ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Issue 5, May 2018

An Innovative Method of Solar Panel Cleaning System

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Abstract: In this project the proposed concept is to clean the solar panel using wiper mechanism. Now-a-days automation plays a vital role in all industrial applications however the proper cleaning of solar panel used in industries and commercial purposes are still a challenging task. Solar panels are designed to absorb the solar radiation from the sun as a source of energy for generating electricity or heat. The utilization of solar panel over a long period of time is difficult due to the accumulation of dust particles and so its efficiency will be reduced. To improve the efficiency of solar panel, we fabricated a "Solar panel cleaning system using wiper mechanism". Automatic solar panel Cleaning System proposed to overcome the real time problems with the continued expansion of industries.

Keywords: Solar Panel, Accumulation, Heating.

I. INTRODUCTION

Solar panel refers to a panel designed to absorb the sun rays as a source of energy for generating electricity or heat. A photovoltaic (pv) model is packaged in a way it constitutes an array of 60 cells**.** Photovoltaic modules constitute the photovoltaic array of photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is related by its dc output power under standard test conditions (stc) and typically ranges from 100 to 365 watts. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for storage, interconnecting wiring and optionally a solar tracking mechanism. Depending on construction, photovoltaic modules can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar range. Hence, much of the incident sunlight energy is wasted by solar modules and they can give far higher efficiencies if illuminated with monochromatic light

II. KEY PROBLEM

A number of environmental factors such as wind speed, humidity, ambient temperature, solar radiation, atmospheric dust and direction influence the power generation process using installed solar photovoltaic modules. Dust build-up on solar module surface is an issue of great worry, particularly in desert provinces where infrequent to regular dust storms do occur.

The glass cover transmittance decreases because of accumulation of dust on the surface of PV module, which ultimately decreases the amount of solar irradiation reaching the cells. The dust density of the surface, orientation, the tilt angle, exposure period, dominant wind direction, and site climatic conditions determines the reduction in glass transmittance [1,2].The density of deposited dust, the composition of the dust and its particle distribution determines the effect of dust on the power output and current -voltage (I~V) characteristics of PV modules [3,4]. Surveys in Saudi Arabia to study the effect of dust amassing on power production of solar module have revealed that power provided by the modules declined constantly due to dust addition [6].P max which is the average of daily peak power output in a month, for the period of the investigation .The modules power outputs reduced by twenty percent due to a single dust storm in March irrespective of the technology and evaluation. In November, the power production for all the modules amplified to their uppermost values due to rainfall; however it did not recover fully to the original power output at the beginning of the examination. Nevertheless, in one cleaning routine (Dec-Mar) in which the modules was cleaned in a week, the power outputs of the modules remained high. Without further cleaning from April, the power productions began to reduce again. When PV modules are exposed to real outdoor condition for a long

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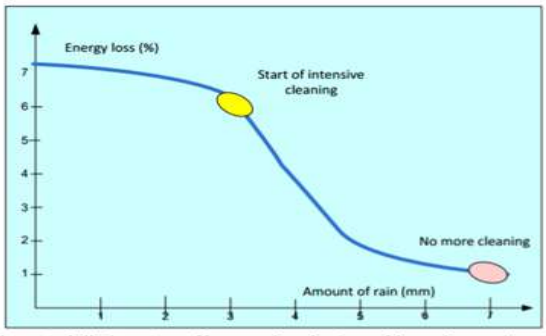
period, it was observed that the performance decreases gradually with dust build-up lest the modules are cleaned by rain or human action. The power output decreases by more than half if no cleaning is accomplished on modules that exceeds six months. Reduction in power output due to dust build-up does not depend only on the length of module exposure, but also on the occurrence and strength of dust. Subsequently, it is suggested that installed PV modules should be cleaned at least once in two weeks. Nevertheless, in the time when sandstorm occurs, immediate cleaning of the solar modules should be performed .It was observed that rainfall improved the power production of dusty solar modules, yet it cannot be trusted upon for cleaning since it is not foreseeable.

III. Cleansing Effects Of Rain

Cleansing effect of rain is to be considered calculating annual loss due to the contamination. However, assessing this impact is difficult. There are two important factors to be highlighted. One is the amount of rain falling at once, and the other temporal occurrence of rains. Significant treatment effects on the panels, thereby reducing the percentage of loss only causes a high amount of rainfall. The intensity of soiling of PV modules is the greatest usually on summer dry period. In this case, the cleansing effect of rain is minimal. As the level of radiation and hours of sunshine in the summer are the biggest, this is way soiling of panels caused the greatest loss in electricity generation during this period of year. In summary, the amount and timing of rainfall occurrence in a calendar year hardily influence the selection of solar system cleaning strategy. If the previous year the cleaning of solar modules is cancelled, the rains are less relevant treatment effect. The reason is that the dirt will burn on to the surface so that they become difficult to remove. Apart from the very rainy climate, at least one cleaning per year for PV modules is essential.



IV. Design Of Solar Panel Cleaning System

PTC CREO 3.0 makes it easier to bring engineers ideas from concept to manufacturing with new tools for more efficient simulation, and expanded environmental factor analysis. In addition to the following enhancements, the recently announced Solid Works Plastics package help users make more informed decisions that result in simplified designs, reduced mistakes and faster time to market.

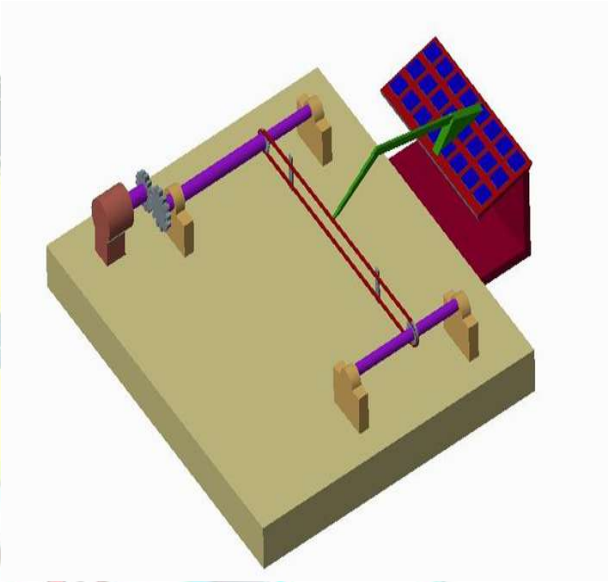


Fig 4.1. Isometric view of cleaning system

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V. DESIGN CALCULATION

SL. NO.	COMPONENTS	PARAMETERS	CALCULATION VALUES
1	Shaft	Bending Moment	M_t = 334.22 × 10^3 N-mm
		Diameter	D=32.40 mm
2	Spur gear	Gear ratio	i = 3.
		Initial torque	M_t =490.08 N-m
		Bending Stress	σ_b =111.23N/mm^2
		Compressible Stress	σc = 852.64 N/mm^2
		Centre distance	155 mm
		Module	m=5 mm
		Pitch line velocity	v=5.34 m/s
		Induced contact stress	σ_c =756.9N/mm^2

VI. EXPERIMENTAL SETUP

Two shafts are connected using a conveyor belt. The conveyor belt is connected with a wiper and also a limit switch as shown in the fig. 6.1. When the motor is switched ON, it makes the shaft connected with it to rotate in clockwise direction. When shaft rotates it makes the conveyor belt to rotate between the shafts, this turns the wiper ON which cleans the solar panel glass covering. Once the wiper reaches the extreme position of the solar panel, Limit switch is activated and the shaft starts to rotate in the anti clockwise direction. This makes the wiper to clean the solar panel in the opposite direction also.

Fig. 6.1 Photograph of cleaning system

ADVANTAGES

- Autonomous self-cleaning mechanism that can be attached to solar panels and operated with human operation.
- Project will maximize the efficiency of the solar panels.
- Easy to construct, low cost and low maintenance.
- In future the dust detecting system allows for the system to be cleaned only when necessary.
- The reduced voltage from cloudy day wouldn't "fool" the system into thinking that it needs to be cleaned.
- This system is applicable for both the indoor and outdoor environment.

VII. CONCLUSION

The presence of solar panel dust was removed by using wiper mechanism. The dust has a major impact on the efficiency and performance of the solar panel. This mechanism is actuated by an electric motor and the rotary motion of the motor is converted into oscillatory motion with the help of Rack and pinion mechanism. The wiper blade moves over the solar panel and the accumulated dust on the panel is removed. It is observed that, the efficiency

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of the panel is much improved by using this cleaning method. Also, there is an increase in power of solar panel. This is easily maintainable and low cost. Power consumption is also less for this process.

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