

# Centralized Solar Air Cooling With Dehumidifier And Evaporative System

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**Abstract :** The cooling technique could be very essential to maintain food, fish and many gadgets at a consistent temperature to avoid the impact of viruses. The cooling process makes use of specific techniques to cool the air. But thinking about the bottom and maximum profitable software, the water cooling system for our task is considered. The primary goal of our assignment is to supply the cooled air with the help of water flow. It consists of sun panel, battery, fan, water tank and pump. Current methods of air cooling are evaporative coolers, air conditioning, enthusiasts and dehumidifiers. But the operation of those merchandise wishes a supply known as strength. The manufacturing of power is ultimately chargeable for hot and humid situations, that is, international warming. In hot and humid situations, the want to sense at ease and comfy has emerge as one of the few wishes and, for this motive, the usage of structures along with air conditioning and refrigeration has extended rapidly. Most of the time, those structures aren't appropriate for villages because of the longer period of the power cut and the high cost of the goods. Solar energy systems are taken into consideration as one of the paths to greater sustainable electricity structures, considering that solar cooling structures in villages would comprise many appealing features. Despite the accelerated performance and obligatory strength performance necessities, peak electricity call for is developing and there may be presently no accepted solar air cooling era appropriate for residential applications, in particular for cities, colleges and workplaces.

**Keywords-** Evaporative pad, Solar Power Systems, Dehumidifier, Water Circulation.

## I. INTRODUCTION

Solar electricity is the light and radiant warmth of the Sun that influences Earth's climate and climate and sustains existence. Solar strength is from time to time used as a synonym for solar strength or greater specially to refer to the strength generated with the aid of sun radiation. Since historic instances, solar electricity has been harnessed for human use via more than a few technology. Solar radiation together with secondary sun sources along with wind and wave power, hydroelectricity and biomass account for most of the people of to be had go with the flow Of renewable energies on Earth. Solar energy technologies can offer power technology through thermal vehicles or photovoltaic method, heating and cooling of areas in lively and passive solar homes; potable water by means of distillation and disinfection, daylight hours lighting fixtures, warm water, thermal energy for cooking and excessive temperature procedure warmth for business functions. Solar light may be converted into energy using photovoltaic (PV) power, solar electricity attention (CSP) and diverse experimental technology. Photovoltaic strength has been used frequently to energy small and medium-sized programs, from the calculator powered with the aid of a single solar cellular to off-grid homes powered by using a photovoltaic array. The time period "photovoltaic" comes from the Greek φώς (phos) which means that "light," and "voltaic," which means electric, from the name of the Italian physicist Volta, whose call is a unit of electrical ability, volt. The sun mobile, or photovoltaic mobile (PV), is a device that converts light into direct present day the usage of the photoelectric impact. The first sun cellular became constructed by using Charles Frits in the 1880s. Although the selenium prototype cells converted much less than 1% of the incident mild into energy, each Ernst Werner von Siemens and James Clerk Maxwell identified the importance of this discovery.

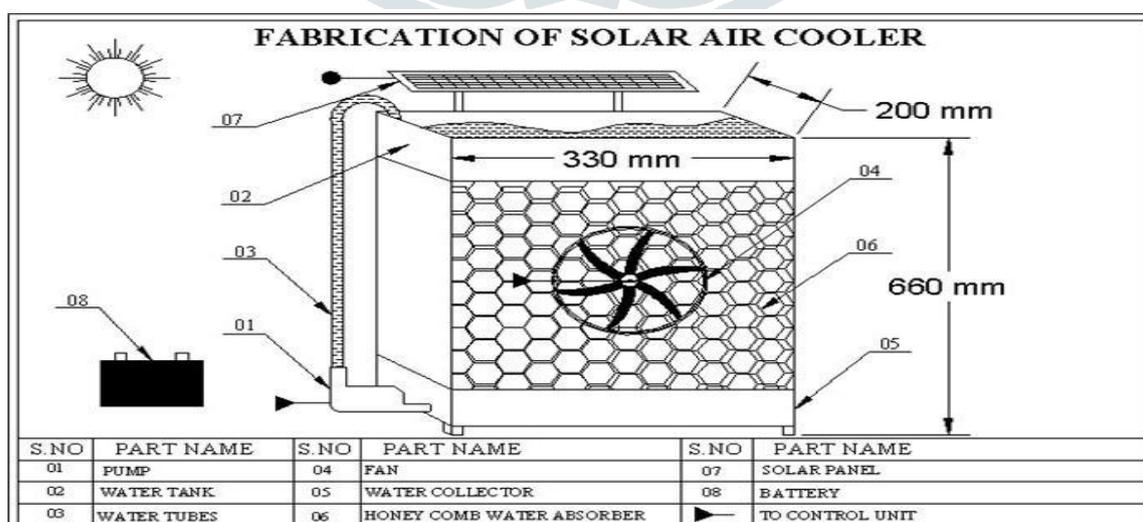


Figure 1:Fabrication of solar air cooler

## II. EXPERIMENTAL STUDY

### 2.1 Component and Their Specification

1 SOLAR PANEL: A sun panel is a device that collects and converts sun strength into power or warmth. It is referred to as photovoltaic panels, which might be used to generate strength directly from sunlight. Solar thermal electricity collection structures, that are used to generate power thru a device of mirrors and fluid stuffed tubes. Solar thermal collector, that's used to generate heat. . It is power portal. A sun energy era that uses sun cells or photovoltaic solar arrays to transform sunlight immediately into electricity. Photovoltaic, is where mild is converted into electric electricity. It is better called a way to generate sun energy by using sun cells packed in photovoltaic modules, often electrically connected within the form of photovoltaic solar assemblies to convert the solar power into power. The photovoltaic solar panel is that the photons of sunlight push the electrons to a better state of electricity, growing power. Solar cells produce direct modern strength from mild, which can be used to power device or to recharge a battery. A much less not unusual form of technology is thermo voltaic, wherein the thermal radiation of a hot body aside from the sun is used. Photovoltaic devices also are used to provide energy in the transmission of wireless optical energy.

2 FAN: An impartial fan generally works with an electric motor. Fans frequently connect directly to the motor outlet, with out the want for gears or belts. Smaller lovers regularly work with shaded pole AC motors or brushed or brushless DC motors. In our case, it works with a DC motor that has 3 blades.

3 DC PUMP: A pump is a device used to transport gases, drinks or sludge. A pump moves liquids or gases from lower pressure to better stress, and overcomes this stress difference by way of adding power to the gadget, along with a water system. A fuel pump is normally called a compressor, besides in very low strain programs, including heating, air flow and air con, wherein the working equipment consists of enthusiasts or blowers. The pumps work through the usage of mechanical forces to push the material, both with the aid of physical lifting or with the aid of compression pressure. Manual, alternative, superb displacement, water pump. A positive displacement pump causes a liquid or gasoline to move via trapping a hard and fast quantity of fluid or gasoline after which forcing the displacement of that quantity trapped in the discharge pipe. They are especially cheaper and are widely used to pump water from reservoirs or to pump low volumes of reagents out of storage drums. Conversion of brought electricity to increase in kinetic strength increase in speed. Conversion speed growth to pressure growth. Kinetic head to strain head conversion. Meet all bosses as Kinetic, Potential and Pressure. Periodic addition of electricity. The brought electricity forces the displacement of the fluid in a closed extent. The displacement of the fluid produces a right away boom in stress. One type of pump that changed into as soon as not unusual in the course of the world changed into a manual water pump over a water well in which people should paintings to extract water, before maximum homes had individual water materials. Manual pumps are considered the most sustainable low fee alternative for safe water deliver in aid environments. A guide pump opens get right of entry to to deeper groundwater that is regularly unpolluted and additionally improves the safety of a properly by protective the water supply from contaminated buckets. This way that communities are often trapped without spare elements and might no longer use their hand pump and must go back to conventional and once in a while distant contaminated assets. This is unlucky, due to the fact water initiatives have often invested many assets to provide that community with a guide pump.

4 BATTERY: In our undertaking we are the usage of a secondary kind battery. It is rechargeable. A battery is one or more electrochemical cells, which shop chemical strength and make it to be had as an electric powered current. There are two kinds of batteries, number one (disposable) and secondary (rechargeable), which convert chemical energy into electric electricity. Primary batteries can best be used once due to the fact they use their chemicals in an irreversible reaction. Secondary batteries may be recharged due to the fact the chemical reactions they use are reversible; They are recharged via running a fee current thru the battery, but in the opposite path of the discharge modern. Secondary batteries, additionally referred to as rechargeable batteries, can be charged and discharged often before they run out. After wearing out a few batteries may be recycled.

5 MOTOR: An engine is an electric gadget that converts electrical energy into mechanical electricity. Most electric automobiles function thru the interaction between the motor's magnetic subject and the electric modern-day in a twine winding to generate pressure inside the form of a shaft rotation. Electric vehicles can be powered by using direct current (DC) assets, such as batteries, motorized vehicles or rectifiers, or by way of alternating modern-day (AC) sources, including an electrical network, inverters or electric generators. An electric generator is mechanically same to an electric powered motor, but operates in the opposite course, changing mechanical power into electrical strength.

6 SILICA GEL: Silica, or silicon dioxide (SiO<sub>2</sub>), is the same material found in quartz. The gel form contains millions of tiny pores that can adsorb and hold moisture. Silica gel is essentially porous sand. ... Once saturated, you can drive the moisture off and reuse silica gel by heating it above 300 degrees F (150 C). Thermal conductivity ~0.01 w/mk, Bulk density~0.45 g/ml, Porosity~80%, Specific surface area~142~357m<sup>2</sup>/g, Mean pore diameter~13nm, Primary Particle Diameter~5-50nm.



Figure 2:White silica gel

Thermal conductivity ~0.01 w/mk

Bulk density~0.45 g/ml

Porosity~80%

Specific surface area~142~357m<sup>2</sup> /g

Mean pore diameter~13nm

Primary Particle Diameter~5-50nm

Table 1: Function and specification of system parts

Sr.No	Component Name	Specification
1	Solar Panel	20W
2	Motor	12W
3	Fan	5*4=20W
4	Duct	3inch
5	Battery	7amp
6	Silica Jell	
7	Wooden box	2*3feet
8	Submersible Pump	12W

## 2.2 Experimental Setup:-

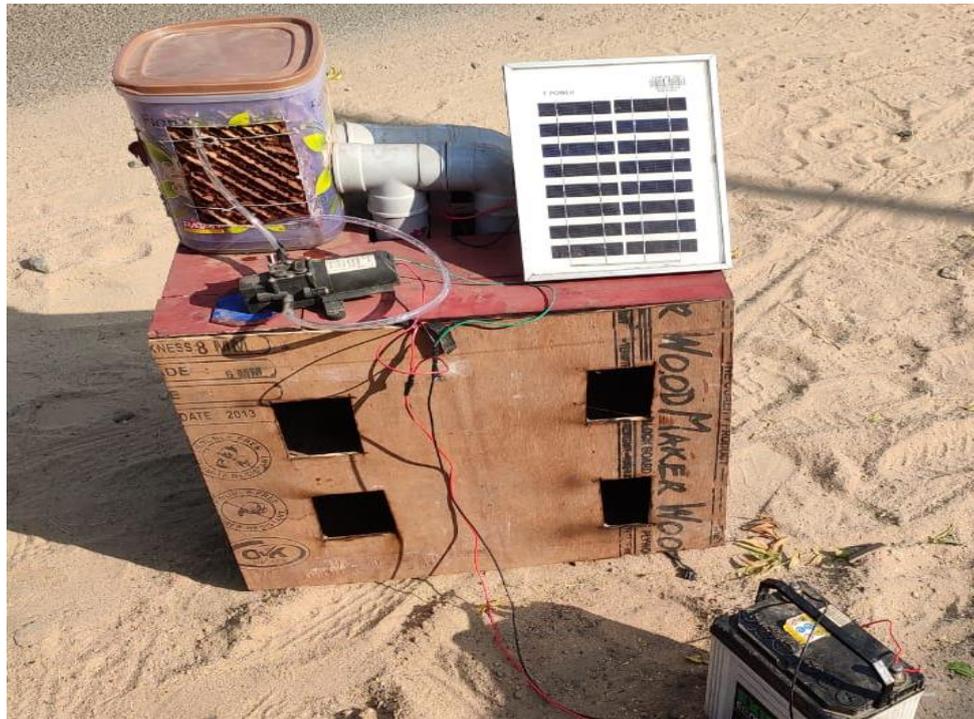


Figure 3: Experiment setup

- Evaporative coolers (frequently referred to as "swamp coolers") function at the principle that circulating air is drawn through an evaporative pad that has water cascading alongside the surface of the pad, able to reducing air temperature as effective, however sometimes more strength green, than traditional compressor-type air conditioning devices, below greater most desirable situations and environmental eventualities.
- The areas in the southwest of the us. . And similar dry and arid environments around the arena show the finest benefit while using those kinds of units. the cooling structures rely upon an internally or externally provided air supply / shipping gadget for circulating air (i.e. a fan) to draw air and blow the air drift over the cooling approach (i.e. the heating pad) Evaporation.
- The air should come into contact with the liquid to affect the cooling procedure. The air need to come into touch with the liquid to affect the cooling system. A cooling fluid which includes water has the gain of a excessive extent heat capacity and a much higher thermal conductivity compared to air.
- The heat exchange coefficient for beverages together with water is normally higher than for air, which results inside the possibility of compact and energy green cooling machine configurations. Semiconductor substances which include arsenide, indium, cadmium, silicon, selenium and gallium are used to make photovoltaic cells. Mostly, silicon and selenium are used to make the mobile.
- Consider that the figure beneath shows the constructions of the silicon photovoltaic mobile. The higher surface of the cellular is manufactured from a thin layer of the p-kind material so that mild can effortlessly input the material. The metallic rings are located across the p-kind and n-kind fabric that acts as their high quality and poor output terminals respectively.
- That after the cooling air comes from the dehumidifier, that over time the use of the silica gel dehumidifier, that the dehumidifier humidifies the cooling air and that it also gives fresh dry air to the room
- Central air conditioners, on the other hand, work by taking humidity out of the home. These systems produce cold, dry air and work best in an airtight home. The major advantage of an evaporative cooler is that its operating costs are typically one-third those of a central air conditioner.
- The initial equipment cost is also lower than air conditioners. Along with lower operating costs and simple installation, evaporative cooling can be a perfect, ozone-friendly alternative to traditional air conditioning.

### III. RESULT AND DISCUSSION

#### 3.1 Results

Table 2: Humidity and cop data of evaporative solar air cooler without dehumidifier

Without Dehumidifier												
Sr. No.	Time	Water Tem.(°C)	Inlet Air Tem.(°C)	Outlet Air Tem.(°C)	Diff. In Tem.(°C)	Humidity(Atm)%	Humidity(WD)%	Voltage(V)	Current(I)	Power(W)	Cooling Effect	COP
1	9:30	23.1	24.4	23.3	1.1	30	28	11.4	0.96	10.944	10.1706	0.929331
2	10:00	24	26.2	25.1	1.1	29	27	11.1	0.99	10.989	10.1706	0.925526
3	10:30	25.3	28.1	26.9	1.2	28	26	10.7	1.05	11.235	11.0952	0.987557
4	11:00	26.7	30.1	28.8	1.3	26	24	10.6	1.1	11.66	12.0198	1.030858
5	11:30	27.4	31.2	29.6	1.6	25	23	10.1	1.18	11.918	14.7936	1.241282
6	12:00	27.9	32.3	29.4	2.9	23	22	9.8	1.22	11.956	26.8134	2.242673
7	12:30	28.3	32.9	29.7	3.2	22	21	9.4	1.28	12.032	29.5872	2.459043
8	1:00	29.2	33.3	29.9	3.4	21	20	9.2	1.32	12.144	31.4364	2.588636
9	1:30	29.4	32.6	29.4	3.2	22	21	9.1	1.36	12.376	29.5872	2.390692
10	2:00	30.1	31	28	3	23	22	9	1.33	11.97	27.738	2.317293
11	2:30	29.9	31.2	28.4	2.8	24	22	8.7	1.32	11.484	25.8888	2.254336
12	3:00	29.4	30.8	28.6	2.2	25	23	8.9	1.06	9.434	20.3412	2.156159

Table 3: Humidity and cop data of evaporative solar air cooler with dehumidifier

With Dehumidifier												
Sr. No.	Time	Water Tem.(°C)	Inlet Air Tem.(°C)	Outlet Air Tem.(°C)	Diff. In Tem.(°C)	Humidity(Atm)%	Humidity(WD)%	Voltage(V)	Current(I)	Power(W)	Cooling Effect(Q)	COP
1	9:30	23.2	24.6	23.4	1.2	31	25	11.4	0.98	11.172	11.0952	0.993126
2	10:00	24.3	26.2	25	1.2	30	24	11.2	0.99	11.088	11.0952	1.000649
3	10:30	25.4	28.3	26.1	2.2	29	23	10.8	1.07	11.556	20.3412	1.760228
4	11:00	26.8	30.3	27.9	2.4	28	22	10.7	1.14	12.198	22.1904	1.819183
5	11:30	27.6	31.4	28.9	2.5	27	21	10.2	1.19	12.138	23.115	1.90435
6	12:00	28.1	33	29.5	3.5	25	19	9.9	1.28	12.672	32.361	2.553741
7	12:30	28.5	33.2	29.6	3.6	22	16	9.5	1.32	12.54	33.2856	2.654354
8	1:00	29.4	33	29.1	3.9	24	15	9.3	1.36	12.648	36.0594	2.850996
9	1:30	29.7	32.8	29	3.8	24	15	9.2	1.37	12.604	35.1348	2.787591
10	2:00	30.3	32.5	28.9	3.6	25	18	9.1	1.34	12.194	33.2856	2.72967
11	2:30	29.9	31.7	28.3	3.4	25	18	8.9	1.33	11.837	31.4364	2.655774
12	3:00	29.6	30.9	28.1	2.8	26	20	9.1	1.08	9.828	25.8888	2.634188

#### 3.2 Discussion

- As per show into table 2 of the humidity & cop of solar evaporative cooler without dehumidifier and following to discuss of the results.

- From what the humidity is the atmosphere and the coolest time is changed over time, to show the time when the sunrise is the humidity is 30% to 9:30 am in the atmosphere and after the continuation, the humidity decreases with respect to time. That humidity is at least 21% at 1pm and that after humidity continues to rise in the atmosphere.
- the time when the sunrise to be the humidity are the 28% at 9:30 am at evaporative solar air cooler of without dehumidifier and than after the to be continue the humidity are decrease with respect to time. Than the humidity are the minimum 20% at 1pm and than after the again the humidity are continues to increase into atmosphere. Than coefficient of performance are change respectively with temperature difference & cooling effect.
- When sunrise occurs at the time when solar energy is created that is less than the time since the power and voltage are less than the given cooling effect, they are minimum to be shown in the table at 9:30 a.m. the effect is 10.944 watts, and that time is cop given at 0.929331. that the time at temperature is also less than at 9:30 am since the temperature difference is 1.1 ° C.
- the day is in the afternoon that at 1pm given the maximum solar energy than the high voltage and current which means that the cooling effect given is maximum is 31.4364watts that time given the maximum of cop are 2.588636. that time also die of the maximum temperature that means the die of the maximum temperature difference 3.4 ° C.

As per show into table 3 of the humidity & cop of solar evaporative cooler with dehumidifier and following to discuss of the results.

- From what the humidity is the atmosphere and the coolest time is changed over time, to show the time when the sunrise is the humidity is 31% to 9:30am in the atmosphere and after the continuation, the humidity decreases with respect to time. That humidity is at least 22% at 12:30pm and that after humidity continues to rise in the atmosphere.
- the time when the sunrise to be the humidity are the 25% at 9:30 am at evaporative solar air cooler of with dehumidifier and than after the to be continue the humidity are decrease with respect to time. Than the humidity are the minimum 15% at 1pm and than after the again the humidity are continues to increase into atmosphere. Than coefficient of performance are change respectively with temperature difference & cooling effect.
- When sunrise occurs at the time when solar energy is created that is less than the time since the power and voltage are less than the given cooling effect, they are minimum to be shown in the table at 9:30 a.m. the effect is 11.052watts, and that time is cop given at 0.993126. that the time at temperature is also less than at 9:30 am since the temperature difference is 1.2 ° C.
- the day is in the afternoon that at 1pm given the maximum solar energy than the high voltage and current which means that the cooling effect given is maximum is 36.594watts that time given the maximum of cop are 2.850996. that time also die of the maximum temperature that means the die of the maximum temperature difference 3.9 ° C.
- COP of the system increases up to 2.85 and then it starts decreasing in with dehumidifier and in without dehumidifier it increases up to 2.58 and starts decreasing. We get the minimum humidity of 15% in with dehumidifier and in without dehumidifier we get minimum humidity of 20%.

3.2.1 : COP(Without Dehumidifier) VS COP(With Dehumidifier)

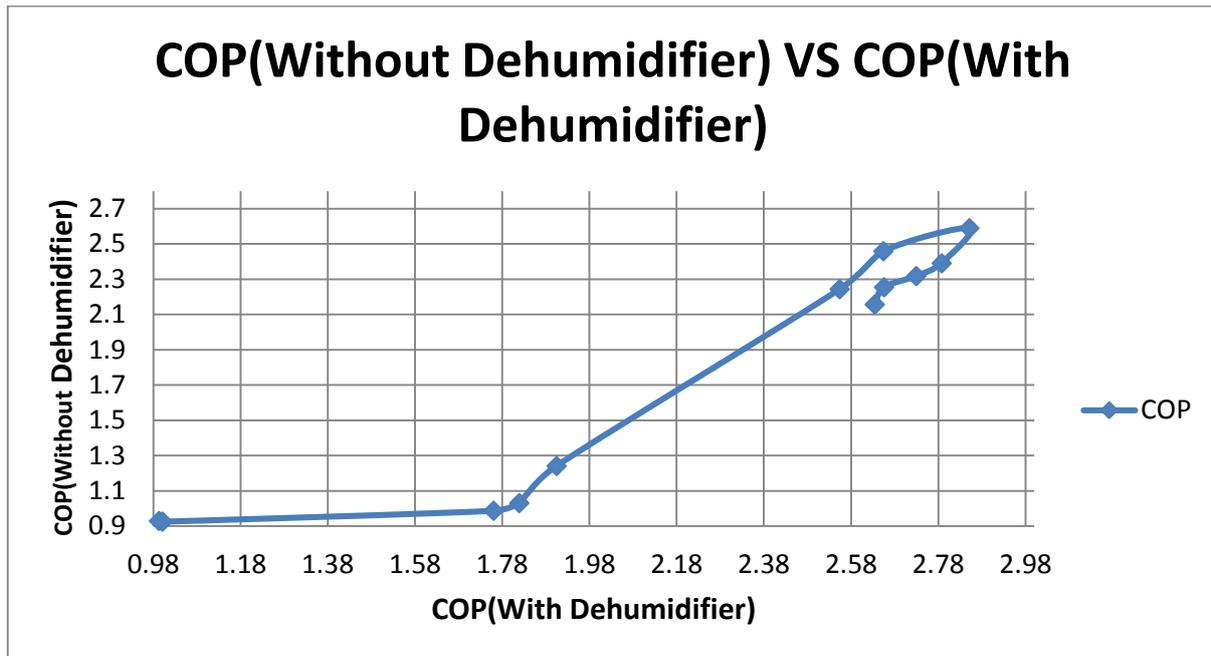


Figure 4: COP(Without Dehumidifier) VS COP(With Dehumidifier)

- As per this graph, we can say that the COP of the air cooler with dehumidifier higher than that of without dehumidifier . COP of the system increases up to 2.85 and then it starts decreasing in with dehumidifier and in without dehumidifier it increases up to 2.58 and starts decreasing.

3.2.2 : Humidity(Without Dehumidifier) VS Humidity(With Dehumidifier)

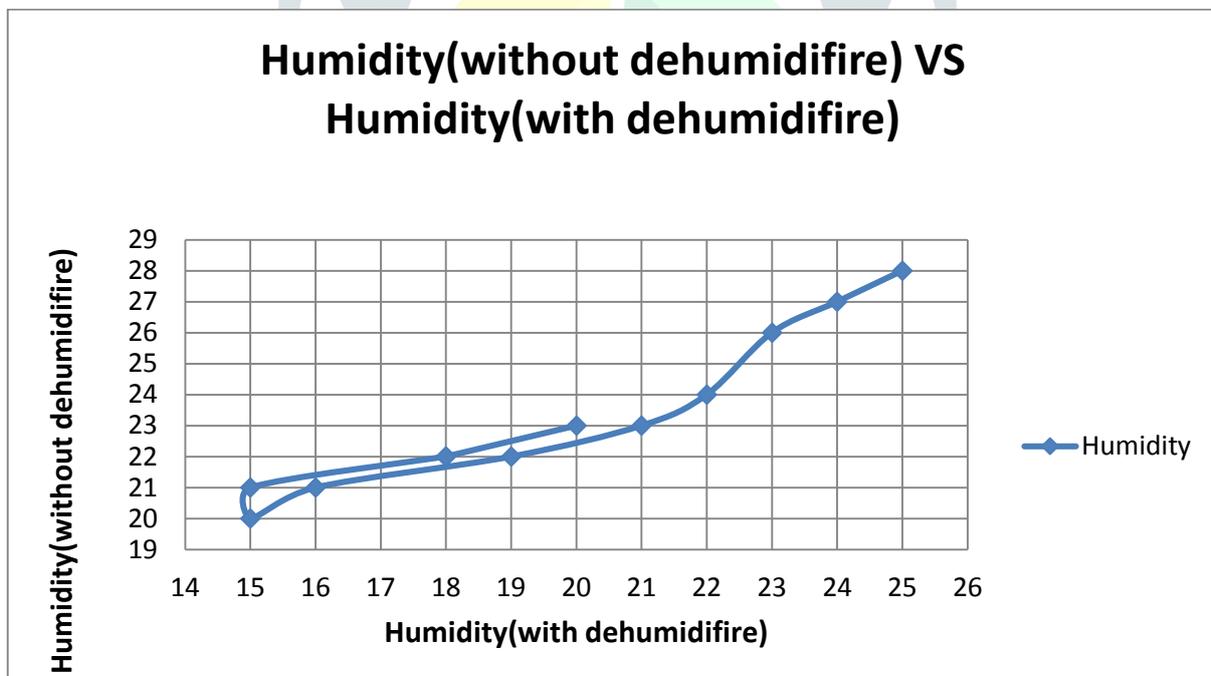


Figure 5: Humidity(Without Dehumidifier) VS Humidity(With Dehumidifier)

- As per the graph, we can say that the Humidity is less in air cooler with dehumidifier than that of simple air cooler. We get the minimum humidity of 15% in with dehumidifier and in without dehumidifier we get minimum humidity of 20%.

### 3.3 Power ,Cooling Effect and Coefficient of Performance Calculation

(1)Power  $P= V*I$  Watts

Where  $V=$  voltage

$I=$ Current

(2)Cooling Effect= $m c$  (Inlet temperature-outlet temperature)Watts

Where  $M=$  mass flow rate

$C=$  specific he

(3)COP=Cooling Effect / power

## IV. CONCLUSION

From the experiment we will conclude that the COP of the air cooler with dehumidifier is more than that of the simple air cooler without dehumidifier. From the experiment also we will conclude that the humidity of the air cooler with dehumidifier is less than that of the simple air cooler without dehumidifier. The cooling temperature we get with our machine is lower than that of the easy air cooler. In this device, the humidity within the room is less than that of the environment. This project has also reduced the cost involved in the concern. It does no cost the environment and we can save electricity.

## REFERENCE

- [1] Prachi K. Taweale & Pratik Bhake, "Evaporative Cooling Technology – A Literature Review", International Journal of Science, Research & Development.
- [2] D. A. Hindoliya, "Direct Evaporating For Thermal Comfort in a Building in the Summer Months for Four Climatic Zones of India".
- [3] Velasco Gomez & Rey Martinez, "The Phenomenon of Evaporative Cooling from a Humid Surface as an Alternative Method for Air Conditioning", International Journal of Energy & Environment.
- [4] S. S. Kachhwaha and Suhas Prabhakar, "Heat and mass transfer study in a direct evaporative cooler", Journal of Scientific and Industrial Research.
- [5] Vivek W. Khond, "Experimental Investigation of Desert Cooler Performance Using Four Different Cooling Pad Materials", American Journal of Scientific & Industrial Research.
- [6] Shatat M, Worall M, Riffat S. Opportunities for solar water desalination worldwide:
- [7] Li C, Goswami Y, Stefanakos E. Solar assisted sea water desalination: a review. *Renew Sustain Energy Rev* 2013;19:136–63.
- [8] Lorente S, Bejan A, Al-hinai K, Sahin AZ, Yilbas BS. Constructal design of distributed
- [9]. Solar powered air conditioning system' by Dauta - 2013, *Energy Procedia* 36, 444-453.
- [10]. White paper on solar thermal technologies, cleantech consultants by Vaidyanathan, A. -2012
- [11].A review of solar photovoltaic technologies, *Renewable and sustainable energy reviews* by Bhubaneswari, P. -2011-1625-1636.
- [12]. Improving the environmental cooling for air coolers' by Farhan, A.K. – 2000, Volume 5, ISSN: 1819-6608.
- [13]K.F. Fong, T.T. Chow, C.K. Lee, Z. Lin,L.S. Chan, Comparative study of different solar cooling systems for buildings in subtropical city, *Solar energy* 84 (2010) 227-244.
- [14]S. Viani, S. Picenni, Stato dell'arte delle tecnologie per il solar cooling (State of art of solar cooling technologies, RdS 2009, www.rse-web.it, March 8, 2013.
- [15]A. Rossetti, S. Viani, Valutazione delle prestazioni di sistemi di solar cooling esistenti (Evaluation of the performance of existing solar cooling plants),RdS 2010, www.rse-web.it, March 8, 2013.