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# Study on Solar Powered Air Cooler

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**Abstract**: 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

The functionality of solar powered cooler is dissimilar as that of traditional coolers. The solar energy is stored in battery in the form of an electrical energy by photovoltaic effect. This battery is in turn connected to solar cooler power source. Then 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.

It do not creates the overheads of maintenance or purchasing of pump neither it has to be sent for servicing every season. The concept of solar powered air cooler sounds good and economical; hence almost every class of our society can bare its expenses.

**Keywords**: solar; air cooling; solar chill; photovoltaic; eco-friendly.

## I. INTRODUCTION

Residential and commercial air-cooling consumes over 15% of all electric energy generated and creates two sources of environmental pollution: one is the ozone-depletion effect of traditional refrigerants belonging to CFC groups, and another is the emission of greenhouse gases connected with the electricity generation. Additionally, with energy cost rising constantly, industry is looking to reduce electricity expenses as a means of lowering their fixed costs in order to stay competitive.

As a kind of renewable energy, solar energy is paid more and more attention in the world. Solar system can be classified into two categories; those are thermal systems which convert solar energy to thermal energy and photovoltaic systems which convert solar energy to electrical energy. However, more solar radiation falling which falling on photovoltaic cells is not converted to electricity, but either reflected or converted to thermal energy. This method leads to a drop of electricity conversion

In summer (hot) and humid conditions feel uncomfortable because of hot weather and heavy humidity. So it is necessary to maintain thermal comfort conditions. Thermal comfort is determined by the room's temperature, humidity and air speed. Radiant heat (hot surfaces) or radiant heat loss (cold surfaces) are also important factors for thermal comfort. Relative humidity (RH) is a measure of the moisture in the air, compared to the potential saturation level. Warmer air can hold more moisture. When you approach 100% humidity, the air moisture condenses – this is called the dew point. The temperature in a building is based on the outside temperature and sun loading plus whatever heating or cooling is added by the HVAC or other heating and cooling sources. Room occupants also add heat to the room since the normal body temperature is much higher than the room temperature. Need of such a source which is abundantly available in nature, which does not impose any bad effects on earth. There is only one thing which can come up with these all problems is solar energy..

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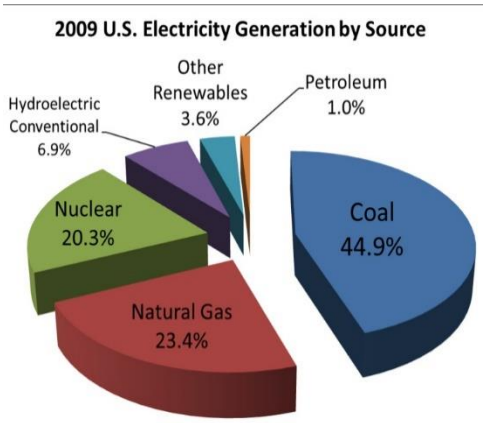
## II. PRESENT PROBLEM

The producing of electricity is ultimately responsible for hot and humid conditions i.e. global warming. As in below shown chart it is clear that major quantity of electricity is produced by coal (fossil fuel).

- Fossil fuels also contain radioactive materials, mainly uranium and thorium, which are released into the atmosphere, which contribute to smog and acid rain, emit carbon dioxide, which may contribute to climate change.
- Longer power cut durations in villages and high cost of cooling products.




## III. PROPOSED SOLUTION

Need of such a source which is abundantly available in nature, which does not impose any bad effects on earth. There is only one thing which can come up with these all problems is solar energy.

Solar energy, radiant light and heat from the sun, is harnessed using a range of technologies such as solar heating, solar photovoltaic. The Earth receives 174 petawatts (PW) of incoming solar radiation. Approximately 30% is reflected back to space while the rest is absorbed by clouds, oceans and land masses. Photovoltaic is a method of generating electrical power by converting solar radiation into direct current electricity by photovoltaic effect.

## IV. OBJECTIVE

- To make aware of non-conventional energy sources to reduce environmental pollutions.
- To provide solution for power cut problems in villages.
- To replace existing costlier and high energy consumption cooling methods.
- Saving power and electricity
- Minimizing the need of season wise servicing.
- Reducing the overheads creates by the electricity pump to lift the water when the voltage supply is low
- To enable people of those rural areas which do not have electricity supply to have cool air during summer days.
- To reduce the electricity bills
- Reducing the expenses made on maintenance of cooler by replacing the concept of pump.

## V. CONSTRUCTION OF SOLAR POWERED AIR COOLER

The solar powered air cooler mainly consists of solar panel, charge controller, battery, inverter, centrifugal fan, cooling pads, water sump.

- **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. Photovoltaic, 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

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common form of the technologies is thermo photovoltaic, 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,

- **Charge controller:**

Charge controller is employed in between solar panel and battery which prevents overcharging. Solar energy conversion process and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk.

- **Battery**

In solar powered air cooler, 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 modeled 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.

- **Inverter**

The energy which is stored in battery in the form of electrical energy directly can be used to run the centrifugal fan or else need to be converted to AC (alternate current) by the help of inverter.

Centrifugal fan

A centrifugal fan is a mechanical device for moving air or other gases. The terms "blower" and "squirrel cage fan", (because it looks like a hamster wheel), are frequently used as synonyms. These fans increase the speed and volume of an air stream with the rotating impellers.

Centrifugal fans use the kinetic energy of the impellers to increase the volume of the air stream, which in turn moves them against the resistance caused by ducts, dampers and other components. Centrifugal fans displace air radially, changing the direction (typically by 90°) of the airflow. They are sturdy, quiet, reliable, and capable of operating over a wide range of conditions.

Centrifugal fans are constant displacement devices or constant volume devices, meaning that, at a constant fan speed, a centrifugal fan moves a relatively constant volume of air rather than a constant mass. This means that the air velocity in a system is fixed even though the mass flow rate through the fan is not.

In solar powered air cooler, the fan is run by the energy which is stored in battery. 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

## VI. WORKING METHODOLOGY

The solar powered air cooler mainly consists of three sections,

**Solar Conversion**

Solar energy conversion is done by using battery, inverter 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 or lifespan, and may pose a safety risk. The stored energy directly can be used for DC loads or else need to be converted AC (alternate current) by the help of inverter. Below shown figure explains solar energy conversion.

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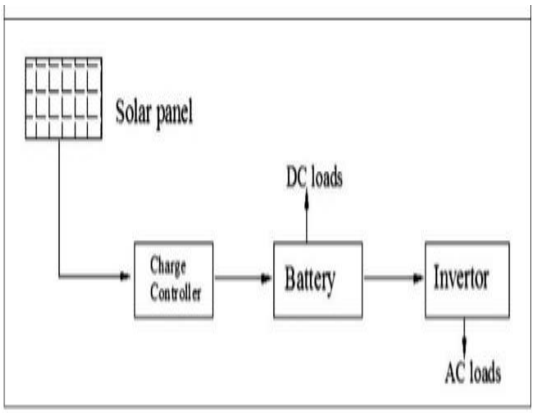


Fig3. Solar Energy Conversion Process

**Cool Air Generation by Centrifugal Fan**

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 occurs between air and water thus generated cool air enters into the room.

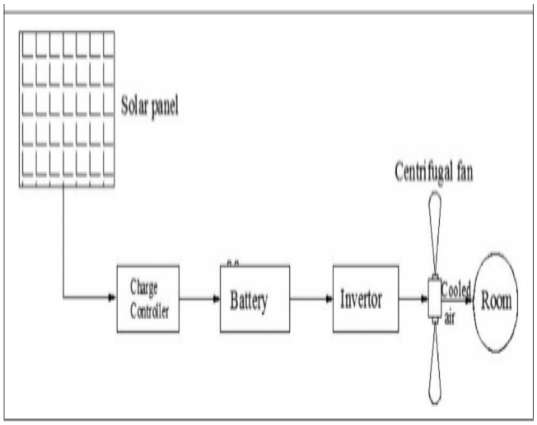


Fig.4. Process of Cool Air Generation by Centrifugal Fan

**Cooling Cabin for Household Food Items**

First thing, here it is natural cooling process. Cooling cabin is provided just below the air cooler section. This cabin built is up with cooling pads and ceramic slabs. Ceramic slabs are surrounded by cooling pads through continuous water supply is provided. This process leads to producing cooler region in the cabin. So, this cabin can be used for preservation of food.

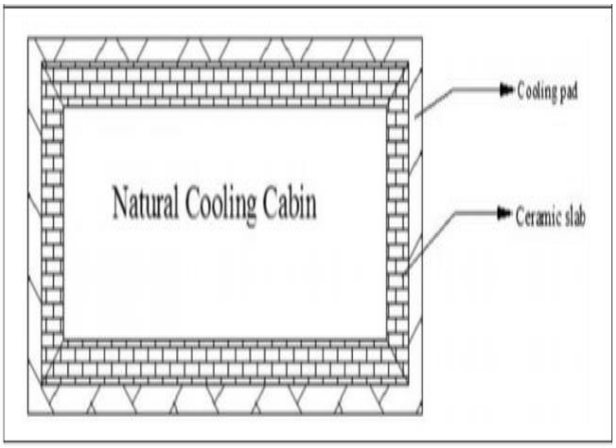


Fig.5 Construction of Natural Cooling Cabin

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## VII. WORKING MODEL

The above shown model consists of energy conversion unit, air cooler unit and cooling cabin. As the electrical energy supplied to the fan from inverter, it starts to produce airflow to the room at the same time water passed through the cooling pads. Fan sucks the outside air through the cooling pads, so heat transfer occur between air and water. So the cool air enters into the room. Next thing is cooling cabin provided just below the air cooler section. This cabin built is up with cooling pads and ceramic slabs. Ceramic slabs are surrounded by cooling pads through continuous water supply is provided. This process leads to producing cooler environment in the cabin. So this cabin can be used for preservation of food.

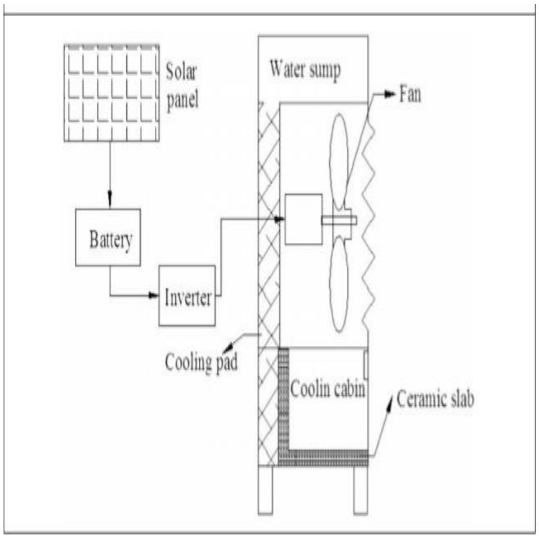


Fig.5 Solar Air Cooler with Cooling Cabin

## VIII 3D MODELLING OF THE COOLER FAN

Modeling of the cooler fan has been done with the help of modeling software NX 8.0, formerly known as NX Unigraphics, is an advanced CAD/CAM/CAE software package developed by Siemens PLM Software. It is used among other tasks for:

- Design (parametric and direct solid/surface modeling).
- Manufacturing finished design by using included machining modules.

Below shown images are captured from NX 8.0

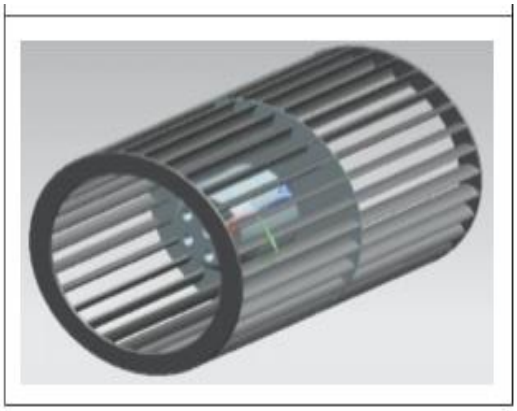

Fig.8 3D Model of the Impeller

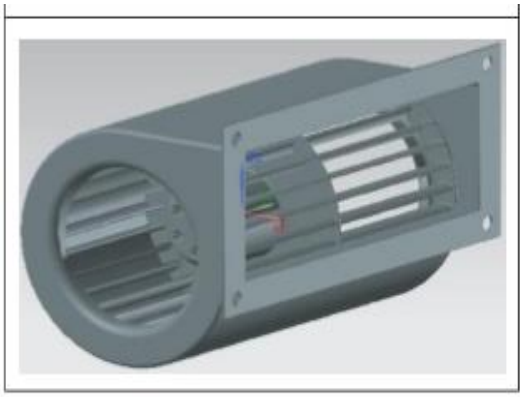

Fig.9 3D Model of the Impeller Inserted in Casing

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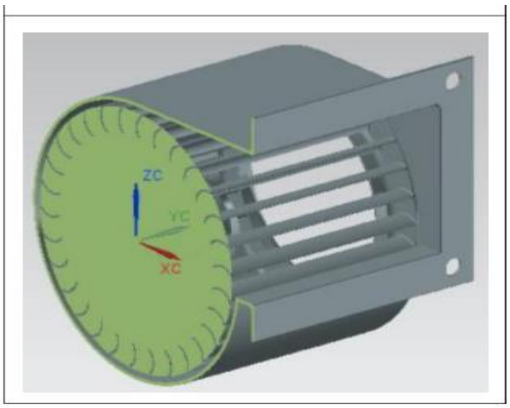


Fig.10 Section View of the Fan

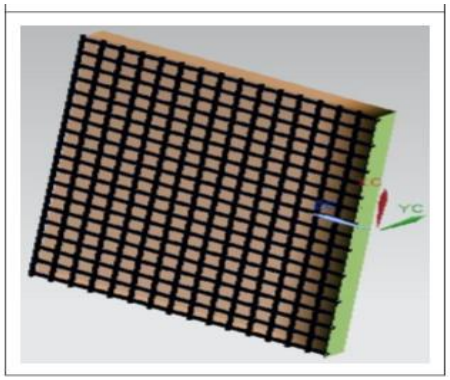


Fig.11 Cooling Pad Placed Between Metal Meshes

## IX. ADVANTAGES

- Low cost
- High reliable
- Low maintenance
- Simple in design
- reduce the environmental pollutions.

## XII. LIMITATION

- . Solar power is not available at night time

## XIII. APPLICATIONS

1. It can be used in the rural areas where power cut is a problem.

2. It can be used in schools, colleges, and office.

## XIV. 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 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.

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