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Retrofitting of Desert Cooler with Refrigeration System

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Abstract – *Humans always prefers for better comfort and superiority at each level of their lives. Considering air conditioning, evaporative coolers are used in hot and dry climates. But these coolers are not suitable in humid environment and their performance drops down in places where there is poor ventilation. The factor which is responsible is uncontrollable humidity increment in working environment. This report is sequential details about research carried out on the evaporative cooler in order to overcomes its limitations and increase its cooling efficiency. The main parameter in this report is creating a cool and comfortable environment. This report briefly explains the basic concept required to understand working in this paper.*

I-INTRODUCTION

With the development of society an economy, living standard of people is improving, and higher living conditions are demanded. So more efforts are taken for better conditioning of indoor air for human comfort. India is a tropical country in which most of the regions experience very low temperatures during winter and very high temperatures during the summer season. That is, the temperature range between summer and winter seasons is very large. Hence, it is not a very comfortable experience. Though various methods of heating are available during winter, methods of cooling down temperature are limited. Air conditioners have high initial and running cost, which are not affordable for everyone. Desert coolers are relatively economical, but not that satisfactory. In this paper we have tried to modify the existing desert cooler. We added a Vapour Compression Refrigeration System (VCRS). Our paper deals with better cooling efficiency, better relative humidity and saving in work done on a system. The main objective is to create economic desert cooler design to obtain more cooling effect than ordinary cooler at same cost in more hot regions, reduce the maintenance cycle period.

II- DESIGN MODEL AND COMPONENTS OF THE SYSTEM

The size and capacity of an air cooler is mostly determined by:

- The size of the room to be cooled.
- The temperature preferred inside the room to be cooled.

A) Parameters affecting the rate of cooling

As the cooling process starts by the evaporative cooling, the rate of cooling depends upon many numbers of factors, such as

- Atmospheric Temperature
- Atmospheric Humidity
- Temperature of supplied water.
- Air flow rate.

Thus as above stated factors, the controlling factors are air flow rate and temperature of water supplied, others are environmental dependent factors. This will affect the cooling rate of the air in room.

The design model in fig. 1 shows various components of retrofitted desert cooler.

B) Components of the System

The main components of the system are Desert Cooler, Tanks, Compressor, Condenser, Capillary Tube, Evaporator, Stand, Control panels.

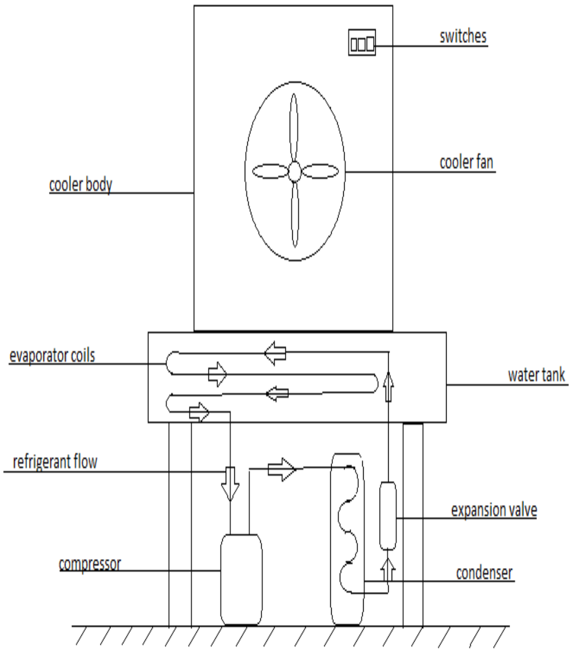

Fig. 1. Components of Retrofitted Desert Cooler.

C) Construction

- The parpert is basically the combination of refrigeration system with a desert cooler. The refrigeration system is installed with the cooler to attain lower temperatures in hot climatic conditions. This consists of the basic parts of refrigeration system, i.e. compressor, condenser, expansion valve and evaporator, along with the normal desert cooler.
- The refrigerating system is fitted at the lower part of the cooler, with compressor condenser and expansion valve below the cooler. Only the evaporator is placed inside the water tank where the interaction of evaporator will take place with the water. Due to this, the temperature of water will lower down below the atmospheric which will be circulated in the cooler. The compressor (0.25 HP) is used to circulate the refrigerant in the refrigeration system which helps to lower the temperature of water. The compressor uses the power to compress the vapour refrigerant and thus produces the vibration. Hence it is placed at the lower region of the model. Thus all the mounting of the refrigeration system are placed in the lower parts to reduce the vibrations and to give support to the system as well. The condenser and the expansion valve are also situated at the bottom along with the compressor. Condenser is used to reject the heat from the refrigerant to the atmosphere. This is done by natural convection as only the air is used for heat rejection from the condenser. The condenser is a tubing system with 22 tubes in a line. In addition to this, fins are provided to increase the surface area for better heat rejection as well as to give support to the condenser tubes. Then the refrigerant is sent to the expansion device where the pressure and temperature is further reduced to make it able to remove the heat from the water.

- The evaporator is placed in the water tank which will reduce the temperature of the water and then will be circulated in the cooler. The water tank in which the evaporator is placed is insulated to reduce the heat loss from the water. Temperature sensor is placed in the water to measure the temperature of water.
- Submersible pump is used to pump this cooled water in the desert cooler system which flows through the side walls of the cooler and the cooler fan supplies the air to the room. The air after coming in contact with the cold water is cooled which then cools the entire room where it is supplied.

III- WORKING METHODOLOGY

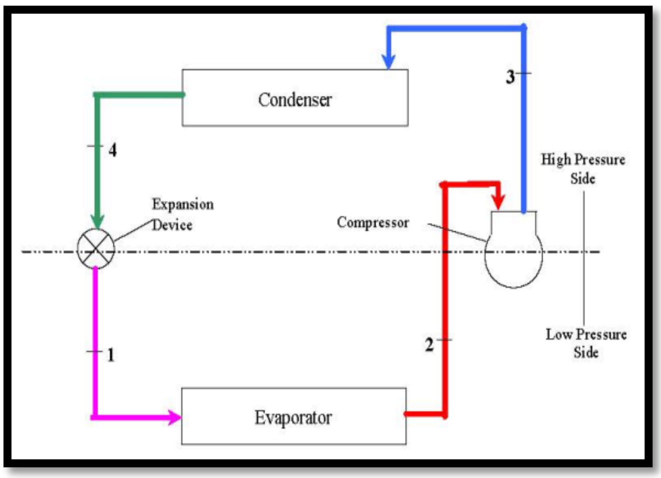

Fig.2- Vapour Compression Refrigeration System

Figure 2 shows a standard vapour compression refrigeration cycle. It mainly comprises of compressor, condenser, evaporator and an expansion device. Ideal vapour compression refrigeration cycle consists of four processes.

- 1-2: Constant pressure heat addition in the evaporation
- 2-3: isentropic compression
- 3-4: Constant pressure heat rejection in the condenser
- 4-1: Throttling in an expansion valve

- As our paper combines the function of refrigeration system with desert cooler, following line sketch indicates the proposed design of our paper.
- As shown in the figure 1, it consists of standard refrigeration cycle as stated above attached to the body of dessert cooler for more cooling effect.
- The compressor and condenser are placed separate from the cooler body for their proper working as these components require more space. Therefore they will be placed under the cooler stand.
- Then the expansion device i.e. capillary tube is placed inside the cooler body as enough space is available there.
- The most important component of our paper i.e. evaporator makes direct contact with the cooler body. The evaporator coils are placed in the bottom of the cooler tank where the refrigerant gains latent heat from water and its phase change takes place. Hence refrigeration effect can be obtained to cool the water to its maximum extent.
- For better temperature and humidity control evaporator pressure regulating valve can be used.
- To avoid a formation of ice of water in a tank the temperature cut off system is fitted in the cooler and obtain proper required temperature as per the human comfort.

IV-CONCLUSION

In the paper, we thus can conclude that the cooling effect produced will be higher than the regular desert cooler as water have the greater capacity to carry the heat along with it. Thus the cooling effect will be higher and are well suited for high temperature regions. Also the electric consumption is also low as compared to the air conditioner as it is an alternative solution for the high temperature regions. But due to its high power consumption, it is not feasible to use it in day to day life for the most people. Hence the project "Retrofitting of desert cooler with refrigeration system" is more feasible.

FUTURE SCOPE

In this paper, optimization of working parameters can be done in order to produce an effective and efficient system.

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