A Review on Solar Energy Collecting methods and Improvements

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Abstract- *Solar power has gained much popularity in last two decades and with ever increasing demand of energy it promises to be one the most finely available energy resources in the world. The technique of converting sun radiation into electricity is termed as solar power. The following paper contains literature survey throwing light upon the various solar collecting methods and ways to increase its efficiency.*

Keywords: Solar collectors, Photogalvanic cell, Efficiency, Sun tracking.

I. INTRODUCTION

Solar power is a form of energy harnessed from the power and heat of the sun's rays. It is renewable, and therefore a "green" source of energy. The reason for it to be a "green" is that, like wind power, solar power is a virtually unlimited and inexhaustible resource unlike power produced from expendable fossil fuels. As technologies improve and the materials used in PV panels become "greener," the carbon footprint of solar power becomes smaller and smaller and the technique becomes more accessible to the masses.

II. METHODS OF HARNESSING SOLAR POWER

The most common way of harnessing energy from the sun is through photovoltaic (PV) panels – those large, mirror-like panels you've likely seen on rooftops, handheld solar devices, and even spacecrafts. These panels operate as conductors, taking in the sun's rays, heating up, and creating energy.

On a larger scale, solar thermal power plants also harness the power of the sun to create energy. These plants utilize the sun's heat to boil water and, in turn, power steam turbines. These plants can supply power to thousands of people.

Other solar technologies are passive. For example, big windows placed on the sunny side of a building allow sunlight to heat-absorbent materials on the floor and walls. These surfaces then release the heat at night to keep the building warm. Similarly, absorbent plates on a roof can heat liquid in tubes that supply a house with hot water.

III. REVIEW OF WORK DONE

Prakash Kumar Sen et.al.[1] studied the performance, application and efficiency of a flat plate solar collector at various flow rates. A usual flat-plate collector is made up of an absorber which is kept inside an insulated box together with transparent cover sheets (Glazing). Its surface is coated with a selective material to maximize radiant energy absorption. These collectors are used to heat a liquid or air to temperatures less than 680°C but the loss due to emissivity is high in these forms of collectors. They have designed a new collector by combining standard flat plate collector along with low-el double glazing. They designed a prototype collector with an indium tin oxide (ITO) low-e coating applied in the argon-filled glazing. The lower glass pane have a low iron content and coated on one side with ITO coating system that give out solar transmittance of 86.5 %. If an auxiliary antireflective coating is put on the opposite side of the glass pane, the solar transmittance is increased to 89 % and leads to the reduction in thermal emissivity from 83 % (uncoated glass) to 30 %. Theoretical and experimental analysis was performed on a flat plate collector with a single glass cover. It is observed that the emissivity of the absorber plate has a major impact on the top loss coefficient and consequently on the efficiency of the Flat plate collector. The efficiency of FPC is found to increase with increasing ambient temperature.

Ayush Khare et.al.[2] designed a parabolic solar collector with principal focus at 0.3m so as to reduce the heat loss by receiver and lowering the defects. This system can be well utilized for water heating purposes. Parabolic- trough collectors are widely employed for solar steam-generation as temperatures of about 300˚C can be obtained without any serious degradation in the collector's efficiency. The collector is made in a profile of parabola. The design parameter is classified in geometrical and functional. The geometrical parameters include width, length and focal length while functional parameter includes various types of efficiency. The primary plan for a solar concentrator was to use semi-spherical surface roofed with many small sections of mirror to form a

segmented, spherical concentrator. Referring to the optics section of a University Physics textbook it was found that the focal point of a spherical mirror should be situated at a space of half of the radius of the spherical section, directly on top of the vertex of the sphere. It was found out that remarkable technology break through to make parabolic-trough solar water heating economically attractive in areas with less sun or for facilities that have low cost conventional energy available. Further improvement in mirror and coating technology will further enhance its efficiency.

Sawsan A. Mahmoud et.al.[3] studied the performance of photogalvanic cell storage using Rose Bengal – Oxalic acid – CTAB System. A H-shape glass tube was used for the experiment with proper amount of oxalic acid, CETAB and NaOH. A platinum electrode of varying cross-section was dipped in one member with a window and a saturated calomel electrode (SCE) was absorbed in another member of the H-tube. The terminal of the electrode were connected to a digital pH meter and the whole cell was placed in the dark. The potential (mV) was measured in the dark when the photogalvanic cell attained a stable potential. Then, the member containing platinum electrode was exposed to a 200 W tungsten lamp as a light source. A water filter was placed between the illuminated chamber & the light source to cut-off infrared emission. The photo potential and photo current generated by the system was measured with the help of the digital pH meter and micro ammeter, respectively. It was concluded that the Rose Bengal system is the most effective among the various systems being utilized for the same and research must be carried out to achieve further advancement in its conversion and storage capacity.

Musa Yilmaz et.al.[4] works throws light upon utilization of self designed solar tracking system and reducing the energy consumption of tracking system so that more electric energy can be generated in Turkey's highly abundant solar energy area. There design of tracking system mainly emphasized on two parameters one is sun tracking and the other being the solar angles. For proper tracking of sun they have used an actuator motor instead of a mechanical DC motor as the latter one cannot track exact position of the sun and also requires a separate circuit for its working. The actuator motor can change position based on control signals. For solar angles, earth is considered to be fixed and the sun spins around north-south axis. The solar declination angle (δ) is between the plane of the equator and a line drawn from the center of the sun to the center of the earth. It varies between +23.450 and - 23.450 degree. Experiment was carried out on the roof of the building with both fixed as well as tracking panel. It led to the result that efficiency of the system has increased significantly by 31% and during winter months the tracking system based panel deliver higher efficiency in comparison to normal system.

K Prasada Rao et.al.[5] proposed the development of inverter for proper energy capture of solar energy by using a controller. The work also focuses on solving the irradiation problem hugely faced and eliminating by using a voltage and current control loop. A Solar inverter or PV inverter is a type of electrical inverter that is made to change the direct current (DC) electricity from a photovoltaic array into alternating current (AC) for use with home appliances and possibly a utility grid. In this controller, the d-axis grid current element reflecting the power grid side and the signal error of a relative–integral outer voltage regulator is planned to reflect the change in power cause by the irradiation difference. Hence, with this information, the proposed algorithm can greatly decrease the power losses caused by the lively tracking errors under quick weather changing conditions. The result shown by the simulation and experimental techniques also supports the advantage of the system. Along with it the current MPPC method allows us to differentiate the part of increment perturbation and irradiation change in power variation, hence identifying the correct way of the MPP.

Julia Marin-Saez et.al.[6] studied energy analysis of holographic lenses for solar absorption. The use of holographic elements in the design of photovoltaic solar concentrators has become very common as an alternative solution to refractive systems, due to their high efficiency, low cost and potential of building integration. Holographic Optical Elements (HOEs) are a versatile technology and has multiple applications. One of the common application is solar absorption, for which different configurations have been studied. With the adequate design, both holographic gratings and cylindrical and spherical lenses can act as solar concentrators. Efficiency of HOEs increases for a particular range of wavelength and incident angle. For analysis three wavelength were selected which are 532, 632.8 and 800 nm mark wavelength. The lenses used need to meet the Bragg condition at the centre of lens and the analysis is done on MATLAB software. They ensure that the whole HOEs operate at the volume regime when reconstructing with $\lambda = 800$ nm. The high angular selectivity of holographic lenses working in the volume regime may be a downside in solar concentration application, even if tracking in the direction of utmost selectivity is carried out. The analytical results showed that holographic lens working in both volume & transition regime is more useful than the one working in volume regime as it has much greater efficiency.

Pakhare Priyanka Anant et.al.[7] studies the dual axis tracking system and energy distribution using Light Dependent

Resistor(LDR).It is to detect light intensity change on the face of the resistor. The proper and well-organized use of LDR also reduces the overall cost and complication of the system. The resistivity of LDR decreases with increase in illumination. The working system comprises of arduino which has both analog as well as digital input and output. The system depend on luminosity of sun for proper functioning, The sun rays are fall on solar panel and LDR's. After that this value is feed to the arduino which is analog in nature. If this value is greater or equal to the predefined value then maximum energy is generated and panel will not move but if this value is less than that of predefined value then arduino sends signal to the driver circuit and solar panel starts to rotate. After tracking some angle if the LDR gets value equals to predefined value then driver circuit is stopped by arduino. For dual axis system two LDR's are utilized. The arduino utilized is 8051, PIC ARM. The results shows that the output is increased by nearly 40%.

Shui-Jinn Wang et.al.[8] worked on increasing the efficiency of crystalline silicon solar cell by using Graded-Refractive-Index SiON/ZnO Nanostructures. Surface roughening is of huge interest in accordance with solar cells as it helps in increasing the reflectivity. Zinc oxide (ZnO) is a promising material for surface roughening. It has a wide direct band gap (3.37 eV at room temperature), large exciton binding energy (about 60 meV). One-dimensional ZnO nanowire (NW) arrays have received great attention due to their ease of fabrication, low-temperature processing, and unique properties, such as large length-to-diameter ratio, high surface-to-volume ratio, and carrier captivity, which could advance device performance. Four types of SC, namely, SC-A, SC-B, SC-C, and regular SC, prepared in this study. The regular SCs, prepared using the standard fabrication process, had a KOH-etched micropyramid surface and a Si3N4 antireflection (AR) coating. The light reflectance and refractive indexes of the prepared SiON films and ZnO nanostructures were characterized using a spectrophotometer and an ellipsometer, respectively. The outcome reveal that a 150nm thick SiON film deposited atop ZnO NT arrays does not significantly absorb sunlight where as It can be seen that the SiON/ZnO NT arrays have the best antireflective properties (around 10%) in the visible-light spectrum, while the ZnO NWs arrays have reflectance of about 14%. It was further found that enhanced energy conversion Efficiency enhancement ($\Delta\eta/\eta$) SCA, SC-B, and SC-C show $\Delta\eta/\eta$ increases of 39.2%, 27.6% and 19.2% respectively.

Omar Behar et.al.[9] studies the effect of tracking system on the parabolic trough solar collector in three regions of Algeria, Egypt and Spain. Four tracking orientation of collector are used which are Collectors rotate about east-west axis with daily adjustment, Collectors rotate about east-west axis with continuous adjustment, Collectors rotate about north-south axis with continuous adjustment & Collectors rotate about north-south axis parallel to the earth's axis with continuous adjustment. Before comparing the results each solar field is evaluated on the basis of solar time, incidence angle of collector & sun elevation. The amount of energy collected during the various seasons from four modes is recorded in graphical format and tells us regarding which modes collect more amount of energy during which season of the year. The research led to the following conclusions i.e. North-South collector with continuous adjustment absorbs a lot of energy in summer, East-West continuous adjustment and East-West Daily Adjustment collector absorbs more energy in the winter & North-South with axis parallel to earth with continuous adjustment has a poor performance in summer and winter.

IV. CONCLUSION

From this review, numerous ways of harnessing solar energy and ways to increase their efficiency can be brought into light with the help of the reference paper given below. The proper selection of methodology for capturing energy mainly depends upon the location of solar field along with economic practicability. Further development in this field will lead to a better tomorrow. With the dual axis automatic sun tracking mechanism large amount of energy can be harnessed and the efficiency can be increased to great extent.

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