AUTOMATIC MECHANISM OF SOLAR PANEL CLEANING SYSTEM IN SOLAR POWER PLANTS

N.B.V.Lakshmi Kumari [1],Abdullah [2],Iqbal Ahmed Shariff[3],Taha Naveed Shibli[4],Anas Mohammed Ajaz[5]

[1]Assistant Professor , Mechanical Eng. Dept., Muffakham Jah College of Engineering and Technology, India,
[2,3,4,5]Student(BE) , Mechanical Eng. Dept., Muffakham Jah College of Engineering and Technology, India.

Abstract

Renewable energy is generally defined as energy that is collected from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services.

Renewable hydroelectric energy provides 16.3% of the world's electricity.Solar energy, radiant light and heat from the sun, is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, concentrated solar power (CSP), concentrator photovoltaics (CPV), solar architecture and artificial photosynthesis.The solar panel efficiency rating measures what percentage of sunlight hitting a panel gets turned into electricity. As the efficiency of the solar panel is the most vital in solar energy .In the present research paper a system for solar panel cleaning is designed and simulated considering the design considerations.

Key Words : Solar ,Solar Panels, Efficiency.

1.INTRODUCTION

Renewable energy resources and significant opportunities for energy efficiency exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. . Renewable energy also reduce environmental pollution such as air pollution caused by burning of fossil fuels and improve public health, reduce premature mortalities due to pollution and save associated health costs that amount to several 100 billion dollars annually only in the United States.

Hydroelectric energy is by far the most prevalent, accounting for 83% of the world's electricity generation from renewable sources. This is most likely because the requisite technology to generate electricity by harnessing the flow of water has been around the longest, dating back to the early 20th century. Wind energy is the next largest, at just over 7% of the electricity generated from renewable sources, followed by biowaste and biomass energy (7%), geothermal energy (2%), and solar, tidal, and wave energy (less than 1%).

Global renewable power production increased by 6.3% on the year in 2017, mainly due to wind, solar and hydropower capacity additions, and green sources covered 25% of the world's power demand.

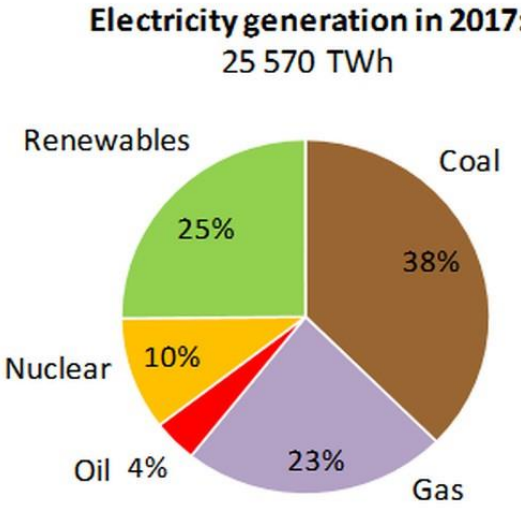


Fig1.Global Energy Scenario

By technology, wind and photovoltaic (PV) power contributed the most to growth in the year with shares of 36% and 27%, respectively. For solar in particular, China was the driving force on that market with over 50 GW of new capacity additions.

Most of the photovoltaic cells on the market today operate at an efficiency of less than 15%; that is, of all the radiation that falls upon them, less than 15% of it is converted to electricity. The maximum theoretical efficiency for a photovoltaic cell is only 32.3%, but at this efficiency, solar electricity is very economical.

As the primary element of construction of solar panels, silicon, is the second most common element on the planet, there is very little environmental disturbance caused by the creation of solar panels.

2. TYPES OF SOLAR POWER GENERATION

Solar power plants use one of two technologies:

2.1 Photo Voltaic Cell

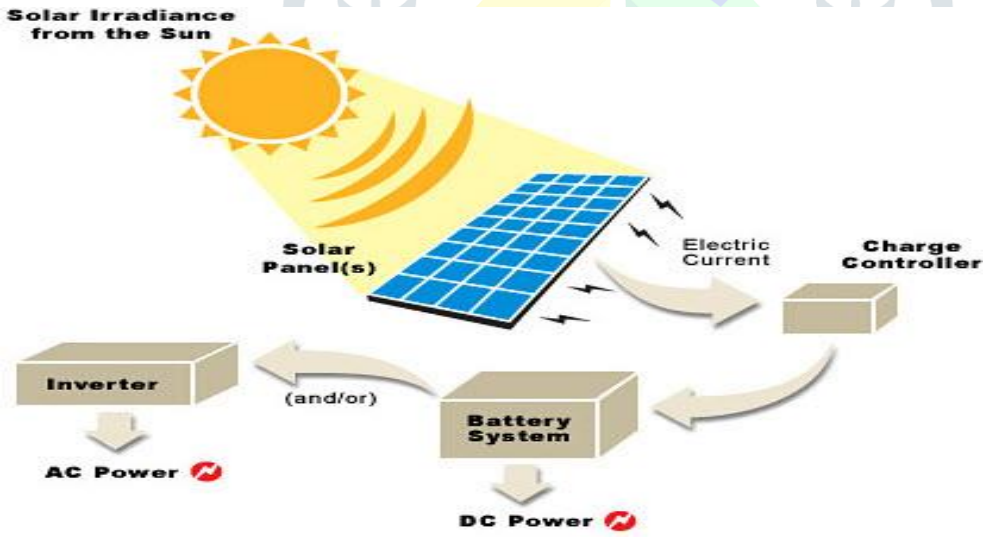


Fig2.Block diagram of Photovoltaic power generation

The array of a photovoltaic power system, or PV system, produces direct current (DC) power. For practical use this usually requires conversion to certain desired voltages or alternating current (AC), through the use of inverters. Multiple solar cells are connected inside modules.

2.2 Concentrated Solar Power

Concentrated solar power (CSP), also called "concentrated solar thermal", uses lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Contrary to photovoltaics – which converts light directly into electricity – CSP uses the heat of the sun's radiation to generate electricity from conventional steam-driven turbines.

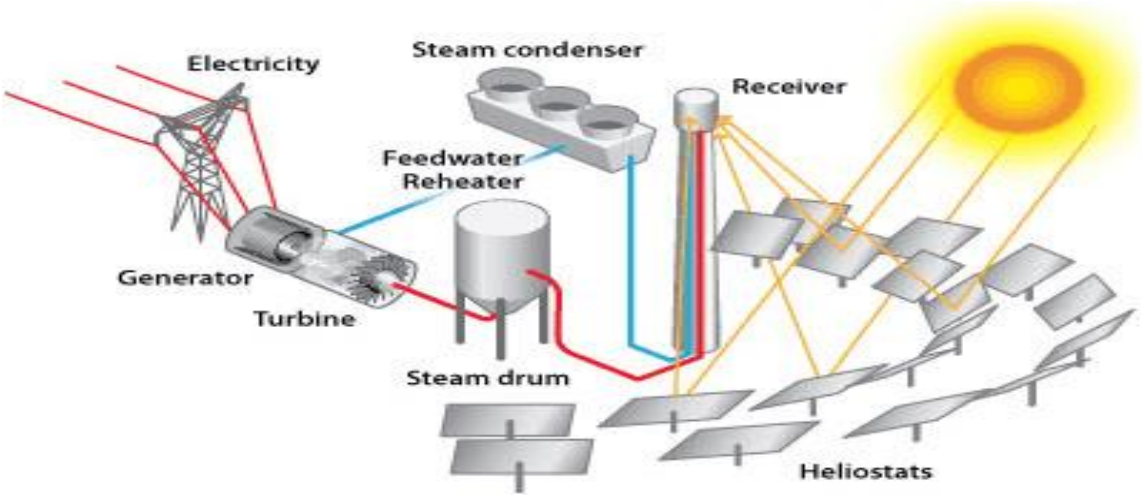


Fig.3 Concentrated Solar Power System

A wide range of concentrating technologies exists: among the best known are the parabolic trough, the compact linear Fresnel reflector, the Stirling dish and the solar power tower.

3. SOLAR POWER PLANT SETUP

The following design of Cleaning system(our project) is been made under the authority of Aryhama solar power plant located at Kolanpak village, AlierMandal, Nalgonda District. Andhra Pradesh, India**.**

.

3.1 EFFICIENCY OF SOLAR POWER PLANT

Theenergy conversion efficiency(η) of asolar cellis the percentage of thesolar energyto which the cell is exposed that is converted intoelectrical energy.

This is calculated by dividing a cell's power output (inwatts) at its maximum power (Pm) by the irradiance (input light),*E*, in W/m2and thesurface areaof the solar cell (*A*cin m2).

$$\eta_{max} = \frac{P_{max}}{E * A_c} \text{ X } 100\ \%$$

The solar panel efficiency rating measures what percentage of sunlight hitting a panel gets turned into electricity. High efficiency doesn't mean better it just means you use less space for the solar array.The typical solar panel efficiency rating is around 14-18% efficient.

3.2 Factors that Affect Solar Panel Efficiency

Besides solar panels efficiency and size, there are other factors that affect how much power your solar panels will create.

- Solar Panel Pitch and Orientation
- Temperature
- Shade
- Front surface soiling

High temperature can severely reduce the solar panel's production of power. Higher temperature increases the conductivity of the semiconductor, charges become balanced within the material, reducing the magnitude of the electric field, inhibiting the charge separation, which lowers the voltage across the cell. Depending on the location, heat can reduce the output by 10% to 25%.

Solar cells cannot absorb light as effectively when the surface of the solar panels are covered with dirt or pigeon droppings, which doesn't get washed by the rain. Making frequent physical inspections and spraying water on your modules can help reduce the problem.

4.METHODTO KEEP THE SOLAR PANELS CLEAN AND FREE FROM DUST AND DIRT

The best method is to install a **self cleaning** system at the time of the installation of power plant, this can help economically and increases the production by a large margin.

4.1 THE MECHANISM

The Base is the part that supports all the other parts involved in the mechanism. The base contains the slider system at the side to which the sliding block is coupled and sliding block slides along the side of the base with the help of a sliding mechanism. The base also contains a rack on the top where the rod is fixed with the help of pinion for the forward motion of the rod

The main purpose of the sliding block is to carry the motor. The motor is rested and fixed on the upper portion of the sliding block. The rod is coupled to the motor directly

The rod has two gears attached on either side which move in mesh on the rack provided on the base for the forward motion of rod. So the rod has both rotating and linear motionwhich cleans the solar panel with a to and for motion.

The base is placed on an inclined setup matching the inclination of the solar panels and the motor is started. The motor drives the rod and the rod in turn moves forward carrying the slider along with it with the rack and pinion mechanism on the base and sliders on the side. Thus one to and fro motion will help clean the solar panels with the help of water and cloth attached on the rod with some pores on it.

4.2 USING SOLID WORKS SOFTWARE METHODOLOGY
DESIGN AND MODELLING

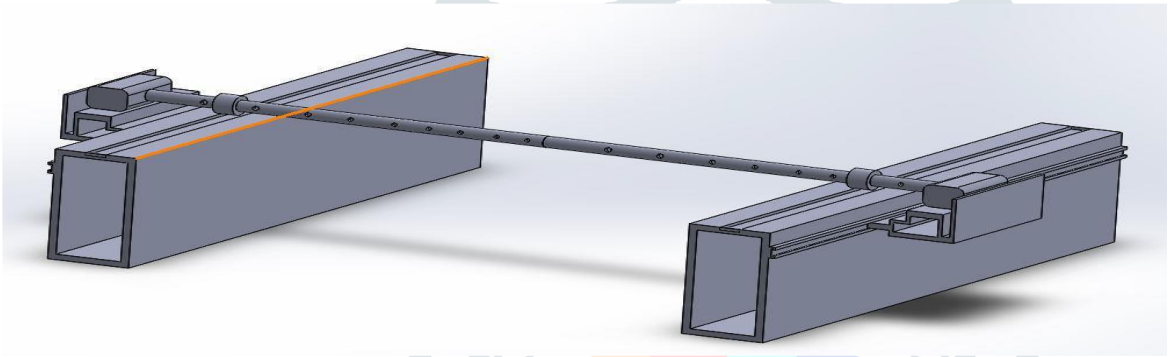
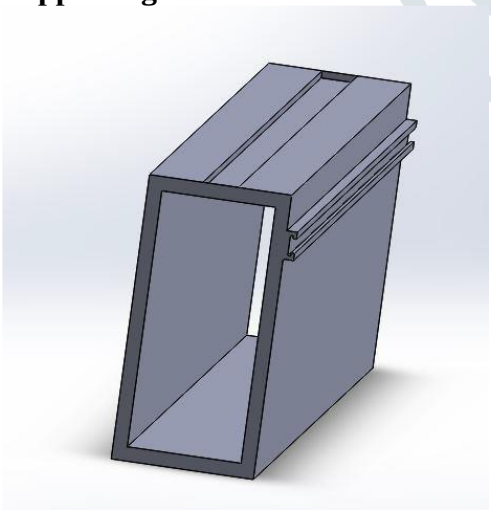
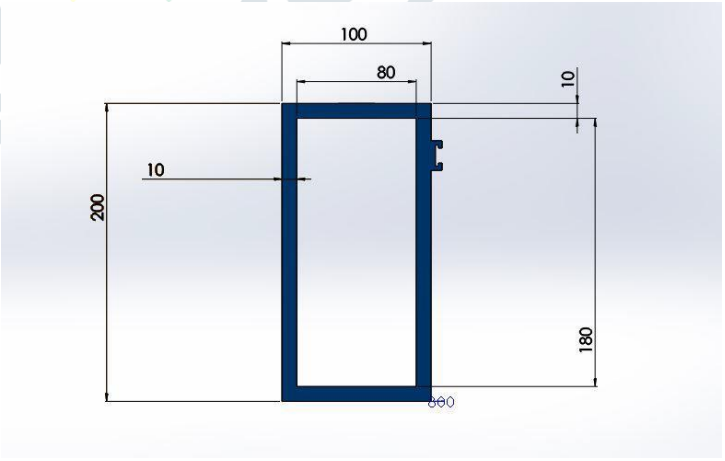


Fig.4 Isometric view

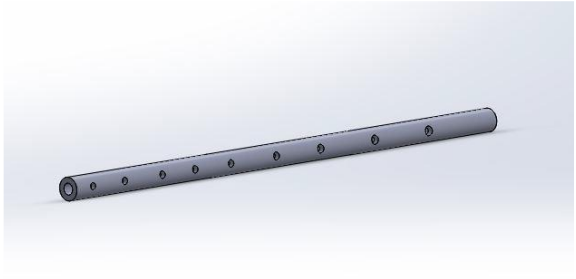
4.2.1 INDIVIDUAL PARTS DESIGN AND MODELLING :

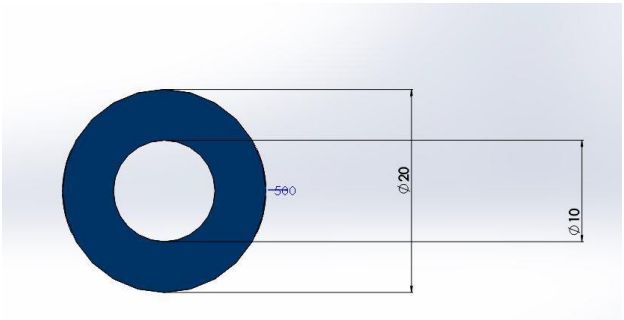
Supporting Base:



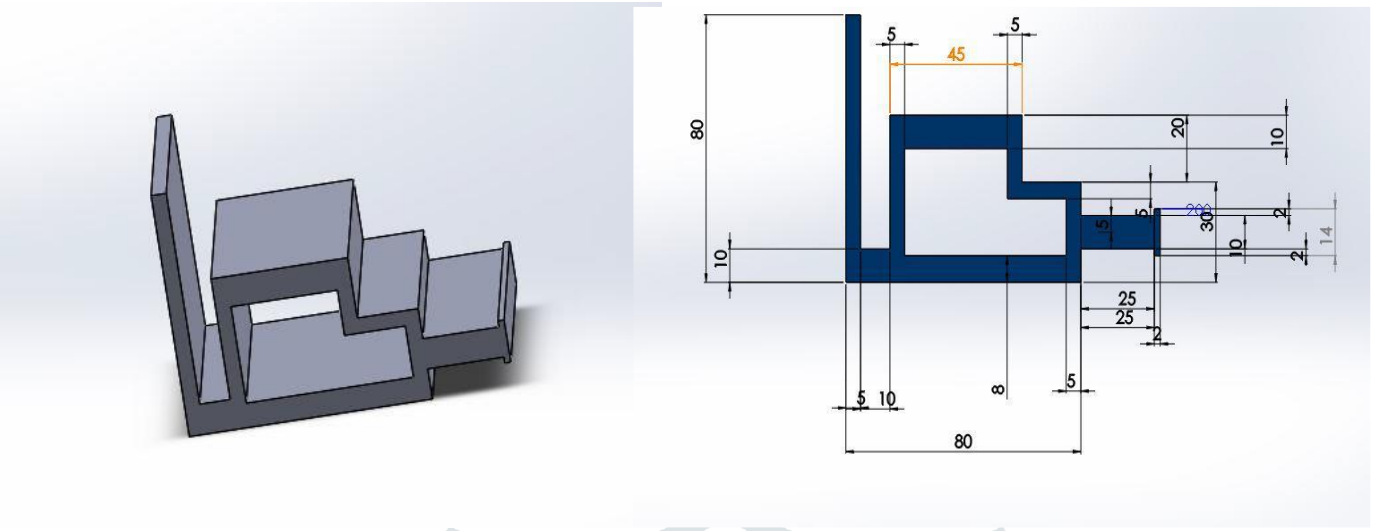


Rod:





Sliding Block:



5.RESULTS AND CONCLUSIONS:

5.1 RESULTS

The estimation of the turnover of a solar power plant

- The usual benchmark for energy generated from a 1 MW Solar Power plant is considered as 1 Million units.(may vary)
- So for 6MW plant the units produced are 6 Million units
- The average price of selling the power in INDIA is Rs.5.5/unit
- So for 9 million units the total turnover of a 6 MW power plant will be (6 million * 5.5) = 3.3 crores Indian rupees

5.2 LOSS DUE TO LOW EFFICIENCY

That loss may range as high as 25% in some areas according to the National Renewable Energy laboratory. Individual dealers have reported losses as high as 30% for some customers who failed to ever clean their panels.

- So considering a Loss of 10% efficiency by dust
- 10% loss implies a loss of 6 Lac units which means a loss of 33 Lac indian rupees
- So increasing the efficiency by 10% will result in a profit of 33 lac

That is the reason cleaning is required and we have based our research project in this field

5.3 CONCLUSION

- The given automated system was modelled and Designed accordingly.
- This model is designed to help the solar power plants to clean the solar panels efficiently and hence increasing the productivity and efficiency of the solar panels and the Power plant.
- The modelling is done with the economical type of mechanism involved in the cleaning process which will cost low and help increase the power production of the solar power plant.

References

1. FAHRENBRUCH, A. L., & BUBE, R. H. (1983). *FUNDAMENTALS OF SOLAR CELLS.* New York: ACADEMIC PRESS.
2. LEWIS, N. S., & NOCERA, D. G. (2006). Powering the planet: Chemical challenges in solar energy utilization. *PNAS*, 15729-15735;.
3. Rajput, D. S., & Sudhakar, K. (2013). Effect Of Dust On The Performance Of Solar PV Panel. *International Journal Of ChemTech Research*, 1083-1086.