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Fabrication and Analysis of Solar Powered Air Cooler

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----------ABSTRACT----------

Cooling process is very important to maintain the foods, fish and many items at constant temperature to avoid the effect of viruses. Cooling process employs the different methods to cool the air. But considering the lower application and cost effective the water cooling system is considered for our project. The main aim of our project is to supply the cooled air with the help of water circulation. It consists of Solar panel, Battery, Fan, Water tank and Pump. 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. 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.

Keywords– *Cooling, Power Cut Problems, Solar Power Systems, Sustainable Energy Systems, Water Circulation.*

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I. INTRODUCTION

Solar energy is the light and radiant heat from the Sun that influences Earth's climate and weather and sustains life. Solar power is sometimes used as a synonym for solar energy or more specifically to refer to electricity generated from solar radiation. Since ancient times, solar energy has been harnessed for human use through a range of technologies. Solar radiation along with secondary solar resources such as wind and wave power, hydroelectricity and biomass account for most of the available flow of renewable energy on Earth.

Solar energy technologies can provide electrical generation by heat engine or photovoltaic means, space heating and cooling in active and passive solar buildings; potable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes.
Sunlight can be converted into electricity using photovoltaics (PV), concentrating solar power (CSP), and various experimental technologies. PV has mainly been used to power small and medium-sized applications, from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array.

The term "photovoltaic" comes from the Greek φώς (*phos*) meaning "light", and "voltaic", meaning electrical, from the name of the Italian physicist Volta, after whom a unit of electrical potential, the volt, is named.A solar cell, or photovoltaic cell (PV), is a device that converts light into direct current using the photoelectric effect. The first solar cell was constructed by Charles Fritts in the 1880s. Although the prototype selenium cells converted less than 1% of incident light into electricity, both Ernst Werner von Siemens and James Clerk Maxwell recognized the importance of this discovery.

1.1 NEED FOR RENEWABLE ENERGY

Renewable energy is energy generated from natural resources—such as sunlight wind, rain, tides and geothermal heat—which are renewable (naturally replenished). In 2006, about 18% of global final energy consumption came from renewable, with 13% coming from traditional biomass, such as wood-burning. Hydroelectricity was the next largest renewable source, providing 3%, followed by solar hot water/heating, which contributed 1.3%. Modern technologies, such as geothermal energy, wind power, solar power, and ocean energy together provided some 0.8% of final energy consumption.

Climate change concerns coupled with high oil prices, peak oil and increasing government support are driving increasing renewable energy legislation, incentives and commercialization. European Union leaders reached an agreement in principle in March 2007 that 20 percent of their nations' energy should be produced from renewable fuels by 2020, as part of its drive to cut emissions of carbon dioxide, blamed in part for global warming. Investment capital flowing into renewable energy climbed from $80 billion in 2005 to a record $100 billion in 2006.

II. EXPERIMENTAL SETUP

2.1 SOLAR PANEL:

A solar panel is a device that collects and converts solar energy into electricity or heat. It known as Photovoltaic panels, used to generate electricity directly from sunlight Solar thermal energy collection systems, used to generate electricity through a system of mirrors and fluid-filled tubes solar thermal collector, used to generate heat solar hot water panel, used to heat water. It is energy portal. A solar power technology that uses solar cells or solar photovoltaic arrays to convert light from the sun directly into electricity. Photovoltaics, is in which light is converted into electrical power. It is best known as a method for generating solar power by using solar cells packaged in photovoltaic modules, often electrically connected in multiples as solar photovoltaic arrays to convert energy from the sun into electricity. The photovoltaic solar panel is photons from sunlight knock electrons into a higher state of energy, creating electricity.

Solar cells produce direct current electricity from light, which can be used to power equipment or to recharge a battery. A less common form of the technologies is thermo photovoltaics, in which the thermal radiation from some hot body other than the sun is utilized. Photovoltaic devices are also used to produce electricity in optical wireless power transmission.

2.2 FAN

A standalone fan is typically powered with an electric motor. Fans are often attached directly to the motor's output, with no need for gears or belts. Smaller fans are often powered by shaded pole AC motors or brushed or brushless DC motors. In our case it is powered by dc motor having three blades.

2.3 DC PUMP

A pump is a device used to move gases, liquids or slurries. A pump moves liquids or gases from lower pressure to higher pressure, and overcomes this difference in pressure by adding energy to the system such as a water system. A gas pump is generally called a compressor, except in very low pressure-rise applications, such as in heating, ventilating, and air-conditioning, where the operative equipment consists of fans or blowers.

Pumps work by using mechanical forces to push the material, either by physically lifting, or by the force of compression. Hand-operated, reciprocating, positive displacement, water pump. A positive displacement pump causes a liquid or gas to move by trapping a fixed amount of fluid or gas and then forcing displacing that trapped volume into the discharge pipe. They are relatively inexpensive, and are used extensively for pumping water out of bunds, or pumping low volumes of reactants out of storage drums. Conversion of added energy to increase in kinetic energy increase in velocity. Conversion of increased velocity to increase in pressure. Conversion of Kinetic head to Pressure Head. Meet all heads like Kinetic, Potential, and Pressure. Periodic energy addition. Added energy forces displacement of fluid in an enclosed volume. Fluid displacement results in direct increase in pressure. One sort of pump once common worldwide was a hand-powered water pump over a water well where people could work it to extract water, before most houses had individual water supplies.

Hand operated pumps are considered the most sustainable low cost option for safe water supply in resource settings, A hand pump opens access to deeper groundwater that is often not polluted and also improves the safety of a well by protecting the water source from contaminated buckets. This means that communities are often stuck without spares and cannot use their hand pump anymore and have to go back to traditional and sometimes distant, polluted resources. This is unfortunate, as water projects often have put in a lot of resources to provide that community with a hand pump.

2.4 BATTERY

In our project we are using secondary type battery. It is rechargeable type. A battery is one or more electrochemical cells, which store chemical energy and make it available as electric current. There are two types of batteries, primary (disposable) and secondary (rechargeable), both of which convert chemical energy to electrical energy. Primary batteries can only be used once because they use up their chemicals in an irreversible reaction. Secondary batteries can be recharged because the chemical reactions they use are reversible; they are recharged by running a charging current through the battery, but in the opposite direction of the discharge current. Secondary, also called rechargeable batteries can be charged and discharged many times before wearing out. After wearing out some batteries can be recycled.

Batteries have gained popularity as they became portable and useful for many purposes. The use of batteries has created many environmental concerns, such as toxic metal pollution. A battery is a device that converts chemical energy directly to electrical energy it consists of one or more voltaic cells. Each voltaic cell consists of two half cells connected in series by a conductive electrolyte.

One half-cell is the positive electrode, and the other is the negative electrode. The electrodes do not touch each other but are electrically connected by the electrolyte, which can be either solid or liquid. A battery can be simply modelled as a perfect voltage source which has its own resistance, the resulting voltage across the load depends on the ratio of the battery's internal resistance to the resistance of the load.

When the battery is fresh, its internal resistance is low, so the voltage across the load is almost equal to that of the battery's internal voltage source. As the battery runs down and its internal resistance increases, the voltage drop across its internal resistance increases, so the voltage at its terminals decreases, and the battery's ability to deliver power to the load decreases.

III. WORKING PRINCIPLE

Solar panel consists of number of silicon cells, when sun light falls on this panel it generate the voltage signals then these voltage signals are given to charging circuit. Depending on the panel board size the generated voltage amount is increased. In charging circuit the voltage signal from the board is gathered together and stored in the battery. There are two tanks provided one at the top and another one at the bottom. The water from the top tank is made to pass through the tubes which are fixed between the two tanks. A fan is provided at the centre of the tank in such a way that the supply for the fan is coming from the battery which stores the current from the solar panel. When the water falls from the top tank to the bottom tank due to gravity, the fan is made to run, so that the cool air will be supplied all the way through. At the bottom of the tank, there will be a DC pump which pumps the water again to the top tank. The power for the DC pump is coming from the battery connected to the solar panel. The fan and pump is controlled separately with help of manual operated switch.

IV. EQUATIONS

Fan (condenser fan =12" x 10B)
Motor in put = 80watts
Weight =1000gms
Speed =2300rpm
Max current =6.7amps (12 v dc)
Blade = nylon glass filled
Air flow = 1400m3/h @17 Pascal fan inlet pressure

4.1 SOLAR PANEL SPECIFICATIONS

Maximum Power (Pmax) 5watts
Tolerance =10/-10%
Maximum Power Voltage 12 volts
Maximum Power Current .71 amps
Open Circuit Voltage (Voc) 10.8 volts
Short Circuit Current (Isc) 0.57amp
Temp coefficient of Voc -0.37x102 A/C°
Temp coefficient of ISC 0.08x102 A/C°
NOC 47 C°
Max System Voltage 600 Volts
Dimensions 12.5 - 7 – 1 (LxWxD - inches)
Weight 2.2 lbs
Cells - 36
Cell Technology - Polycrystalline
Cell Shape - Rectangular
Temperature Coefficient
Power Pmax/°C – minus 0.44%

4.2 SOLAR PANEL CALCULATION:

VOLT = 12 V
WATT = 5 W
W = V X I
5 = 12 X I
I = 5/12
I = 420ma

4.3 BATTERY CALCULATION:

B_{AH}/C_I = 8 ah/420ma
= 19 hrs.
To find the Current
Watt = 18 w
Volt = 12v
Current =?
P= V x I
18 =12 x I
I = 18/12
= 1.5 AMPS

V. FIGURES AND TABLES

5.1 FIGURES

Using AUTOCAD we made a 2D drawing of the solar air cooler.The length, width and height of the solar air cooler are 330 mm, 200 mm, 660 mm respectively.The battery is connected to fan and pump. The solar panel directly connected the battery.

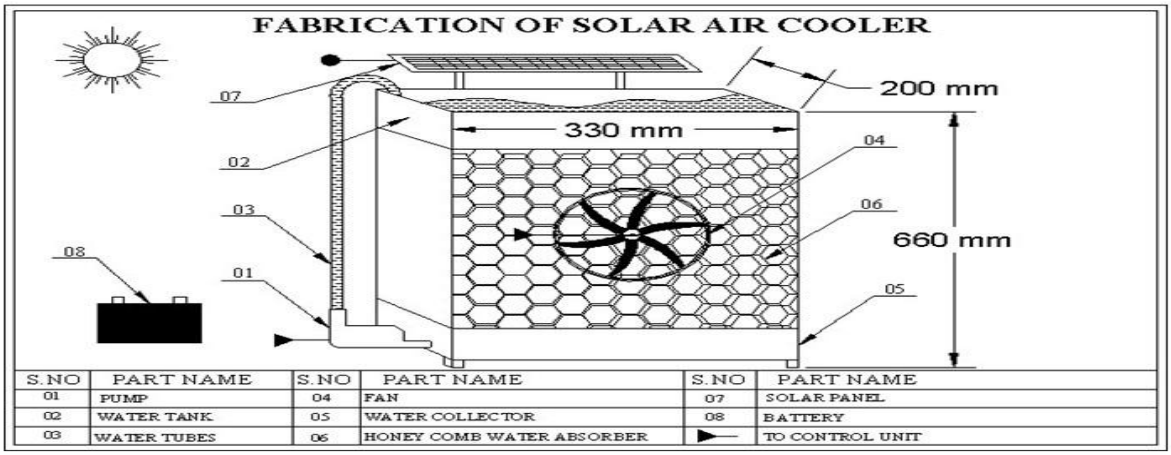


Fig 1 : Solar Air Cooler

5.2 ANALYSIS OF SOLAR AIR COOLER

We conducted an analysis on the solar air cooler by placing the experimental setup under three conditions

1. Inside a well lit room.
2. Outside the room exposed to direct sunlight.
3. Outside the room under the shade.

We measured the current and voltage under the above conditions and determined the voltage and tabulated the readings shown in Table 1.The maximum power was obtained when the cooler was exposed to direct sunlight.

SL NO	CONDITIONS	VOLTAGE (V)	CURRENT (A)	POWER (W)
1	Inside a well lit room	5.96	0	0
2	Outside the room exposed to direct sunlight	20.1	0.044	0.8844
3	Outside the room under the shade	13.5	0.02	0.27

Table 1

SL NO	CONDITIONS	VOLTAGE (V)	CURRENT (I)	OUTLET AIR TEMPERATURE (°C)	INLET AIR TEMPERATURE (°C)	DIFF IN TEMP (°C)	COOLING EFFECT (W)	COP (%)
1	Water at 25°C	8.14	0.91	29	31.8	2.8	6.475	0.87
2	Water at 15.2°C	8.16	0.91	27.1	31.9	4.8	11.1	1.494

Table 2

We measured the outlet and inlet air temperatures of air under two conditions:

1. Cooling water at 25°C
2. Cooling water at 15.2°C

We determined the cooling effect and COP in both cases. Results show us that the values of COP and cooling effect almost doubled when the temperature was reduced by 9.8°C.

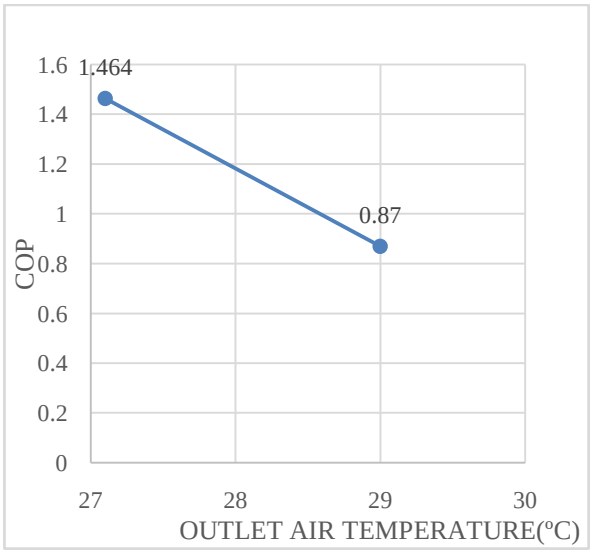
5.3 GRAPHS

Using the values from table 2 we plot two graphs

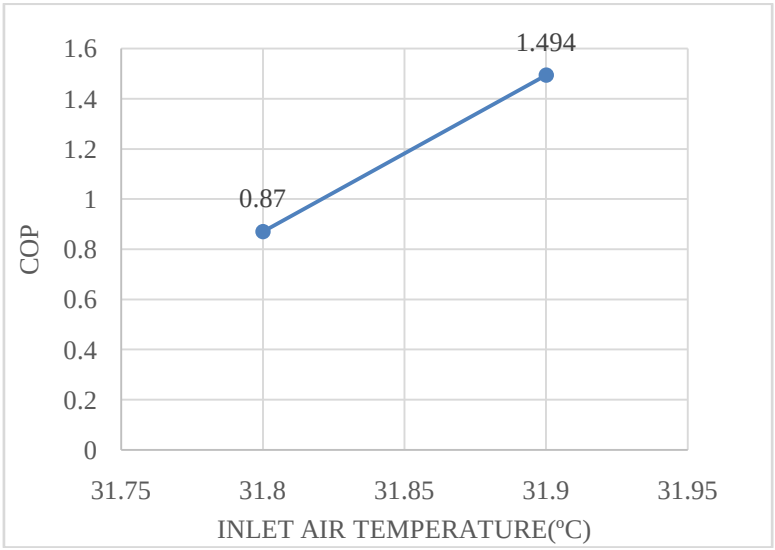
1. COP vs Inlet Air Temperature
2. COP vs Outlet Air Temperature

In the Graph 1, value of COP increases with increase in Input Air Temperatures.

And in Graph 2, the value of COP decreases with increase in Output Air Temperatures



Graph 1: COP vs Inlet Air Temperature



Graph 2 : COP vs Inlet Air Temperature

VI. ADVANTAGES

1. Low cost
2. High reliable
3. Low maintenance
4. Simple in design

VII. DISADVANTAGES

1. Solar power is not available at night time

VIII. APPLICATIONS

1. It can be used in the rural areas where power cut is a problems.
2. It can be used in schools, colleges, and offices.

IX. CONCLUSION

The project carried out by us made an impressing task in the field of Cost of generation of power is very less so the source of power is free and available in plenty and then is no power interruptions. This project has also reduced the cost involved in theconcern. Project has been designed to perform the entire requirement task which has also been provided.

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