NATIONAL CONFERENCE ON INNOVATIVE TRENDS IN ENGINEERING & TECHNOLOGY – NITET-19
15-16th March 2019
NOVATEUR PUBLICATIONS
International Journal Of Innovations in Engineering Research And Technology [IJIERT]
ISSN: 2394-3696

EXPERIMENTAL INVESTIGATION OF COOLING PROPERTIES OF DESERT COOLER CUM REFRIGERATOR

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Abstract— Refrigeration is a process in which work is done to move heat from one location to another. Refrigeration has had a large impact on industry, lifestyle, agriculture and settlement pattern.

Now a day's people are using cooler, air conditioning system, refrigerator for cooling of room and eatable substance separately. So we are committed to make a project which will help us for many functioning which are doing by three machines. To purchase separate air conditioning, refrigerator and cooler which is not affordable for some people. We also minimize the pollution such as ODP (ozone deflection potential).

An evaporative cooler is a device that cools air through the evaporation of water. 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), which can cool air using much less energy than refrigeration. 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 evaporative cooling is dependent on the wet bulb depression, the difference between dry-bulb temperature and wet-bulb temperature. In arid climates, evaporative cooling can reduce energy consumption and total equipment for conditioning as an alternative to compressor-based cooling. Passive evaporative cooling strategies offer the same benefits of mechanical evaporative cooling systems without the complexity of equipment and ductwork.

keywords— **refrigeration, heat, eco-friendly, ODP, Refrigeration Compression Cycle, Refrigerator.**

Introduction

Refrigeration:-

Refrigeration is a process in which work is done to move heat from one location to another. The work of heat transport is traditionally driven by mechanical work, but can also be driven by heat, magnetism, electricity, laser, or other means. Refrigeration has many applications, including, but not limited to household refrigerators, industrial freezers, cryogenics, and air conditioning. Heat pumps may use the heat output of the refrigeration process, and also may be designed to be reversible, but are otherwise similar to refrigeration units.

Refrigeration has had a large impact on industry, lifestyle, agriculture and settlement patterns. The idea of preserving food dates back to the ancient Roman and Chinese empires. However, refrigeration technology has rapidly evolved in the last century, from ice harvesting to temperature-controlled rail cars. The introduction of refrigerated rail cars contributed to the westward expansion of the United States, allowing settlement in areas that were not on main transport channels such as rivers, harbours, or valley trails. Settlements were also popping up in infertile parts of the country, filled with new natural resources. These new settlement patterns sparked the building of large cities which are able to thrive in areas that were otherwise thought to be unsustainable, such as Houston, Texas and Las Vegas, Nevada. In most developed countries, cities are heavily dependent upon refrigeration in supermarkets, in order to obtain their food for daily consumption. The increase in food sources has led to a larger concentration of agricultural sales coming from a smaller percentage of existing farms. Farms today have a much larger output per person in comparison to the late 1800s. This has resulted in new food sources available to entire populations, which has had a large impact on the nutrition of society.

LITERATURE REVIEW

Vijaykumar Kalwa [1] in hot and humid conditions the need to feel relaxed and comfortable has become one of few needs and for this purpose utilization of systems like air-conditioning and refrigeration has increased rapidly. These systems are most of the time not suitable for villages due to longer power cut durations and high cost of products. Solar power systems being considered as one of the path towards more sustainable energy systems, considering solar-cooling systems in villages would comprise of many attractive features. This technology can efficiently serve large latent loads and greatly improve indoor air quality by allowing more ventilation while tightly controlling humidity. Despite increasing performance and mandatory energy efficiency requirements, peak electricity demand is growing and there is currently no prevalent solar air-cooling technology suited to residential application especially for villages, schools and offices. This project reviews solar powered air cooler with cooing cabin for household food items hence their viability for residential application.

Alosaimy A S [2]in the present work, novel configuration of solar powered desiccant dehumidification system is investigated. The proposed system comprises two evaporative air coolers. One of the two coolers functions as an absorber and the second, which is coupled with solar water heater, functions as a desiccant regenerator. In the experimental part of this investigation, Calcium Chloride is regenerated using solar energy. Hot water from a solar collector is circulated through an air heater to regenerate the liquid desiccant. Mathematical model, which can be applied for analysis of the proposed system, is developed. Absorption-regeneration cycle for the dehumidifier is described and analysed. An expression for the efficiency of the simple cycle is introduced. Theoretical analysis shows that strong and weak solution concentration limits play a decisive role in the value of cycle efficiency. System efficiency with consideration of heat and work added to the system is well defined. The limits of regeneration temperature and mass of strong solution per kg of produced vapour are found highly dependent on the operating concentration of desiccant. Experimental results show that solution with 30% concentration can be regenerated up to 50% using solar energy. Good agreement is found between the trained data of the ANN model and the experimental measurements for the whole range of the air inlet temperature.

Farhan a. khmamas, [3] the present air cooling methods are evaporative coolers, air conditioning, fans and dehumidifiers. But running these products need a source called electricity. The producing of electricity is ultimately responsible for hot and humid conditions i.e. global warming. In hot and humid conditions the need to feel relaxed and comfortable has become one of few needs and for this purpose utilization of systems like air-conditioning and refrigeration has increased rapidly. These systems are most of the time not suitable for villages due to longer power cut durations and high cost of products. Solar power systems being considered as one of the path towards more sustainable energy systems, considering solar-cooling systems in villages would comprise of many attractive features. This technology can efficiently serve large latent loads and greatly improve indoor air quality by allowing more ventilation while tightly controlling humidity. Despite increasing performance and mandatory energy efficiency requirements, peak electricity demand is growing and there is currently no prevalent solar air cooling technology suited to residential application especially for villages, schools and offices. This project reviews solar powered air cooler for residential and industrial applications.

OBJECTIVE AND SIGNIFICANCE OF RESEARCH

Objective:-

Our objective behind this idea is to give maximum benefit to the customer in minimum cost. We are committed to make multipurpose cooling machine. It is useful in many ways such as it works without refrigerant, so it is eco-friendly for us we use cabin for not only cooling purpose of vegetable & fruits but also we can use it for cooling of room. We can use it in summer season because of high refrigeration effect. Our project is eco-friendly so for future scope it is benefited for next generation which will enjoy population free earth.

Significance of Research:-

Some of benefit of behind our project is described as follows.

1. Here we are not using the refrigerant so it minimize the cost & harmless for refrigerant environment i.e. eco-friendly
2. We made our project multipurpose in which we can cool vegetable, fruits and room also.
3. It has good refrigeration effect because of this we can cool substance rapidly.
4. It requires less maintenance.

Now a day's people are using cooler, air conditioning system, refrigerator for cooling of room and eatable substance separately. So we are committed to make a project which will help us for many functioning which are doing by three machines. To purchase separate air conditioning, refrigerator and cooler which is not affordable for peoples. Because of not using refrigerant here, we minimized ODP (ozone deflection potential).

For our project we use less number of components like motor, pump, fan coir etc. If we compare our project to refrigerator and air conditioning system which needs more components such as compressor, condenser, expansion valve, evaporator etc.

DEVELOPMENT OF MODEL

AC Motor:-

Figure 1 : AC motor

Working of AC motor :-

An AC motor is an electric motor driven by an alternating current (AC). The AC motor commonly consists of two basic parts, an outside stationary stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft producing a second rotating magnetic field. The rotor magnetic field may be produced by permanent magnets, reluctance saliency, or DC or AC electrical windings. Less commonly, linear AC motors operate on similar principles as rotating motors but have their stationary and moving parts arranged in a straight line configuration, producing linear motion instead of rotation.

Operating principles:-

AC motors operate with two rotating (or moving) magnetic fields on the rotor and stator respectively. Pulling or pushing the poles of the two magnetic fields along, the speed of the stator rotating magnetic field (Ws) and the speed of the rotor rotating magnetic field (Wr), which is relative to the speed of the mechanical shaft (Wm), must maintain synchronism for average torque production by satisfying the synchronous speed relation (i.e., ±Ws ±Wr = Wm). Otherwise, asynchronously rotating magnetic fields would produce pulsating or non-average torque. The two main types of AC motors are classified as induction or synchronous. The induction motor (or asynchronous motor) always relies on a small difference in speed between the stator rotating magnetic field and the rotor shaft speed called slip to induce rotor current in the rotor AC winding. As a result, the induction motor cannot produce torque about synchronous speed where induction (or slip) is irrelevant or ceases to exist. In contrast, the synchronous motor does not rely on slip-induction for operation and uses either permanent magnets, salient poles (having projecting magnetic poles), or an independently excited rotor winding.

The synchronous motor produces its rated torque at exactly synchronous speed. The brushless wound- rotor doubly-fed synchronous motor system has an independently excited rotor winding that does not rely on the principles of slip-induction of current. The brushless wound-rotor doubly-fed motor is a synchronous motor that can function exactly at the supply frequency or sub to super multiple of the supply frequency. Other types of motors include eddy current motors, and also AC/DC mechanically commutated machines in which speed is dependent on voltage and winding connection.

Specifications :-

- Single phase fan duty CSR type ac motor 230 v, 50 Hz.
- Ref. IS:996 :2009.
- Rat output: 18 watt.
- Current Max.0.65 A PF 0.9
- Eff.20% min .insulation E class. Cap 2.5 mfd 440v
- Min RPM: 2200. Cap: 2.5

Submersible Pump:-

Figure 2: Submersible pump

Working of submersible pump :-

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

Working principle :-

The submersible pumps used in ESP installations are multistage centrifugal pumps operating in a vertical position. Although their constructional and operational features underwent a continuous evolution over the years, their basic operational principle remained the same. Produced liquids, after being subjected to great centrifugal forces caused by the high rotational speed of the impeller, lose their kinetic energy in the diffuser where a conversion of kinetic to pressure energy takes place. This is the main operational mechanism of radial and mixed flow pumps.

The pump shaft is connected to the gas separator or the protector by a mechanical coupling at the bottom of the pump. When fluids enter the pump through an intake screen and are lifted by the pump stages. Other parts include the radial bearings (bushings) distributed along the length of the shaft providing radial support to the pump shaft turning at high rotational speeds. An optional thrust bearing takes up part of the axial forces arising in the pump but most of those forces are absorbed by the protector's thrust bearing. Applications Submersible pumps are found in many applications. Single stage pumps are used for drainage, sewage pumping, general industrial pumping and slurry pumping. They are also popular with pond filters.

Specifications:-

- Ac 220v/240/50, Hz 18 w
- Hmax : 106m FL max : 820L/H

Pipes:-

Figure 3: Pipes

Function of pipes :-

Pipe is a device which is used to carry of water from submersible pump and throw on coir which is placed on net.

Coir:

Figure 4: Coir

Function of coir :-

There is only one function of coir is to hold the water

Galvanized sheet:-

Figure 5: Galvanized sheet

Function of galvanized sheet :-

It is nothing but the iron and steel Galvanized sheet is act as foundation of the project and act as protecting cover.

OBSERVATIONS AND CALCULATIONS

Observations:-

Sr. No.	Conditions	DBT (^{0}C)	WBT (^{0}C)
1.	Initial Condition	22	17
	Final condition	17	14
2.	Initial Condition	24	19
	Final condition	18	15
3.	Initial Condition	28	22
	Final condition	23	16.5
4.	Initial Condition	30	23
	Final condition	20	16
5.	Initial Condition	23	18
	Final condition	19	15
6.	Initial Condition	20	15
	Final condition	16	12

Table 1:Observations

Calculation

1) Room temperature: - DBT = 30^{0}C
   WBT = 23 ^{0}C

2) Cabin Temperature: -DBT = 30^{0}C
   WBT = 23 ^{0}C

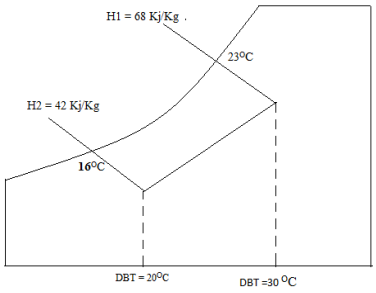
H1 = 68 KJ/Kg RH1 = 55 %
H2 = 42 KJ/Kg RH1 = 48 %
V1 = 0.86 M^3/Kg

Heat removed from air,

= air flow rate per minute x(H1-H2)
Volume of air inlet

= $\frac{2x60\ (68-42\ )}{0.86}$

= 3.62x10^3 KJ/Kg



CONCLUSION

Now a day's people are using cooler, air conditioning system, refrigerator for cooling of room and eatable substance separately. So we are committed to make a project which will help us for many functioning which are doing by three machines. To purchase separate air conditioning, refrigerator and cooler which is not affordable for some peoples. Because of not using refrigerant here. We minimize pollution such as ODP (ozone deflection potential).

It is eco-friendly for us we cabin also use it for not only cooling purpose of vegetable & fruits but also we can used it for cooling of room. We can use it in summer season because of high refrigeration effect. Our project is eco-friendly so for future scope it is benefited for next generation which will enjoy population free earth.

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