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Effect of Humidity on the Efficiency of Solar Cell (photovoltaic)

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Abstract: Out of 100% energy coming from sun approximately 30% of the energy is either reflected back or is absorbed by clouds, oceans and land masses. In cities where the humidity is more, like Karachi Mumbai, Malaga, Hamburg and Los Angles where in average humidity ranges in (40-78 %), results in a minimal layer of water vapor at the front solar cell directly facing Sun. The Solar energy which actually strikes the solar cell is subjected to loss in absorption/reflection of energy. There have been approximate losses of about 15-30% of the energy in addition to 30%. One of the effects that we found out after our experimental analysis was of the humidity that it brings down the utilization of solar energy approximately to 55-60% from just 70% approximately of utilized energy.

Keywords: Solar energy, humidity factor, absorption, effect, reflection, efficiency, approximation.

Introduction

If we talk about the energy which is received from Sun, Earth receives approximately of 1413 W/m^2 and the actual consumption which appears on the scale formulated is approximately 1050W/m^2 as recorded by Pacific Northwest Forest and Range Experiment Station Forest Service, U.S. Department of Agriculture, Portland, Oregon, USA in in 1972.As per the facts observed, approximately of 30% energy is lost in between. As per the statistical figures stated, that the Earth's top of the atmosphere sunlight's intensity is about 30% more intense than the actual received on the land. In the Solar panels what we use today, actually we make use of the 70% energy coming from the Sun and utilize the working of our panels to fulfill our energy needs. [1-3]

As per the fact that the earth's crust mainly consists of 70% of Water, the energy which strikes the earth is indirectly striking the water/oceans which helps in increasing of humidity level on the overall basis. The humidity doesn't only create hurdles for the energy actually received at the top of the atmosphere but also effects the device consumptions by many aspects.[4-5]

The aspects what we covered is the effect of humidity on the Solar panels which create obstacles for drastic variation in the power generated , indirectly making the device work less efficient than it could have without it. The cities where in the humidity level is above the average range of 30 actually results in the minimal layer of water on the top of the Solar panel which results in decreasing of the efficiency.

As per the facts when the light consisting of energy/Photon strikes the water layer which in fact is denser, Refraction appears which results in decreasing of intensity of the light which in fact appears the root cause of decreasing of efficiency. Additional there appears minimum components of Reflection which also appears on the site and in that, there appears light striking is subjected to more losses which after the experiments conducted resulted approximately in 30% loss of the total energy which is not subjected to utilization of Energy for the Solar panel.[6]

AS far as the efficiency of the Solar cell is concerned, Efficiency is termed as the amount of the light that can be converted into usable format of electricity. Because of the efficiency depends upon the value of Maximum Power Point of the Solar cell , due to the above effect of humidity ,the maximum power point is deviated and that indirectly results in decreasing of the Solar cell Efficiency.[7-8]

Interesting facts appears to provide surprising figures about the population in Coastal areas around the globe. According to National Oceanic and Atmospheric Administration USA, about 52% of the Population in USA lives coastal counties Los angles, Texas, Calif Etc. [9]

According to the top world users of Solar Energy ,Germany(9785MW),Spain(3386MW), Japan(2633MW) and USA(1650) appears to dominate among the users of Solar Energy and where in the coastal humidity ranges among the cities as Hamburg(Germany) as 50-70% , Malaga(Spain) as 65-80%,Tokyo(Japan) 45-65% and Log angles (USA) as 70-95%.[10]

The usage of the Solar Panel is readily effected by the effect of humidity and the values corresponds to change is the humidity is subjected to change

Experiment and Analysis:

Various experiments were conducted and in the test bench included 50W BP Solar Panel having specification of Vamp = 17.3V and Imp = 2.9A with temperature coefficient of Isc= (0.065 ± 0.015) % / °C, Temperature coefficient of Voc=-(80 ± 10) mv / °C and Temperature coefficient of power=-(0.5 ± 0.05) % / °C, and Tungsten Halogen Bulb of 1000W, 2 Humidifier, Hygrometer, Thermometer, Output Load as tungsten filament bulbs(15,20,25W) , 2 Millimeters.

Results were calculated initially with normal temperature in Karachi which was 32*C (305K) and humidity 25.The humidifier was used as to increase the humidity level of the area where in the Solar panel was connected with the load and was subjected to a constant intensity by using tungsten Halogen bulb and the distance was kept 2 foot. The readings were noted and the humidity was carefully calculated by the use of Hygrometer.

The results showed the drastic change in the readings when the humidity was subject to gradually increase. Below is the chart in where the readings are noted

Temperature(K)	Humidity (%)	Voltage (DC)	Current Amps(DC)	Powers(watts)
305	25	17.10	2.78	47.538
305	30	16.72	2.63	43.973
305	35	16.53	2.42	40.002
305	40	16.45	2.3	37.605
305	45	16.41	2.14	35.117
305	50	16.33	2.04	33.313
305	55	16.32	1.88	30.681

Table 1: Humidity vs. voltage, current and power readings taken through the experimental set up as discussed.

Below are the graphs where in the relation between Humidity to voltage, current and power are calculated

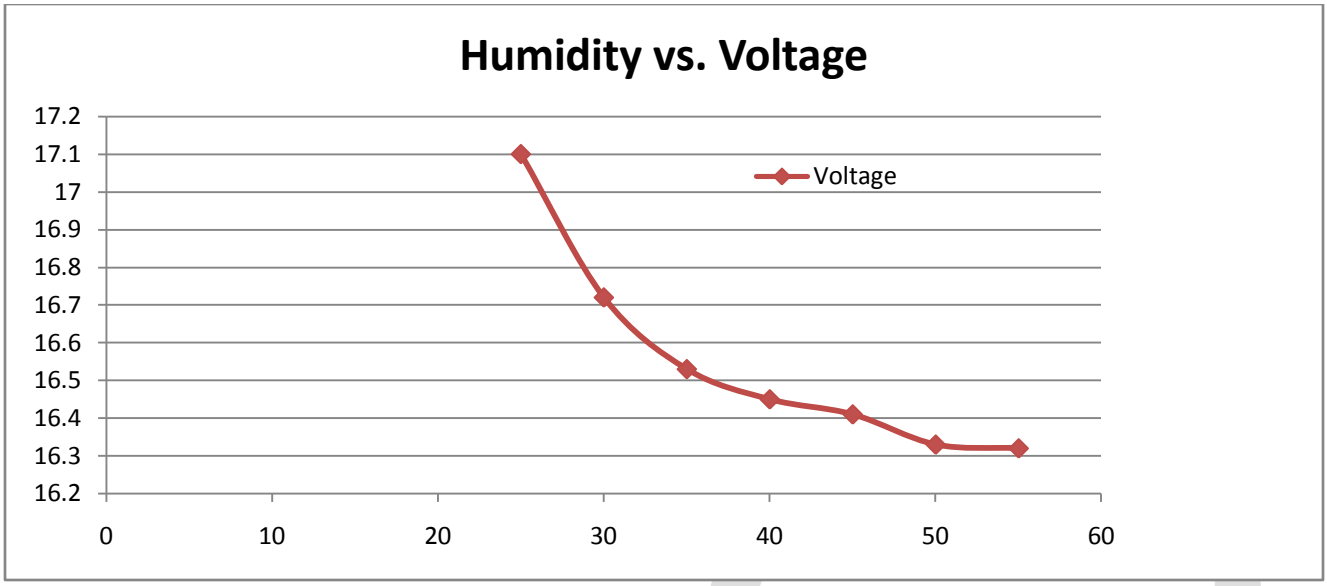
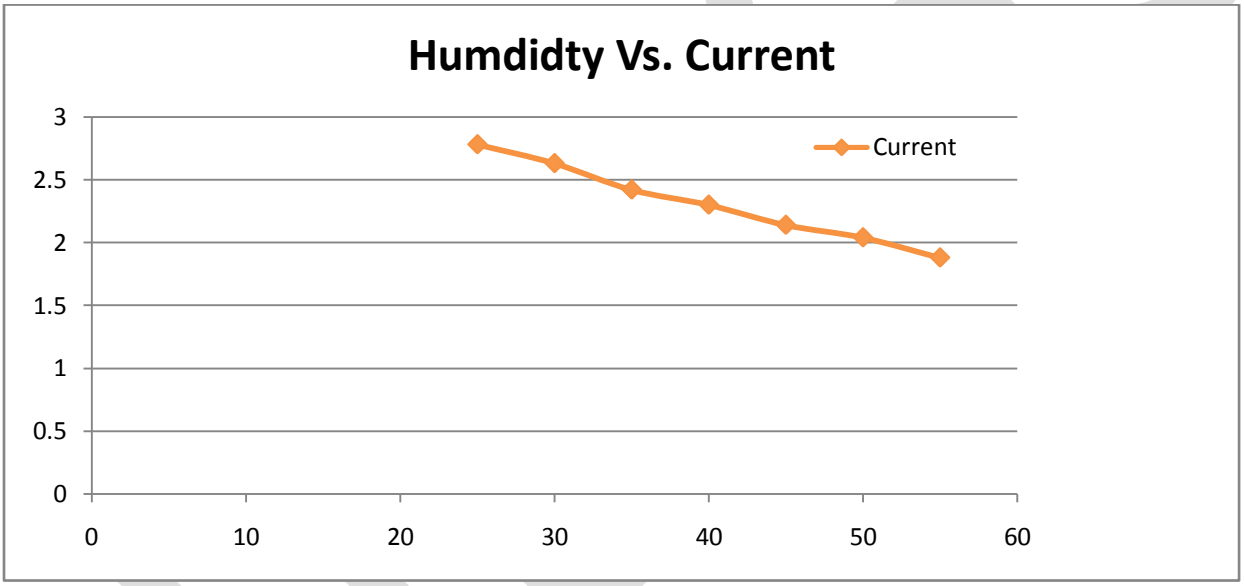


Fig1. Graph between Humidity and Voltage. Humidity appears as X axis and Voltage appears at Y axis



. Graph between Humidity and Current. Humidity appears as X axis and Current appears at Y axis

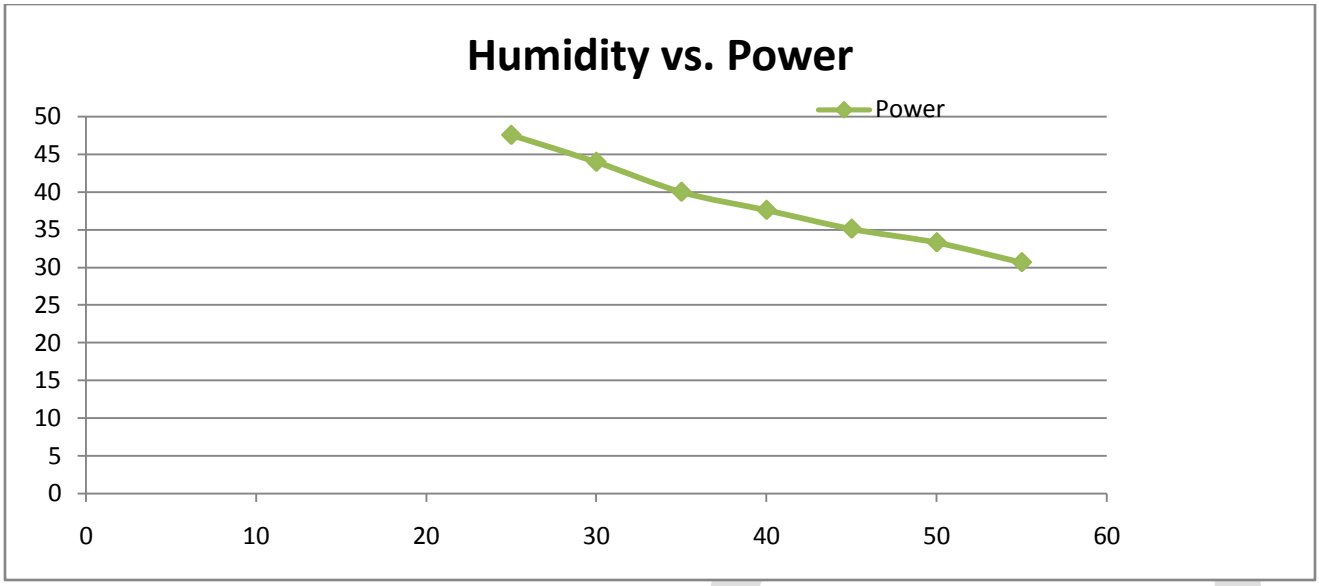


Fig3. Graph between Humidity and Power. Humidity appears as X axis and Power appears at Y axis

After the results which are obtained so far , the readings clearly shows that the humidity level do effect the working of the solar panel and can drag down the efficiency of the Solar panel is installed in cities where in the normal humidity level appear more.

Percent Reduction in Power =(P (Without Humidity)-P (with Humidity))/P (Without Humidity)*100

5% Humidity Increased

1st= ((47.538-43.973)/47.538)*100=7.499% Approx.

10% Humidity Increased

2nd= ((47.538-40.002)/47.538)*100=15.85% Approx.

15% Humidity Increased

3rd = ((47.538-37.605)/47.538)*100=20.89% Approx.

20% Humidity Increased

4th= ((47.538-35.117)/47.538)*100=26% Approx.

25% Humidity Increased

5th= ((47.538-33.313)/47.538)*100=29.92% Approx

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CONCLUSION

After the experiments conducted, humidity drastically effect the performance of the Solar Panel and proves out to decrease the Power produced from the Solar Panels up to 15-30% if subjected to environment where in the Humidity level remains high

Future Prospects and Suggestions:

After observing such a drastic change when it comes to change in humidity level , the required Solar Panels should be designed in such a way specially in Pakistan which could be made to have less effects of humidity level on the Power ratings.

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