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Solar Air Cooler with Heater

M. Ravichandran[1], P. Susila[2], T. Senthil Kumar[3]
[1]*PG Research Student, Dept. of Mechanical Engg., University College of Engg. (BIT campus), Trichy, India*
[2]*Professor, Dept. of Mechanical Engineering, University College of Engineering (BIT campus), Trichy, India*
[3]*Professor & Dean, University College of Engineering (BIT campus), Trichy, India*

***Abstract*: Mechanical Engineering without production and manufacturing is meaningless and Inseparable. Production and manufacturing process deals with conversion of raw materials inputs to finished products as per required dimensions, specification and efficiently using recent technology. The new developments and requirements inspired us to think of new improvements in air conditioning Engineering field. Nowadays heater as well as cooler is available in market separately. Hence we decided to take over both applications in a same system. It's a new step ahead in air conditioning Engineering field. Our project fulfilled all our requirements as our thoughts. Heater can be used in winter and cooler in summer. Hence it is a multipurpose project. Our project is vital one to the environment. In our project, solar power is stored in a battery. This power is used to run the air collar whenever we required. The water heater works with a separate A.C supply. Solar energy means all the energy that reaches the earth from the sun. It provides daylight makes the earth hot and is the source of energy for plants to grow. Solar energy is also put to two types of use to help our lives directly solar heating and solar electricity. Solar electricity is the technology of converting sunlight directly in to electricity. It is based on photovoltaic or solar modules, which are very reliable and do not require any fuel or servicing. Solar electric systems are suitable for plenty of sun and are ideal when there is no main electricity. Our objective is to design and develop a solar system normally "Solar Air Cooler with Heater".**

***Keywords*: Air cooler, Heater, Solar power.**

1. Introduction

Human beings give off heat, around an average of 100 kcal per hour per person, due to what is known as 'metabolism'. The temperature mechanism within the human body maintains a body temperature of around 36.9 ºC (98.4 degree F). But the skin temperature varies according to the surrounding temperature and relative humidity. To dissipate the heat generated by metabolism in order to maintain the body temperature at the normal level, there must be a flow of heat from the skin to the surrounding air. If the surrounding temperature is slightly less than that of the body, there will be steady flow of heat from the skin. But is the surrounding temperature is very low, as on a cold winter day the rate of heat flow from the body will be quite rapid, thus the person feels cold, on the other hand on a hot summer day, the surrounding temperature is higher than that of the body, and so there cannot be flow of heat from the skin to the surroundings, thus the person feels hot.

In such a situation water from the body evaporates at the skin surface dissipating water from the body evaporates at the skin surface dissipating the heat due to metabolism. This helps in maintaining normal body temperature. But if the surrounding air is not only hot but highly humid as well, very little evaporation of water can take place from the skin surface, and so the person feels hot and uncomfortable.

2. Literature survey

A. Fabrication of modern solar air cooler air

Conditioning is one of the major consumers of electrical energy in many parts of the world today and already today air-conditioning causes energy shortage in for example China. The demand can be expected to increase because of changing working times, increased comfort expectations and global warming. Air-conditioning systems in use are most often built around a vapor compression system driven by grid-electricity. However, most ways of generating the electricity today, as well as the refrigerants being used in traditional vapor compression systems, have negative impact on the environment.

B. Design and Development of Modified Air Cooler cum Storage System

The modified air cooler cum storage system is a type of conventional air cooler which is used for providing room cooling as well refrigeration systems. The system consists of a lower tank which is a mud pot whose outer periphery is filled by sand slurry. The lower tank and the slurry are held by a larger mud pot, i.e., a pot-in-pot system. The lower tank is filled with water and it is connected to the upper tray through a pump. The water in the upper tray is passed through a cooling pad which is used for absorbing the water. A fan is fixed next to the cooling pad and is followed by a vent system. The tray also has another port which is connected to the cold storage box. On running the system for 5 hours, the temperature of a 960 cubic feet room gets reduced by 12º C and the temperature of the cold storage box gets reduced by 11º C and reaches 24º C, hence providing the right temperature for storage of perishable items.

C. Solar Powered Evaporative Air Cooler with Cooling Cabin for Household Food Items

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.

D. Development and Testing of Natural Draught Desert Cooler

In the recent decades the demand for air cooling has increased due to high dry bulb temperature and low humidity of air in Rajasthan, especially in Jaywalker and Barmer districts where during summer dry bulb temperature of air reached up to 50ºC while relative humidity is below 48%. This climate is suitable for evaporative cooling. In a conventional air cooler a motor is used to drive the fan and to pump water for cooling and humidification of air. In this paper a modified cooler is presented with low electric energy consumption using natural draft system for air flow through the cooler. The major advantage of this equipment is to eliminate the fan used for air flow through cooler and thus reducing the electricity requirement.

E. Evaluation of the Performance of Local Fibers in Evaporative Cooling

A special test setup is designed to evaluate the performance of three natural fibers to be used as wetted pads in evaporative cooling. The chosen fibers are date palm fibers (stem), jute and luffa. As a reference, a widely used commercial wetted pad is chosen. The performance criteria include cooling efficiency, material performance and cooling efficiency degradation. The results show that the average cooling efficiency is highest for jute at 62.1%, compared to 55.1% for luffa fibers, 49.9% for the reference commercial pad and 38.9% for date palm fiber. Material performance tests comprise salt deposition and bio-degradation (mold forming). Jute has the least salt deposition followed by palm and luffa fibers. The commercial type has the highest salt deposits. The highest resistance to mold forming is offered by luffa followed by palm fibers. The commercial type and jute have very poor performance. The results of the cooling efficiency degradation indicate that luffa has an overall advantage over the other fibers. Palm fibers and the commercial type have a significant reduction in the cooling efficiency, while jute has the highest deterioration. The total results indicate that luffa has an overall advantage over the other fibers. However, if the jute surface can be treated to offer higher mold resistance characteristics, it would provide the best alternative. The results show that the average cooling efficiency is highest for jute at 62.1%, compared to 55.1% for luffa fibers, 49.9% for the reference commercial pad and 38.9% for date palm fiber. Material performance tests comprise salt deposition and bio-degradation (mold forming). Jute has the least salt deposition followed by palm and luffa fibers. The commercial type has the highest salt deposits. The highest resistance to mold forming is offered by luffa followed by palm fibers. The commercial type and jute have very poor performance. The results of the cooling efficiency degradation indicate that luffa has an overall advantage over the other fibers. Palm fibers and the commercial type have a significant reduction in the cooling efficiency, while jute has the highest deterioration. The total results indicate that luffa has an overall advantage over the other fibers. However, if the jute surface can be treated to offer higher mold resistance characteristics, it would provide the best alternative.

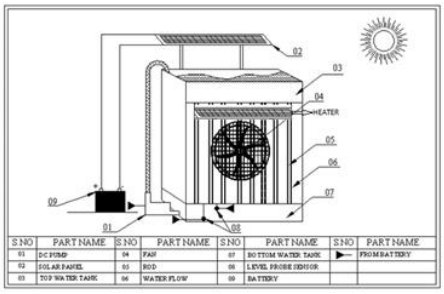

Fig. 1. Design model

3. Working principle

The solar panel is converting sun rays to the Electricity by "Photo-Voltaic Effect". This electrical power is stored in a 12-Volt battery. Battery D.C power is used to run the D.C motor and D.C water pump. Block diagram, Photo-voltaic Effect and major components of our project are already discussed above chapters. The D.C motor is coupled with impeller blades. The D.C motor runs during the air cooler button ON, the impeller blades starts rotating. The water pump is used to circulate the water to the blower unit. The forced air is flow through the water which is sprayed by water pump, so that the cold air produced. The switch control is used to ON/OFF solar air collar circuit and heater circuit. The Heater consists of heating element and single phase power supply. The single phase power supply is given to the heating coil, so that the coil produces hot flame. This hot flame is rashly forced out by the blower.

4. Factors determining the choice of materials

The various factors which determine the choice of material are discussed below.

Properties: The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, surface finish,

rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc. The following four types of principle properties of materials decisively affect their selection.

- Physical
- Mechanical
- From manufacturing point of view
- Chemical

The various physical properties concerned are melting point, Thermal Conductivity, Specific heat, coefficient of thermal expansion, specific gravity, electrical Conductivity, Magnetic purposes etc. The various Mechanical properties Concerned are strength in tensile, compressive shear, bending, torsional and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, and modulus of elasticity, hardness, wear resistance and sliding properties.

Manufacturing Case: Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

Quality Required: This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go for casting of a less number of components which can be fabricated much more economically by welding or hand forging the steel.

Availability of Material: Some materials may be scarce or in short supply. It then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed. The delivery of materials and the delivery date of product should also be kept in mind.

Space Consideration: Sometimes high strength materials have to be selected because the forces involved are high and the space limitations are there.

Cost: As in any other problem, in selection of material the cost of material plays an important part and should not be ignored. Sometimes factors like scrap utilization, appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

5. Conclusion

Comparing the cost of this product with the existing products in the market is solar product appeals better and affordable by common people. This solar product perfectly suits for villages, schools and offices and thus an alternate to the power cut problems. It comprises of many attractive features such as usage of solar energy, cooler and heater at lower cost. It is ecofriendly and natural, electricity savers. Durability of the product is more thus minimizing the cost. No electricity is used so this product saves the energy and saves environment from getting polluted.

References

[1] Farhan A. Khmamas, 2012, “Improving the environmental cooling for air-coolers by using the indirect-cooling method,” in ARPN journal of engineering and applied sciences, vol. 5, No. 2, page No. 66-73, 2012.
[2] A. S. Alosaimy, “Application of Evaporative Air Coolers Coupled with Solar Water Heater for Dehumidification of Indoor Air,” International Journal of Mechanical and Mechatronics Engineering, Vol. 13 No. 1, pp. 60- 68, 2013.
[3] “Basic Photovoltaic Principles and Methods” SERI/SP290-1448 Solar Information Module 6213 Published February 1982 page. No. 9-15.
[4] Arora and Domkundwar, “The course on power plant engineering”.
[5] B. Srinivas Reddy, K Hemachandra Reddy, “Thermal engineering data hand book”.
[6] Arora S. C. and Domkundwar S. (1988), “A Course in Power Plant Engineering”.
[7] Farhan Khmamas, “Improving the Environmental Cooling for Air Coolers by Using the Indirect-Cooling Method,” ARPN Journal of Engineering and Applied Sciences, Vol. 5, No. 2, pp. 66-73, 2012.
[8] SERI (1982), “Basic Photovoltaic Principles and Methods”, SERI/SP-290- 1448, Solar Information Module 6213.
[9] Srinivas Reddy B. and Hemachandra Reddy K, “Thermal Engineering Data Hand Book,” I K International Publishing House, 2007.