# A SOLAR EVAPORATIVE COOLER

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**Abstract -** ***The paper aims at utilizing the energy of sun, which is the main form of non conventional energy source to run an evaporative cooler. The main emphasis will be laid to utilizing solar energy and model of the cooling device will be prepared. Primarily to get a basic idea of the cooler, model will be prepared on modeling software. Furthermore the project will also include an attempt to incorporate some copper tube in passes before the fan of the cooler and in which a cold fluid (water mixed with ice) will be passed. Although this is a hypothesis but if successful it might increase the performance of the cooler than the regular one. This might be useful for people living in countries like India where there is presence of dry air. The incorporation of copper tubes and subsequent flow of cold water might help in lowering the temperature of the dry air bringing it closer to the wet bulb temperature.***

***Key Words:*** *Solar Energy, Evaporative Cooler, Copper Tube, Wet Bulb Temperature*

## 1. INTRODUCTION

The cooling unit consists of a solar panel mounted on a location to fetch maximum sunlight and it is connected by a battery and an inverter unit through a network of electrical wires, which in turn is connected with the evaporative cooler. When sunlight is incident on the photovoltaic panel, due to photovoltaic effect there will be a movement of electrons which will produce electricity. These will charge the battery and the inverter connected to it will convert the DC power from the panel to AC power. As a result power required for the running of fan and pump is obtained. As soon as the power is started the pump will transfer the water from the reservoir to the evaporative pads which will get wet and simultaneously the fan will also be rotating and as a result the temperature of the dry air will get reduced due to the mixing of water and air. This will result in a more humid air which will then be thrown out by the fan. This will than pass over the copper tubes which will be carrying some cold water and as a result will be cooled more and more humid air will be thrown outside. The cooler are equipped with accessories like air splitter to help reach air in all directions of the room. The size of the cooler to cool a room depends on the size of cooler as the specifications of fan and pump may vary according to the cooling area.

## 2. PARTS AND SPECIFICATION

The part along with their technical specifications used for research is accordingly

### 2.1 FANS

This is the most vital part of the evaporative unit as it is responsible for the transferring of the cool air to the external room so as to provide ample cooling, without fan or blower the evaporative unit is of no use. Based on the overall construction the fan is selected for the evaporative unit and based on the blowing capacity of the fan the necessary cooling effect in the room will be maintained.

**Table – 1: Fan Specifications**

| PARAMETER | SPECIFICATION |
|---|---|
| 1. Fan type | Axial type fan |
| 2. Material | Plastic |
| 3. Air flow rate in $m^3$/hour | 4500 $m^3$/hour |
| 4. Fan diameter (mm) | 457 mm |
| 5. Fan motor rpm | 1400 rpm |
| 6. Air throw distance (m) | 17 m |
| 7. Cooling area (squarefeet) | 75 square feet |
| 8. Fan blades | 4 |

### 2.2 PUMP

The pump in the evaporative cooler circulates the water from the water tank and discharges the water to the evaporative pads and as a result it gets wet. They are centrifugal pumps with very low power rating and they generally remain submerged in water hence can also be called as submersible pumps as they are multistage type of centrifugal pump and also can be called as circulator pump in general. They inlet pipe or the inlet vent sucks the water from water tank and the water is than discharged through the pump discharge line i.e. to the pipe which connects the pumps and the evaporative pads. A valve is generally employed so as to determine whether the water in the water tank is sufficient for continuous soaking of the evaporative pads.

**Table – 2: Pump Specifications**

| PARAMETER | SPECIFICATION |
|---|---|
| 1. Pump type | Submersible pump |
| 2. Capacity | Up to five feet |
| 3. Wattage (fan and pump both) | 180 Watt |

## 2.3 EVAPORATIVE PADS, PIPES AND CASING

The pads are generally made of aspen and their width may be in range of 0.75 to 1 inch. It absorbs water and makes the air more humid. The simple PVC pipes are used to transfer the water from reservoir to the pads and the copper pipe is placed before the fan in which cold fluid passes .The casing houses all the parts of the cooler and provides the reservoir for water storage and also has a separate ice compartment through which the water becomes cool and pass through the copper pipe.

**Table – 3: Pipe Specifications**

| PARAMETER | SPECIFICATION |
|---|---|
| 1. Pipe material | PVC, Copper |
| 2. Pipe diameter (mm) | 40 mm |
| 3. Pipe length (feet) | 10 feet each |

**Table – 4: Casing Specifications**

| PARAMETER | SPECIFICATION |
|---|---|
| 1. Material | Plastic |
| 2. Dimension (L*B*H) | 682*582*1100 mm |
| 3. Water storage capacity (Liters) | 25 liters |

**Table – 5: Pad Specifications**

| PARAMETER | SPECIFICATION |
|---|---|
| 1. Material | wood wool |
| 2. Dimension | As per requirement to be stacked on three sides of the cooler |
| 3. Thickness (inches) | 1 inch |

## 2.4 SOLAR PANEL

When a number of solar cells or photovoltaic cells are connected to form an assembly then it is called as the solar panel. Many cells are enclosed together into a common structure to form a solar panel. They form the most crucial part of this evaporative unit as such as an internal combustion engine is to an automobile unit, it is the main gatherer of power. The solar panel can be used as a component of a larger photovoltaic system or as a single panel to generate and supply electricity in commercial and residential applications.

**Table – 6: Solar Panel Specifications**

| PARAMETER | SPECIFICATION |
|---|---|
| 1. Material | Polycrystalline silicon |
| 2. Dimension (mm) | 1640*994*46 mm |
| 3. Wattage | 200 Watt |

## 2.5 BATTERY AND INVERTER

The battery stores the energy generated using solar plates and inverter converts AC Power to DC power. They are the ignition system of the evaporative cooling unit

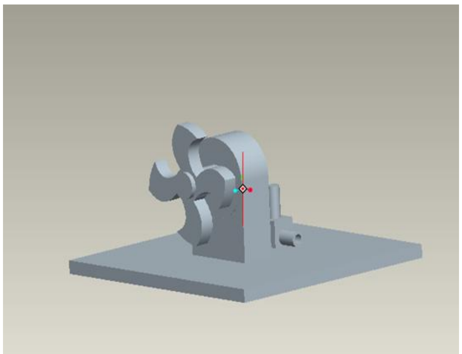
**Table – 7: Battery Specifications**

| PARAMETER | SPECIFICATION |
|---|---|
| 1. Type | Lead acid battery |
| 2. Voltage | 24 V |

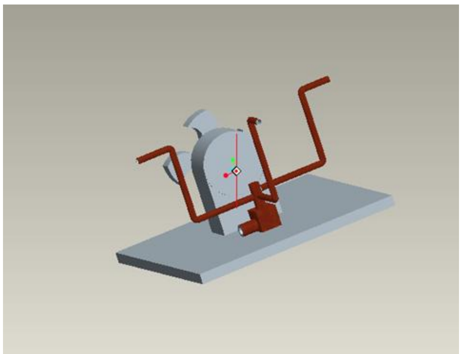
**Table – 8: Inverter Specifications**

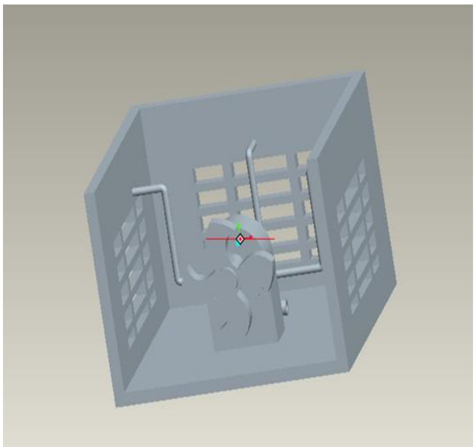
| PARAMETER | SPECIFICATION |
|---|---|
| 1. Input voltage (V) | 21-33 V |
| 2. Output voltage (V) | 115 V |
| 3. Output Power (Watt) | 300 Watt |

## 3. MODELLED PARTS IN SOFTWARE

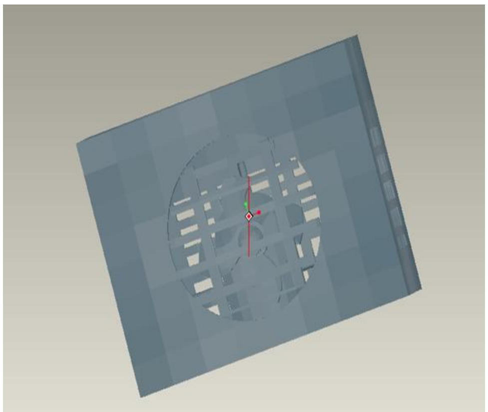


**Figure– 1: Fan of cooler**





**Figure– 3: Casing and evaporative pads of cooler**



**Figure– 3: Final Assembly of unit along with copper tubes in front of fan.**

## 4. CALCULATIONS

The leaving air temperature is of the cooler is given by the following relation

$T_{LA} = T_{DB} - ((T_{DB} - T_{WB}) \text{ x } E)$
$T_{LA}$ = Leaving Air Temp
$T_{DB}$ = Dry Bulb Temp
$T_{WB}$ = Wet Bulb Temp
$E$ = Efficiency of the evaporative media.
If an area has a temperature of 108 ˚F at 8 % relative humidity than; the leaving air temperature can be found using the above equation
$T_{DB}$ = 108 ˚F
E = 85 % of a aspen or wood wool pad
$T_{WB}$ = 66 ˚F (obtained from psychrometric chart)
Thus the leaving air temperature will be as follows
$T_{LA}$ = 108° – ((108° – 66°) x 85% efficiency)
$T_{LA}$ = 72.3°F.

Here it might be possible that the temperature can be taken down to 66 ˚F when the leaving moist air passes through the copper tubes filled with cold water.

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## BIOGRAPHIES

Shardul jani works as a Lecturer at Mechanical Engineering department of Silver Oak College of Engineering and Technology. He has a penchant for research work and is extremely good at imparting his knowledge to students. He has a special inclination towards subjects like operations research, industrial Engineering and thermal engineering.

Trushit Vaishnav is currently employed with a MNC and and has undertaken many research ordeals and has completed them successfully. He has a deep insight in subjects like maintainance, safety and Design softwares

 