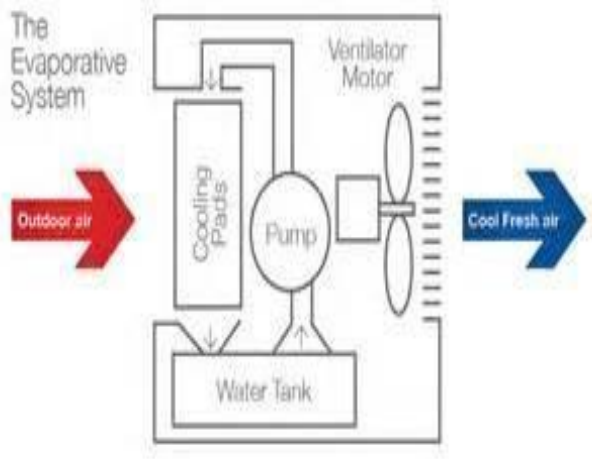

Fig.1 flow diagram of evaporative air conditioner.

1.3 Advantages of Evaporative Cooling Systems:

Compared to the conventional refrigeration based air conditioning systems, the evaporative cooling systems offer the following advantages:

1. Lower equipment and installation costs
2. Substantially lower operating and power costs. Energy savings can be as high as 75 %
3. Ease of fabrication and installation
4. Lower maintenance costs
5. Ensures a very good ventilation due to the large air flow rates involved, hence, are very good especially in 100 % outdoor air applications
6. Better air distribution in the conditioned space due to higher flow rates

1.4 Applicability of Evaporative Cooling Systems:

As mentioned before, evaporative cooling systems are ideal in hot and dry places, i.e., in places where the dry bulb temperature is high and the coincident wet bulb temperature is low. However, there are no clear-cut rules as to where these systems can or cannot be used. Evaporative cooling can provide some measure of comfort in any location. However, in many locations where the humidity levels are very high, stand-alone evaporative cooling systems cannot be used for providing thermal comfort especially in residences, office buildings etc. [3]

2. EXPERIMENTAL SETUP

We have fabricated an experimental setup by using copper tubing as the heat exchanger. We can see the fabricated experimental setup in the fig.2. It's very easy to wrap the copper tube on the grate of fan by using a die and the teeth held nicely against the grate of the fan. We used zip ties to hold the tubing to the grate because we

want to sure, to clip off the loose ends. And also, make sure that both ends of the copper tubing sticking out of the fan, so we hooked up the tube to the pump.

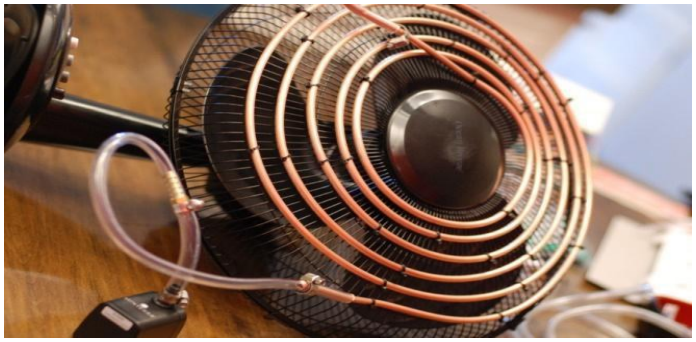

Fig. 2 Experimental setup of evaporative air conditioner

3. RESULTS & DISCUSSIONS

Our work based on homemade air conditioning unit, is very useful for poor people which is of very low cost and easily to carry from one room to other or one place to other place. To make this work more reliable we checked this model for all these rooms ranging from 6 by 6, 10 by 10, 14 by 7 (feet) and thus found that this is more effective on 6 by 6 room. As the room size increases, temperature will be more inside the room. For that sake we have to provide 2 to 3 air conditioning units for more cooling effect for 14 by 7 size room and more Area of rooms.

S.N.	Water cond.	DBT	WBT	Relative humidity	Specific humidity	Dew point Temp.	Enthalpy
1	Without water	35	29	65	0.024	26	99
2	normal water	28	21	54	0.014	18	64
3	Ice water	21	16	48	0.007	10	42

Table 3.1 Psychometric parameters

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Table 3.2 (Comparison Between Without Water Vs Normal Water):-

The successive decrease in value of relative humidity is obtained(about 11%) when we use normal water instead of using no water at all. while there is change in values of specific humidity, dew point temperature and enthalpy is obtain as per follows:

S. No.	Change In Relative Humidity (%)	Change In Specific Humidity(kg/kg of dry air)	Rate of cooling (KJ/kg of dry air)
1.	11	0.01	35

3.2 Table (Comparison Between Without Water Vs Normal Water):-

Table 3.3 (Comparison between Normal Water Vs Ice Water):-

The successive decrease in value of relative humidity is obtained(about 6%) when we use ice water instead of using normal water at all. while there is change in values of specific humidity, dew point temperature and enthalpy is obtain as per follows:

S. No.	Change In Relative Humidity (%)	Change In Specific Humidity(kg/kg of dry air)	Rate of cooling (KJ/kg of dry air)
1.	6	0.007	22

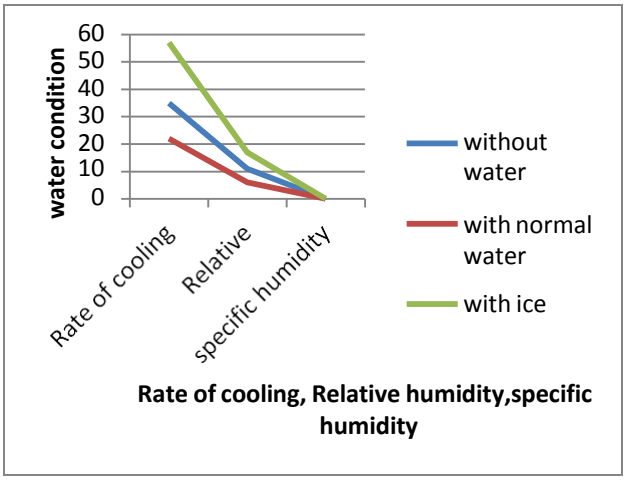
Table 3.3 Comparison between Normal Water Vs Ice Water

Table 3.4 (Comparison Between Ice Water Vs Without Water):-

The successive decrease in value of relative humidity is obtained (about 17%) when we use ice water instead of no use of water. while there is change in values of specific humidity, dew point temperature and enthalpy is obtain as per follows:

S. No.	Change In Relative Humidity(%)	Change In Specific Humidity(kg/kg of dry air)	Rate of cooling (KJ/kg of dry air)
1.	17	0.017	57

Table: 3.4 Comparison between Ice Water Vs Normal Water.



Graph No. 1 Water Condition Vs Rate of Cooling, Relative, Humidity, Sp. Humidity.

4. CONCLUSION:

1. It is very easy to fabricate this unit and also it is very economical.
2. It is very advantageous that the model is easily portable. It is very flexible to carry the unit easily where you want to cool, whether you are working in office or relaxing at home.
3. According to the above mentioned graph 1, we have obtained the humidity about 47 % which is just near to the human comfort value (50%).

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