

# FABRICATION AND PERFORMANCE ANALYSIS OF REFRIGERATION TYPE DESERT COOLER

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## ABSTRACT:-The "FABRICATION AND PERFORMANCE ANALYSIS OF REFRIGERATION TYPE DESERT COOLER"

in which more than cooling of air is possible there by making the same an ideal choice for bigger areas, where in cooling temperature and efficiency required. The water in the tank cools by vapour compressor refrigeration system and this cold water flows through cooling pads. These cooling pads are cellulose cooling pads having hexagonal air pass through passages. Passages are arranged in crisscross manner to allow better mixing of air there by maintaining overall air temperature to means value and water. Cool by the refrigeration system, will further increase the cooling efficiency.

Thus the ambient air is cooler to better level that can in case of conventional air cooler. The cooling pad will be on three sides and half on the fourth side of the body there by again increasing the cooling power of cooler. And at the another half of the fourth side and horizontal flow fan is kept within the body cavity of the air cooler.

**Key Words:** Refrigeration, Desert Cooler, Compressor, Pump, Condensor, Capillary, PVC Pipes.

## 1 INTRODUCTION

An refrigeration type desert cooler is a device that cools water through vapour compression refrigeration system and cools air through the evaporator of water. It is the combination of evaporative cooler and refrigeration system.

Evaporative cooling works by employing water's large enthalpy of vaporization. The temperature of dry air can be dropped significantly through the phase transition of liquid. Water to water vapour evaporation and the temperature of water can be dropped by extracting the heat from water. And to dissipate these heat into surrounding. In extremely dry climates, evaporative cooling of air has the added benefit of conditioning the air with more moisture for the comfort of building

occupants.

The cooling potential for cooling is dependent on the wet bulb depression, the difference between dry-bulb temperature and wet-bulb temperature and cooling of water. In arid climates, this desert cooler can provide more cool air than the normal cooler and act as an alternative to the air conditioners, in climates not considered arid, indirect evaporative cooling can still take advantage of the evaporative cooling process without increasing humidity. Passive evaporative cooling strategies offer the same benefits of mechanical evaporative cooling system without the complexity of the ductwork.

## 2. LITERATURE REVIEW

The researches views are introduced as J.M. Wu, X. Huang, H. Zhang, In this paper Theoretical analysis to the heat and mass transfer between air and water film in a direct evaporative cooler with wet durable honeycomb papers constituting the pad modules is carried out. Y.J. Dai, K. Smith, The characteristics and the performance of a cross flow evaporative cooler using honeycomb paper as packing material have been studied. Under typical conditions, it can reduce the air temperature by 9°C and increase the humidity ratio by about 50%. The minimum air temperature can be obtained at the length of the air channel to be about 5–10 cm. Zhang Qiang, Liu Zhongbao, Yang Shuang, Ma Qingbo, has described the experimental and theoretical analysis of a TSEC unit is done. The outlet air temperature drop by the two-stage evaporative cooler depends on inlet air wet bulb temperature, secondary air relative humidity and packing thickness of DEC. R. Rawangkula et al., reports a performance analysis for a new sustainable engineering application to beneficially reuse an abundant agricultural waste, coconut coir (*Cocos nucifera*), in evaporative cooling pads. Ghassem Heidarinejad et al., this paper shows that under various outdoor conditions, the effectiveness of IEC stage varies over a range of 55–61% and the effectiveness of IEC/DEC unit varies over a range of 108–111%. J. Khedari et al., this research was aimed to

investigate the feasibility of using dried agricultural wastes desiccant for an open cycle AC system. The natural fibers are used with a intention to replace chemical desiccant such as silica gel etc.. The investigation was limited for Coconut coir (*Cocosnucifera*) and Durian peels (*Duriozibethinus*). R. K. Kulkarani and S. P. S. Rajput, This paper analyses the performance of jute fibers ropes that are used in the form of rope bank as wetted media in evaporative coolers. R. Rawangkul, J. Khedari, J. HirunlabhandB.Zeghmati, The objective of this study is to develop a moisture adsorption isotherms model of Coconut coir(*Cocosnucifera*) and to simulate long term performance of this material as desiccant under Bangkok ambient conditions. It is observed that Young coconut coir reveals the average moisture adsorption capacity is about 26% dry basis at the average air relative humidity and temperature of about 73% and 28.6oC, respectively. The maximum moisture adsorption capacity is 37% when air relative humidity is 80%.

### 3 WORKING PRINCIPAL

It work on the principal of water and refrigeration system. Air cooling is a method of dissipating heat. It works by making the object to be cooled have a larger surface area or have an increased flow of air over its surface, or both. An example of the former is to add cooling fins to the surface of the object, either by making them integral or by attaching them tightly to the object's surface (to ensure efficient heat transfer). In the case of the latter it is done by using a fan blowing air into or onto the object one wants to cool. The addition of fins to a heat sink increases its total surface area, resulting in greater cooling effectiveness. And also by cooling the water in the reservoir can increase the cooling efficiency. In all cases, the air has to be cooler than the object or surface from which it is expected to remove heat. This is due to the second law of thermodynamics, which states that heat will only move spontaneously from a hot reservoir (the heat sink) to a cold reservoir (the air).

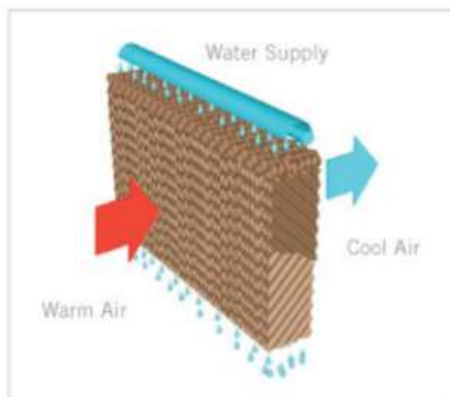


Fig no. 3 air cooling by evaporation

## 4. CONSTRUCTION

### 4.1 FAN



Fig.no.4.1 mechanical fan

A mechanical fan is a machine used to create flow within a fluid, typically a gas such as air. The fan consists of a rotating arrangement of vanes or blades which act on the fluid. The rotating assembly of blades and hub is known as an impeller, a rotor, or a runner. Usually, it is contained within some form of housing or case this may direct the airflow or increase safety by preventing objects from contacting the fan blades. Most fans are powered by electric motors, but other sources of power may be used, including hydraulic motors and internal combustion engines. Fans produce flows with high volume and low pressure (although higher than ambient pressure), as opposed to compressors which produce high pressures at a comparatively low volume. A fan blade will often rotate when exposed to a fluid stream, and devices that take advantage of this, such as anemometers and wind turbines, often have designs similar to that of a fan.

For more details on this topic, see Centrifugal compressor.

Typical applications include climate control and personal thermal comfort (e.g., an electric table or floor fan), vehicle and machinery cooling systems, ventilation, fume extraction, winnowing (e.g., separating chaff of cereal grains), removing dust (e.g. in a vacuum cleaner), drying (usually in combination with heat) and to provide draft for a fire. While fans are often used to cool people, they do not actually cool air (if anything, electric fans warm it slightly due to the warming of their motors), but work by evaporative cooling of sweat and increased heat

convection into the surrounding air due to the airflow from the fans. Thus, fans may become ineffective at cooling the body if the surrounding air is near body temperature and contains high humidity. In addition to their utilitarian function, vintage or antique fans, and in particular electric fans manufactured from the late 19th century through the 1950s, have become a recognized collectible category; for example, in the U.S.A. there is the Antique Fan Collectors Association.

#### 4.2 COMPRESSOR



**Fig.no. 4.2 compressor**

A compressor is a mechanical device that increases the pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor.

Compressors are similar to pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible; while some can be compressed, the main action of a pump is to pressurize and transport liquids.

#### 4.3 PVC PIPES



**Fig. No. 4.3 PVC pipes**

Polyvinyl chloride, also called Polychloroethene or PVC, is a thermoplastic. It soft when heated and hard when cooled. Polyvinyl chloride is made by polymerization of the monomer vinyl chloride (chloroethene)  $\text{CH}_2=\text{CHCl}$ . PVC can be made softer and more flexible by adding plasticizers. Phthalates are often used to soften PVC in this way.

Vinyl polymers are the most common type of plastic. In popular usage, "vinyl" refers mostly to PVC, but there are two other vinyl polymers which are more common. The most common is polyethylene, the second most common is polypropylene. Another, less used, is polystyrene.

Summer heat can cause indoor conditions to become much hotter than desired. Evaporative cooling is one way to reduce temperatures inside buildings. As water evaporates, it absorbs energy from the surrounding environment. A well-maintained ventilation system with evaporative cooling can reduce incoming air 10 to 20°F. Cooler indoor temperatures can improve the environment for plants and animals, plus significantly improve working conditions for employees.

Evaporative cooling systems lower air temperature using mists, sprays, or wetted pads. Introducing water into ventilation air increases relative humidity while lowering the air temperature (see Figure 1). This fact sheet specifically describes systems that utilize wetted pads.

#### 4.4 Evaporative Pad Cooling System



**Fig.no. 4.4 evaporative pad cooling system**

The typical evaporative pad cooling system draws outside air into the building through wet vertical pads. The major components of this system are: pad media, water supply, pump, distribution pipe, gutter, sump, and bleed-off line. As air flows past the moist pad



surfaces, some of the moisture evaporates into the air stream. Heat is withdrawn from the air during this process and the air leaves the pad at a lower temperature with higher moisture content.

#### 4.4.1. Pad Selection, Sizing, and Placement

A pad system should match the ventilation needs of a facility. Most pads are made of either aspen fiber or cellulose (Tables 1 and 2). A cellulose pad typically needs more air and water flow than does an aspen pad. More evaporation can take place through a 6-inch pad than a 4-inch pad.

Place pads continuously along the entire side or end of a building so that they are opposite the ventilation fans to provide uniform ventilation. Pad area for a wall-unit evaporative cooler is calculated by dividing the required airflow by the recommended face velocity (see Table 2) through the pad. A rule of thumb is to have 250 ft/min of air flow through a 4-inch-thick pad contains high humidity. In addition to their utilitarian function, vintage or antique fans, and in particular electric fans manufactured from the late 19th century through the 1950s, have become a recognized collectible category; for example, in the U.S.A. there is the Antique Fan Collectors Association.

#### 4.5 pump



Fig. no. 4.5 Pump

Pump is the pressure buster. We used 2 small sized centrifugal pumps. Pump in our project is used to supply water from lower tank to PVC pipe through which water the distributed to various section of evaporative pads.

#### 4.5.1 Specification of pump

Power:18w  
H Max:1.85M  
Voltage;165-220V  
Output;1100L/H  
Maximum head; 1850MM

Flow rate; 1100LPH

#### 4.6distractor



Fig.no. 4.6 Distractor

#### 4.7 bracket



Fig. No. 4.7 BRACKET

Bracket used in our project is as shown in fig. Bracket is used to support motor.

#### 4.8 copper coil

We used 15 ft long copper tube carrying water to cool the air through indirect evaporation method.



**Fig No. 4.8 Copper coil.**

#### 4.9 Capillary

A capillary tube is a long, narrow tube of constant diameter. The word “capillary” is a misnomer since surface tension is not important in refrigeration application of capillary tubes. Typical tube diameters of refrigerant capillary tubes range from 0.5 mm to 3 mm and the length ranges from 1.0 m to 6 m.



**Fig:-4.9 capillary tube**

#### 4.10 Condenser



**Fig No. 4.10 Condensor**

In systems involving heat transfer, a **condenser** is a device or unit used to condense a substance from its gaseous to its liquid state, by cooling it. In so doing, the latent heat is given up by the substance and transferred to the surrounding environment. Condensers can be made according to numerous designs, and come in many sizes ranging from rather small (hand-held) to very large (industrial-scale units used in plant processes).

#### 5. WORKING

Air cooling is a method of dissipating heat. Heat of air is dissipated. By passing it through the wetted surface. And the efficiency is further increase by decreasing the temperature of water in the reservoir. This is done by the refrigeration system. Vapour refrigerant comes into the compressor and compressor increase the pressure and temperature of refrigerant. And then this high temperature and pressure. Refrigerant will flow Through condenser. The condenser extract the heat from the refrigerant by natural convection at the end of the vapour. Refrigerant get condense and by giving its latent heat to the surrounding it will convert is phase from vapour to liquid.

Then this high pressure low temperature liquid refrigerant allow to flow through the capillary tube. In which throttling process takes place. As the JouleThomsonco-efficient of refrigerant is positive its temperature and pressure decreases then this cold. Refrigerant flow through copper tube.

The copper tube arrange in zigzag manner. In the water tank then the refrigerant extract the heat from the water and get converted into vapour and this vapour refrigerant goes into the compressor and refrigeration cycle repeated.

And the cold water in the reservoir allow to flow through cooling pads with the help of pump. The hot air comes in contact with wetted pads and loose their heat then the cold air comes into the cavity and the motor in the cavity distribute this cold air into room. And the water from the pads get collected into reservoir and get cool down by the cooling coil.

## 6. PERFORMANCE ANALYSIS

### 6.1 Observation data: -

Initial Condition inside the room:

Dry bulb Temperature,  $T_{1\text{ dbt}} = 34^\circ\text{C}$

Wet bulb temperature,  $T_{1\text{ wbt}} = 23^\circ\text{C}$

Condition after direct Evaporation (Without Cooling coil)

Dry bulb Temperature,  $T_{2\text{ dbt}} = 30^\circ\text{C}$

Wet bulb temperature,  $T_{2\text{ wbt}} = 23^\circ\text{C}$

Condition after dual/ mixed cooling (With Cooling coil)

Dry bulb Temperature,  $T_{3\text{ dbt}} = 28^\circ\text{C}$

Wet bulb temperature,  $T_{3\text{ wbt}} = 22.5^\circ\text{C}$

### 6.2 Analysis using Psychrometric Chart

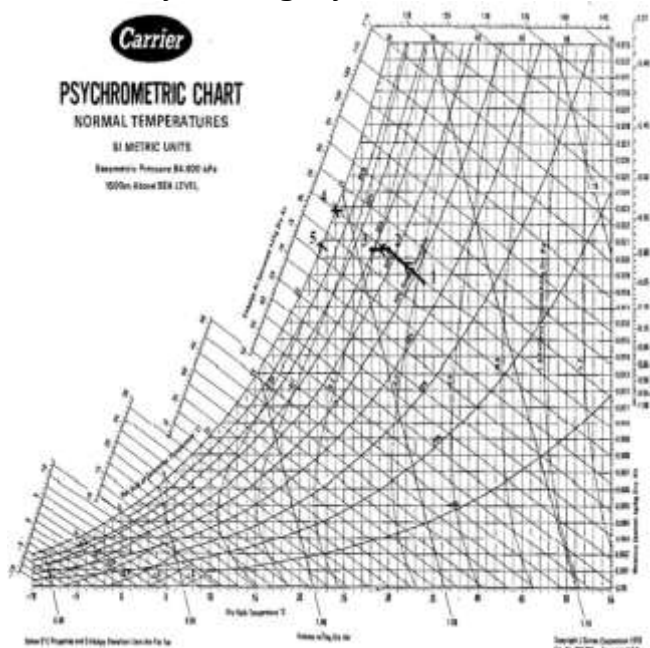


Fig No. 7.2 Process analysis

## 7.3 Effectiveness Calculation

### For Direct Evaporation

$$\epsilon = \frac{t_{dbt1} - dbtt_2}{t_{dbt1} - t_{4(wbt)}} * 100$$

$$\epsilon = \frac{34 - 30}{34 - 23} * 100$$

$$\epsilon = 35.5\%$$

### For Indirect Evaporation

$$\epsilon = \frac{t_{dbt2} - dbtt_3}{t_{dbt2} - t_{5(wbt)}} * 100$$

$$\epsilon = \frac{30 - 28}{30 - 20} * 100$$

$$\epsilon = 20\%$$

Hence Condition of final air achieved is

D.B.T =  $28^\circ\text{C}$

W.B.T =  $22.5^\circ\text{C}$

Relative Humidity = 65%

## 7. Conclusions

We have built a desert cooler which cools the air through both direct and indirect method of cooling. As it uses both method of cooling, efficiency of desert cooler is increases.

Evaporative cooling increases humidity. In dry climates, this may improve comfort and decrease static electricity problems.

The pad itself acts as a rather effective air filter when properly maintained; it is capable of removing a variety of contaminants in air, including urban ozone caused by pollution, regardless of very dry weather.

As our desert cooler is four way type, it can able to supply air in all direction. Because of which room can be better and uniformly cool and desired condition can be easily achieved.

## 8. REFERENCES

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