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Innovation The Research Concept

A Review : Effect of Dust on Photovoltaic Conversion Efficiency of Photo Voltaic Module

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Abstract

The Field of Photovoltaic (PV) has growing very fast and it is expected to grow further, possibly higher rate. The in sight in the importance of solar energy for our future energy supply has been growing vigorously with the growing concerns about the price and availability of fissile fuel. The objective of present work is to reduce the dust of the PV module in order to increase its electrical conversion efficiency. Accumulation of dust from the outdoor, environment on PV module is natural process. There were studies that represent that deposited soil or dust can decrease the ability of solar cell. By doing experiments of dust particle on solar panel with a constant power light bulb, to show the effect of dust on surface of photovoltaic solar panel can reduce the efficiency at greater extent.

Keywords: Photovoltaic, Dust, Efficiency, Power Etc.

Introduction

The power output of a PV module depends on the resistance of the load and the resulting operating point on the I-V curve resulting in a value between zero to the maximum value of P_{MP}.

Aim of the Study

The aim of the study is to find the effect of dust on the performance of photovoltaic modules.

Main Text of the Study

The efficiency of a PV module is this maximum power divided by the incident solar insolation and the area of the module.

$$\eta = P_{MP/}$$
$$IcAc$$

There are many types of solar PV cells available, which are mainly mono crystalline silicon cells, multi crystalline solar cells, amorphous silicon cell and thin film solar cells etc. The study of solar PV module at environmental point of view is developing exercises. To the PV module, it should be technically driven, commercially driven with cost reducing consideration, quality driven and maximum energy output with minimum input driven. For this reason it is necessary to have a look the environmental affective. dust, humidity, irradiance, air velocity, angle of incident etc. The aim of this work is, to design, build, operate and maintain highly efficient solar power plants from start to completion, that too within desired specification budget and time line.

This is absolutely necessary to prove a PV module report at the selected location. We need to know the longitude and latitude of the location, quality of sand and pollutant assembly, air velocity and humidity etc. The knowledge of data regarding the loss of efficiency is first step in designing of the PV solar plant. For this we get the following expected loss of efficiency at the location due to dust and other particle accumulation, month wise degradation of module efficiency. Located in the equatorial region, Bhilwara has an average solar radiation of 4500 KWH per square meter and this ideal location for photovoltaic installation.

A decrease in the performance of PV module throughout its life cycle is not desired. Photo voltaic cell normally provides good electricity last 25 years and it takes at least 5 years for the PV module to create equivalent energy consumed in its manufacturing processes. One of the most affecting factor in the loss of performance of solar PV Panel in India as well as in other countries, the accumulated dust on the panel. The nature of problem is different in various locations. "Hottel and woertz" firstly investigate the impact of dust on solar systems.[1] They noticed a maximum degradation in performance by 4.7% with an average loss in incident solar radiation being less than 1%.

In a study by "Salim" et all into dust accumulation on a solar PV system indicated a 32% reduction in performance after eight month in Riyadh.[2] "Wakim" indicated a reduction in PV Power by 17% due to sand accumulation on panels in Kuwait city after six days.[3]

Furthermore the study also showed that the effect of dust on PV efficiency would be higher in spring and summer than in autumn and winter.

An experiment to investigate the effect of Aeolian dust deposition on photo voltaic solar cells by Dirk Goosen et al. showed that the deposition of finer dust particles on the glazing of PV cells significantly affected the performance of such cells.[4] This experiment was conducted to investigate the effect of wind velocity and air borne dust concentration on the drop of PV cell performance caused by dust accumulation.

In a experiment in Roorkee; Garg" discovered that dust on the plate tilted at 45^{o} would reduce the transmittance by an average of 8% after on expose period of 10 days.[5]

In a work by " Sayigh" in Kuwait, it was observed that about 2.5 g/m^{2}/day of dust were collected between April and June.[6]

The "Google" studied the effect of dust on solar panels of a 1.6 MW solar installation in its mountain view headquarter is California.[7] They made a comparison on two different sets of solar panels in Google campus, the flat one in corporate and the tilted one on roof.

Theoretically dust accumulates on top of the flat panels and rain washed away most dirt on the tilted ones and leaves some accumulation in the corners. The Google crew cleaned them up 15 months after the installation of the panels. For the flat panels, the cleaning resulting in doubling of the energy however for the tilted panels, the difference was found to be relatively small.

Further investigations on the effect of dust accumulation on the tilted glass plates revealed a reduction in plate transmittance ranging from 64% to 17% for the tilted angles ranging from 0% to 60% respectively after 38 days of exposure.

A reduction of 30% in energy gain was observed by the horizontal collector after three day of dust accumulation.

In another study that included investigation of the physical properties and deposition density on the performance of solar PV panel by "El-Shobokshy and Hussein", the artificial dust which includes lime stones, cement and carbon particulates. It was revealed that in the study that cement particles would result in the most significant drop in the PV short circuit voltage i.e. by 80%. It was found that the smaller the particles size for a fix deposition density, the greater would be the reduction in solar intensity received by the solar PV panel.

This was probably due to the greater ability of finer particles to minimize inter- particle gaps and thus decreasing the light more than for larger particles.

Here we perform our experiment with a solar panel of 50 W which is mono- crystalline silicon technology. Radiation will be delivered by set of two spot light between which distances can be varying for uniform illumination. Radiation can be measured by photo radiometer. We use digital multimeter for measuring current and voltage and different types of resisters used for load.

Experiments were conducted also with the clean plastic sheet and with bare panel in order to quantify the effect of dust, cement and carbon particulates. We use dust, cement and carbon particulates accumulation to study the effect any loss. Dust is well distributed over the surface of solar PV panel. Such non- uniformity should be natural.

Shown in figure 1 to 4 are the current voltages or IV curves for solar panels in all condition: clear plastic sheet, plastic sheet coated by sand, with cement and with carbon particulates for a fixed irradiation value.

Figure : 1

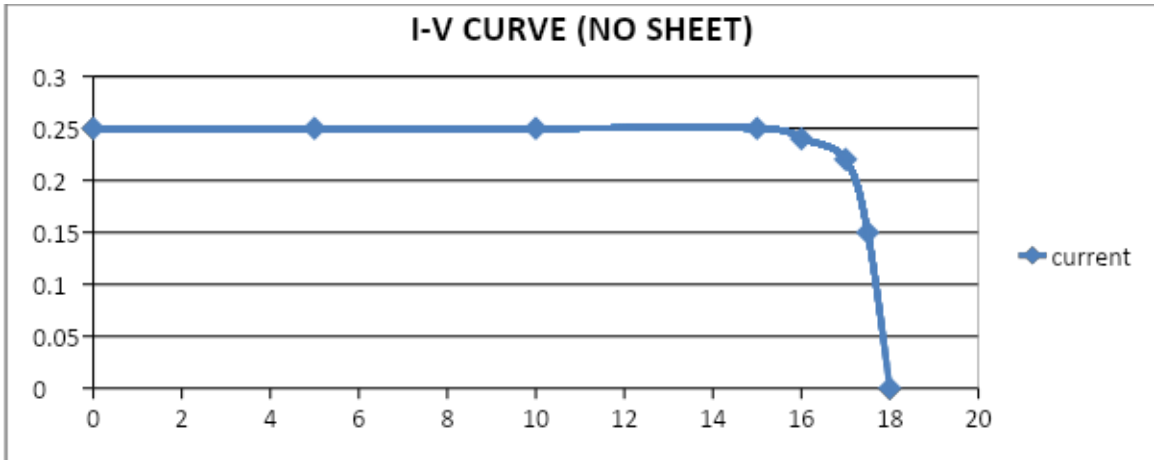


Figure2

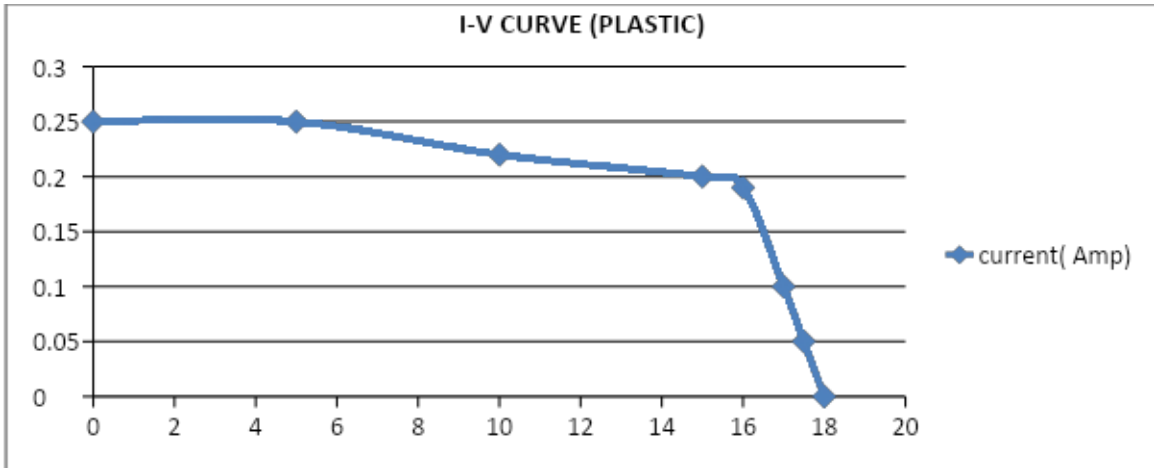


Figure- 3

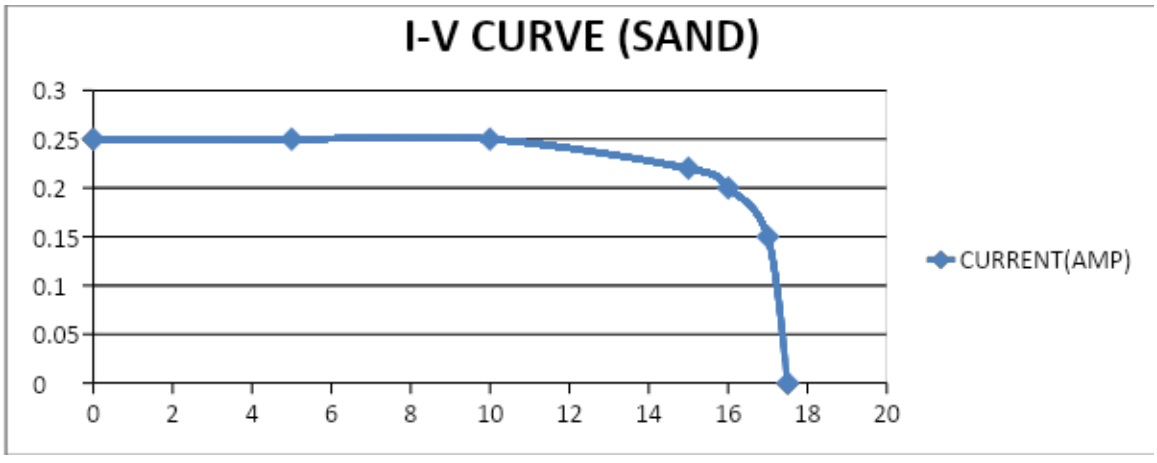
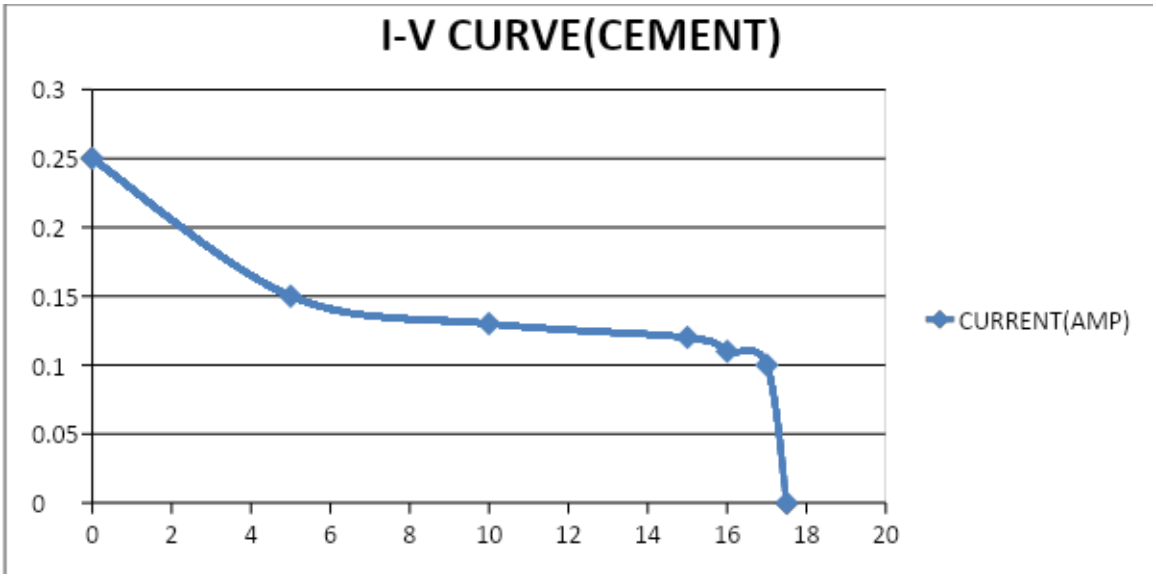


Figure-4



In general the trend of current- voltage characteristics in shown to be similar with that of typical solar panel. Since the area under the curve would represent the electrical power of the solar PV panel, it can be summarized when the panel is not covered by layer of dust, highest power may occur. With the introduction of dust, cement and carbon particulates, the area within the curve become smaller, implying the reduction in energy generated. The peak power which is normally represented by the top corner point of the curve also shows the same trend of reduction due to presence of dust and other particles.

We tabulate the peak powers of the solar PV panel under each experimental condition. The Peak Powers were obtained from calculations using the measured value of current and voltages.

Condition	Peak Power W/m2
No plastic	3.62
dean plastic	3.16
sand	3.49
cement	1.73
carbon particulate	2.41

Here we noticed that highest Peak occurred when the panel was not covered. The clean plastic decreases the power slightly and sand, cement etc. reduce the efficiency of solar panel.

Conclusion

Dust cement and other carbon particulate has an effect on the performance of solar PV module. Hence in practice, those must be removed from the surface of solar PV panel in order to ensure highest of performance. It can be stated that in the case of crystalline silicon PV module, a natural cleaning of it by rainfall, melting snow, wind and gravitational forces is not sufficient. To maximize the output of solar PV modules and reduce the degradation caused by dust accumulation frequently cleaning is strongly recommended.

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