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Effect of Altitude on the Efficiency of Solar Panel

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Abstract- Our previous research work suggests that the efficiency of solar panel is drastically effected when it comes to humidity changes. In this research paper, we observe the effect of power accession of solar panel if it is kept at a altitude/height. According to the experiments conducted, at the same time and at the same intensity of sunlight, the power accession of 7-12% was observed due to placement of Solar Panel at a particular height of 90 foot/27.432m above the datum/ground Level.

Keywords- Solar energy, altitude/height factor, power accession, sea level, efficiency.

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 the Solar Panel is placed at a probable altitude of 27.432 meters/90 foot from the ground level, it is observed that the gases and the humidity factor along with factors affecting from the presence of population, which consists of emission of different gases from the masses, the usage of fossil fuels and much more are actually playing their role in stopping or limiting certain amount of proper intensities to reach to the Solar Panel and hence making the Solar panel less effective.

As per our previous research work done in the same particular area, the humidity's effect was observed to cast a considerable amount of deviation to the Power accession .It was also accounted with the help of Hygrometer and it was proved out to deviate from the readings of the ground level as the amount of humidity was reduced as we turn to a particular height.

As per our experiments which were conducted on a pure sunny day with humidity as 30% , with 3 solar panels , the readings were noted which accounts the normal readings observed at a ground level appears to be under practice these days when it comes to Solar Grounds / Solar Gardens and introduction of Solar Village.

At the same time there were 3 Solar Panels installed at about 27.432 meters above the ground level, and the humidity was observed up there was nearby 26% , with a temperature deviation of 1*C , the readings were taken simultaneous to the one on the ground.

It appears to formulate an interesting fact that Power accession of about 7-12% was observed considered the ground level readings on the datum. It might also be the soul representation of Physics, that the more close you go forward to a light emitting source , the more light would be observed with higher intensity.

Apart from the above stated physics involved, the thing which was observed was, as there appears drastic change in the humidity which also effects the power accession as was observed in our last research work. Apart from the normal readings noted with the effect of humidity , there appears many factors which started neglecting at a height , the certain gasses appears to have less effect on the intensity as they appears to show less resistance in form of reflection or refraction of the light .

Usage of fossil fuels actually delivers the CO2 gas in our environment, due to deforestation in the modern era, appears to cast a lower impact in the absorbance of above stated gas.

The manufacturers of Solar Panels report in the specification sheet that the Panel responds at 1000W/m^2, 25^{0}C. However, the performance of the Solar Panel is strongly affected by various external factors and which may cause the Panel to deviate from the standard values as prescribed by the manufacturers. [3]

This mainly depends on the Solar Radiation reaching the Earth and the values corresponding to Incident irradiation Pi.

Where *Pi* is the Incident irradiation in W/m^2 and is given by :

$$P_i = \int_0^\infty E(\lambda)\, d\lambda$$

Where E (Lambda) *is* the spectral irradiance, I_{sc} is the short circuit current and V_{oc} is the open circuit voltage. The open/short current of the circuit is readily affected by the increasing of humidity range and which indirectly make the system deviate from the standard values provided by the manufacturer.

The spectral irradiances vary at the ground level at its intensities because of various atmospheric parameters.

As far as the Short Current Density, Jsc, is concerned, it is directly related with the spectral irradiance which is

$$J_{sc} = \int E(\lambda)\, SR(\lambda)\, d\lambda$$ 4]

As the placement of the panel is kept on the altitude/height, there appears many factors which are neglected, the most which is counted appears the deviation in the humidity factor and other due to height, there appears neglection to the effect of certain gases on the Panel which actually allows the Panel to work more effectively than before.[4]

As per the facts when the light consisting of energy/Photon strikes the water layer/unwanted gases which in fact appears denser on the ground level, Refraction appears which results in decreasing of intensity of the light which in fact appears to be 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. If there appears the placement of Solar Panels on a particular height, there appears less effect of these factors on efficiency as there appears less humidity and less amount of Gas which indirectly restricting the process of Reflection and Refraction to have less effect on the utilization the energy coming from the Sun.[5]

Experiment and Analysis:

Various experiments were conducted and in the test bench included 6 Solar panel specified as 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, Hygrometer, Thermometer, 6 Output Loads as tungsten filament bulbs (15, 20,25W) , 12 Millimeters. The test bench includes 3 Solar Panel installation on the ground and 3 Solar panels on the altitude of about 90 foot/27.432 meters. Results were calculated initially with normal temperature in Karachi which was 34*C (305K) and humidity 30

Temperature(K)	Humidity (%)	Voltage (DC)	Current Amps(DC)	Powers(watts)
307	30	16.32	2.41	39.331
307	30	17.3	2.34	40.482
307	30	16.45	2.51	42.789

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

Simultaneously the Panels kept on the Altitude of about 27.432 meters, following is the data which was observed. The initial were, due to placement of the system on the altitude , the temperature appeared to deviate a bit from the standard as because of the presence of water particles and other gasses which actually make contribution in lowering the usual temperature. Humidity was observed to be 26% on the altitude

Temperature(K)	Humidity (%)	Voltage (DC)	Current Amps(DC)	Powers(watts)
308	26	16.76	2.63	44.078
308	26	17.64	2.53	44.629
308	26	17.08	2.69	45.945

As it can be observed that there appears a drastic change in the power accession when it comes to placement of Solar Panel on the particular altitude. To compare the respective Power readings in order to observe the difference, the following formulae were used.

Power Accessed = (Power (Altitude)-Power (Ground))/Power (Ground)

Solar Panel	Power(Ground) Watts	Power(Altitude) Watts	% Accession
1	39.331	44.078	12.06
2	40.482	44.629	10.24
3	42.789	45.945	7.37

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.Conclusion:

After the experiments conducted, it was clearly observed that the Power accession of 7-12% is observed when the Solar Panel is installed at a particular altitude ahead of the ground which indeed can be identified as the most probable and easy solution in order to utilize the less resources in getting maximum output.

Future Directions and suggestions:

As it can be observed that by applying simple techniques, the power accession can be varied up to a considerable amount. The agencies which are currently working in the concerned area with same goals should place the panels well above the ground so that to make the best utilization of Power coming from the Sun and make the best efforts in order to utilize the blessing of Sunlight in Pakistan.

REFERENCES:

"Chapter 8 – Measurement of sunshine duration" (PDF). *CIMO Guide*. World Meteorological Organization

"Natural Forcing of the Climate System". Intergovernmental Panel on Climate Change. Retrieved 2007-9-29.Radiation Budget". NASA Langley Research Center. 2006-10-17.

"Introduction to Solar Radiation". Newport Corporation. Archived from the original on Oct. 29, 2013.

M. Chegaar, P. Mialhe , “Effect of Atmospheric parameters on the silicon cells performance”.

http://web.physics.ucsb.edu/~lgrace/chem123/troposphere.htm

Dill, Lawrence M. "Refraction and the spitting behavior of the archerfish (Toxotes chateaus)." Behavioral Ecology and Sociobiology 2.2 (1977): 169-184