iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5338

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

Photovoltaic Air Cooler with Cooling Cabin

P. Naveena[1], K. Archana[2], K. Sai Anusha[3]
[1, 2, 3]Assistant Pr0fess0r, Department 0f Mechanical Engineering,St.Martin's Engineering C0llege,Secunderabad,Telangana, India

Abstract: In the current situation of increase in temperature and humidity in summer season, there is need of the cooling equipment which should be durable and economical. The project deals with the utilization of solar energy as an input energy source for the air cooler with cooling cabin. The air cooler is a typical evaporative cooler that cools air through evaporation of water. The present air cooling methods are evaporative coolers, air conditioning, fans and dehumidifiers. But to operate these equipment, electricity is needed. Cooling is done by using refrigerants, which release harmful CFCs (Chloroflourocarbons) into the atmosphere. So there is a need of a source which is abundantly available in nature and which does not impose any harmful effects on atmosphere. There is only one thing which can come up with all these problems which is Solar energy.
Keywords: Solar energy, Air cooler, Cooling, Cooling cabin.

I. INTRODUCTION

Solar Air Cooler is also a type of Air Cooler which runs on Solar energy. Photo voltaic cells are used to trap the Solar energy. In this project a Solar Air Cooler is made along with the cooling cabin, which can be used to store water bottles, fruits, vegetables, etc. There are many cooling appliances that are being used now which run electricity. In place of electricity if we use renewable energy sources non-renewable energy sources can be saved along with the atmosphere. There are many renewable energy sources that are being used to replace electricity. One such source is Solar energy. Since it freely available from nature, there is no limit to use the Solar energy. Solar panels are used to get energy from the sun.

II. WORKING METHODOLOGY

There are many ways to use Solar energy, one among those is Photo voltaic method, which is a direct method. The Figure 2.1 shows the basic photovoltaic system. From the past few years photo voltaic electricity generation is gaining a lot of attention. A photovoltaic (PV) system is made of one or more solar panels combined with an inverter, Battery and meter that use energy from the Sun to produce electricity. The light from the Sun is made of packets of energy called photons. When these photons fall on a solar panel electric current is produced by a process called the photovoltaic effect. The power produced using Solar panel is usually DC (Direct Current). So in order to convert this DC to AC (Alternating Current) an inverter is used. The converted AC can now be used directly to power some house hold appliances along with Air Cooler or can be sent to the power grid.

A. Components

The components used in this system are,

1) Solar panel
2) Charge/Battery Controller
3) Battery
4) Fan and water pump
5) Cooling pads
6) Cooling cabin for household items

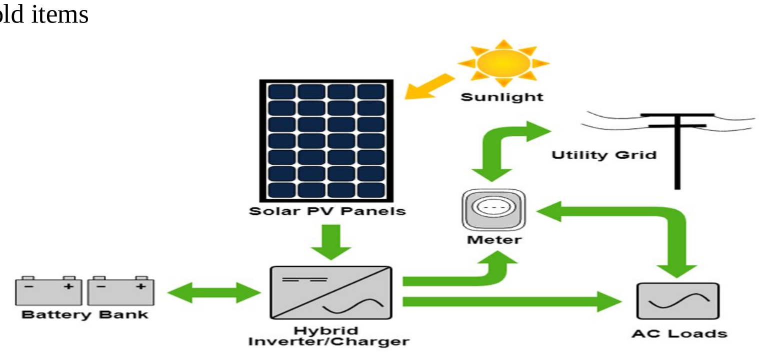

Fig 2.1. Photovoltaic system

i) Solar Panel: A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged, connected assembly of solar cells. The solar module can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 320 watts. The efficiency of a module determines the area of a module given the same rated output - an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, and sometimes a battery and/or solar tracker and interconnection wiring.

ii) Charge/Battery Controller: A charge controller, charge regulator or battery regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life. The terms "charge controller" or "charge regulator" may refer to either a stand-alone device, or to control circuitry integrated within a battery pack, battery-powered device, or battery recharger. The battery controller used is shown in the figure 2.2.

Fig 2.2. Charge Controller

iii) Battery: An electric battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Each battery consists of a negative electrode material, a positive electrode material, an electrolyte that allows ions to move between the electrodes, and terminals that allow current to flow out of the battery to perform work.

iv) Fan and Water Pump: Fan is an electrical device, consists of blades on rotating produces pressurized air into the space. Water pump is used to rotate the water flow from sump of cooler to cooling pads.

The figure 2.3 shows the Photovoltaic air cooler that we made.

Fig 2.3. Photovoltaic Air Cooler

The details of the components used are:

- Solar panel: 40 watts
- Charge controller: 12 volts 5 amps
- Battery: 12 volts 14 amps
- DC Air cooler with pump: 48 watts
- Cooling Chamber: 2.5×2.5×2.5 feet
- Anemometer
- Digital Thermometer

III. PROCESS

Solar energy conversion is done by using a solar panel, battery, and charge controller. As sun light falls on solar panel, which converts into electrical energy by photoelectric effect. This electrical energy stored in battery in the form of chemical energy. Charge controller is employed in between solar panel and battery which prevents overcharging and may protect against overvoltage, which can reduce battery performance.

The photovoltaic effect is the creation of voltage or electric current in a material upon exposure to light. The standard photovoltaic effect is directly related to the photoelectric effect, though they are different processes. When the sunlight or any other light is incident upon a material surface, the electrons present in the valence band absorb energy and, being excited, jump to the conduction band and become free. These highly excited, non-thermal electrons diffuse, and some reach a junction where they are accelerated into a different material by a built-in potential (Galvani potential).

This potential generates an electromotive force, and thus some of the light energy is converted into electric energy. The photovoltaic effect can also occur when two photons are absorbed simultaneously in a process called two-photon photovoltaic effect.

The converted energy is used to run the centrifugal fan. This fan covered with cooling pads, through which water is passed at a specific rate. As the fan sucks the hot air through cooling pads, heat transfer occur between air and water thus generated cool air enters into the room. The circuit diagram of the photovoltaic air cooler is shown in the fig 3.1.

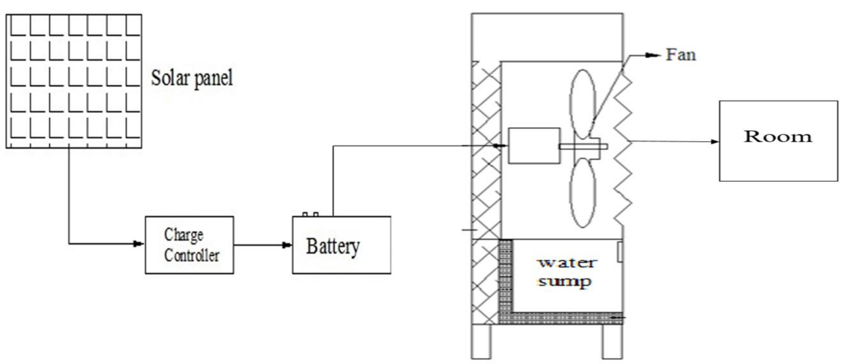

Fig. 3.1 Circuit diagram

IV. RESULTS AND DISCUSSION

The velocities of the fan were recorded at various modes (low, medium, high) and tabulated as shown in table 4.1.

Table. 4.1 Velocity at different modes

S. No	Speed mode	Velocity (m/s)
1	Low	3.425
2	Medium	3.925
3	High	4.225

The Table 4.1 shows the velocities of the fan at 3 modes low, medium and high. The velocity is observed to be increasing from low to high. If we want to increase the velocity of the fan, we can increase the capacity of the battery or we can increase the number of solar panels used.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

The temperature of the cooling cabin was recorded at regular intervals of time using a thermometer and the details are tabulated as shown in the Table 4.2.

Table. 4.2 Temperature of the cooling cabin

Time (min)	Temperature (^{0}C)
0	38
2	32
4	29
6	27.9
8	26.7
10	26
12	25.6
14	25.2
16	24.9
18	24.8
20	24.8

The Table 4.2 shows the temperatures of the cooling cabin for every 2 min till 20 min. We can see that the temperature is increasing with the time. The temperature of the cabin without using the cooler was 38^{0}C (at 0 min). After 20 min of usage of the cooler the temperature of the cabin was 24.8^0 C. The temperature of the cabin can further be reduced if the number of solar panels are increased.

The table 4.3 shows the cost approximation of the Photovoltaic Air Cooler

Table. 4.3 Cost approximation

S. No	Component	Quantity	Cost (Rs.)
1	Solar Panel	1	2500
2	Fan	1	850
3	Cooling pads	2	180
4	Charge Controller	1	1000
5	Battery	1	2000
6	Frame material	-	500
7	Miscellaneous	-	100
	Total		7130

V. CONCLUSION

By comparing the cost of this photovoltaic air cooler with those of the products available in the market, we can say that, our product is more affordable. These type of air coolers can be used anywhere, even in the villages, where there is always shortage of power.

REFERENCES

[1] Alosaimy A S (2013), “Application of Evaporative Air Coolers Coupled with Solar Water Heater for Dehumidification of Indoor Air”, International Journal of Mechanical & Mechatronics Engineering, Vol. 13, No. 01, pp. 60-68.
[2] Farhan Khmamas (2012), “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.
[3] SERI (1982), “Basic Photovoltaic Principles and Methods”, SERI/SP-290-1448, Solar Information Module 6213.