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Comparison between Normal and Hybrid Higher Efficient Solar Energy System

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Abstract

The relevance of the renewable sources increases day by day. Renewable energy is reliable and plentiful and will potentially be very cheap once technology and infrastructure improve. Solar energy is the renewable energy resource which is relatively inexpensive. The reason for its being getting famous is its availability and abundance. In the existing systems we are not using the combination of PV & CST, as the heat generation in the panel reduces the efficiency of the system. In the proposed system (maximum power point tracking efficient solar energy system) the light and heat form of energy is utilized. Solar tracking & power management using the micro controller are included in the HES energy system. In addition to that maximum power point tracking is used by this system become more efficient. Cooling the panel to improve the efficiency, the same water is used to generate the steam, by combining the energy generated in the two forms and storing in the battery. HES energy system offer higher efficiency compared to any of the existing systems.
Keywords: solar energy, photovoltaic thermal energy, cooling system, MPPT, PV, CST

I. INTRODUCTION

Renewable energy is getting more importance in the global economy, and research and development investments in this area almost double in the past nine years, reaching $9.6 billion in 2012. A major part of these investments (51%) is being applied in solar energy, aiming to improve energy output of photovoltaic cells and efficiency of production processes [7] .Solar energy has been considered as a promising solution for the energy and environmental challenges and the global warming threat. We are suffering from an energy crisis and environmental pollution related to fossil fuel combustion. The Sun delivers energy to the Earth with power of 1.2× 105 TW, which is about 104 times of the rate at which human civilization currently produces and uses. Moreover, solar energy is clean, reliable, renewable, and environment friendly .Renewable energy is getting more importance in the global economy, and research and development investments in this area almost double in the past nine years, reaching $9.6 billion in 2012. A major part of these investments (51%) is being applied in solar energy; aiming to improve energy output of photovoltaic cells and efficiency of production processes Word demand for energy is projected to more than double by 2050 and more than triple by the end of the century [1]

There are two forms of energy is available from the solar, light and heat. The light energy is utilized by photovoltaic cells. The heat energy is utilized by using the concentrating solar thermal units (CST).Direct and efficient use of solar energy has been given high priority to address energy and environmental issues. Photovoltaic (PV) technology can directly convert solar energy into electrical energy without any emissions. Since the first recognition in 1839, PV technology has achieved tremendous progress. However, there is still much effort needed in the aspects of efficiency improvement and cost reduction. [5].there is so many methods used to improve the efficiency of the photovoltaic systems like solar tracking. Maximum power point tracking etc. by using the solar tracking the availability of sunlight in the panel is increased. Mppt improves the efficiency and stability of the system by providing constant output.

Concentrating solar power (CSP) systems which use concentrated sunlight to run steam turbines have been receiving a lot of attention in recent years as a potential low cost alternative to photovoltaic cells. [6]The question of storing of the heat generated by sun's energy was solved by Molten-salt thermal energy storage in which liquid salt at 290ºC is pumped from a 'cold' storage tank through the receiver where it is heated to 565ºC and then on to a 'hot' tank for storage. When power is needed, mixture of nitrate salts as the thermal storage medium for power tower concepts using single-phase receiver fluids, the best of which was a 60% sodium nitrate 40% potassium nitrate molten salt [6]In residences, solar heat is usually used to produce hot water or hot air for acclimatization there are two forms to heat water for bathing: using a passage heater or a centralized heater.[7]Similar to the storage of electrical energy, the Heat Battery is an energy carrier used to store solar energy in the thermal form. Solar energy is available few hours a day with different intensities with the possibilities of overcast days. [8].

II. RELATED WORKS

In recent years, introduction of alternative energy sources such as solar energy is expected. The solar heat energy utilization systems are rapidly gaining acceptance as some of the best solutions for the alternative energy sources. However, thermal energy collection of solar heat energy utilization system is influenced by solar radiation and weather conditions. In order to control the solar heat energy utilization system as accurate as possible, it requires method of solar radiation estimation. 24-hours thermal energy collection by using three different NN models. This technique for application of NN is trained by weather data based on tree-based model, and tested according to forecast day. Since the tree-based-model classifies the meteorological data exactly, NN will train the solar radiation with smoothly. This method is confirmed by computer simulations by use of actual meteorological data. [2]The merit of this method is that it requires only meteorological data. In fact, it is possible to forecast preferred results by using only meteorological data in short time. The validity of this method is confirmed by the computer simulations at one-day ahead 24-hours thermal solar collection forecasting.[2]The heat pump is a kind of device that can transfer heat from the cryogenic heat source to the high-temperature heat source through consuming less of the normal energy, according to the different heat source, divided into the air source heat pump, the water source heat pump and the ground–source heat pump, etc. [2]. Hybrid energy supply system of solar energy and ground-source heat pump. In this system, adopt the heat-pipe type vacuum tube collector to gather the solar energy, the ground energy is transferred through the ground–source heat pump system. This system combines by the solar energy collectors, the ground–source heat pump and the heating equipment. It can satisfy the demand of building to provide the heat in winter and the cold in summer, and also can satisfy the demand with the hot water at the same time. [3].

A novel hybrid solar system has been designed to utilize photovoltaic (PV) cells, thermoelectric (TE) modules, and hot water (HW) through a multilayered building envelope. Water pipelines are cast within a functionally graded material layer to serve as a heat sink, allowing heat to be easily transferred into flowing water through an aluminum-rich surface, while remaining insulated by a polymer rich bottom. The theoretical energy conversion efficiency limit of the system has been investigated for documenting the potential of this hybrid solar panel design. Given the material properties of each layer, the actual energy conversion efficiency depends on the solar irradiation, ambient temperature, and water flow temperature. Compared to the traditional solar panel, this design can achieve better overall efficiencies with higher electrical power output and thermal energy utilization.

Based on theoretical conversion efficiency limits, the PV/TE/HW system is superior to PV/HW and traditional PV systems with 30% higher output electrical power. However, the advantages of the PV/TE/HW system are not significant from experimental data due to the low efficiency of the bulk TE material. Thus, QW/QD TE materials are highly recommended to enhance the overall efficiency of the PV/TE/HW design. This design is general and open to new PV and TE materials with emerging nanotechnology for higher efficiencies. [4].Direct and efficient use of solar energy has been given high priority to address energy and environmental issues. Photovoltaic (PV) technology can directly convert solar energy into electrical energy without any emissions. Since the first recognition in 1839, PV technology has achieved tremendous progress. However, there is still much effort needed in the aspects of efficiency improvement and cost reduction. For the single-crystalline single junction Si technology, the conversion efficiency keeps lower than 30%. Thus, a large portion of solar energy is wasted through heat dissipation. Although some emerging technologies can considerably improve energy utilization efficiency, such as multi junction cells , optical frequency shifting , multiple excision generation cells , multiple energy level cells , hot carrier cells , and concentration PV system , these technologies require high cost and complex service conditions, and thus have not been commercially used in solar roofing panel yet.

Solar thermal technology provides another way to use the thermal energy of solar insulation. Solar thermal collectors have been applied to domestic (bathing, cooking, space heating, swimming pool heating, etc.) and commercial sectors (preheating of boiler, hospitals, etc.). However, the applications of solar thermal collectors are limited by heat demand and architectural esthetics. Thermoelectric (TE) module can be a good candidate for thermal energy harvesting. It can directly convert heat energy into electricity, which is determined by the temperature difference between two sides of the module. As a solid-state device without any moving parts, a TE generator can be completely silent and extremely reliable. It can be used for years to provide electrical power. However, the existing TE modules are quite expensive and their conversion efficiencies are low in no concentrated solar energy technologies.. Typically, energy payback time (EPBT) for solar thermal system is less than that of PV systems. The EPBT of PV system can be reduced by using it in a hybrid system integrating PV with solar thermal components, such as hot water (HW) tubes and TE. The combination of two or three of the approaches is not a simple superposition of the materials and costs, but provides a viable solution to significantly increase overall energy utilization efficiency while alleviating the disadvantages of a single approach. A PV-thermal collector enables heat harvesting while improving the PV utilization efficiency by controlling the temperature of PV modules. Currently, some groups have studied the performance of PV–TE hybrid systems, which provide the good justifications of the solar hybrid approaches. a novel hybrid PV/TE/HW solar system including single-crystalline PV cells, bismuth telluride (Bi_2Te_3) TE modules, and HW tubes cast in a functionally graded material (FGM). The performance of this multilayer hybrid system will be predicted and characterized. The testing results show the energy harvesting performance of the hybrid solar panels, which is plausible compared to traditional solar panels. The design with quantum well (QW) and quantum dot (QD) TE modules could enhance the output electric power and, thus, obtain a higher efficiency. Currently, most QW/QD structures are fabricated with a molecular beam epitaxial technique.Which is an expensive process compared to the traditional bulk material fabrication techniques. Recently, it was reported that QD TE structures were fabricated by a colloidal method, which could be a promising technique to make cost-effective TE materials Hybrid solar panels integrated with Si solar cells, TE materials, and FGM water tube systems are demonstrated. The FGM water tube systems have good cooling function, which can recover the PV cell efficiency by 30–50% and 25–40% for the PV/HW and PV/TE/HW system, respectively, by controlling the temperature and also enhance the TE output power by three times. Incorporation of bulk TE modules in the solar panel shows comparable performance as those of PV/FGM design. High-efficiency QW/QD TE materials could potentially contribute higher electric power and enhance the overall efficiency for PV/TE/HW design.[5]. Al tube is used as steam generator. Black color tank is used, to improve the heat developed. Two sensors are used inside the Al tube, temperature and pressure sensor. By using these opening and closing of the solenoid valve is controlled by the microcontroller. The temperature sensor measure the temperature in the Al tube if this value is greater than 120ºc then the solenoid valve become open and water enter into the Al tube. That is controlled by the microcontroller. The pressure sensor measures the pressure inside the tube, if this value greater than 10KN then the outlet solenoid valve is opened with the help of microcontroller. The temperature inside the tube is increased beyond 100ºc only when complete water is converted into steam. Similarly the pressure inside the tube is increased beyond the limit when amount of steam inside the tube is high.

III. PROPOSED APPROACH

Proposed systems MES energy system (maximum power point tracking efficient solar energy system) provides maximum efficiency when the light energy is available. Cool water is used to reduce the heat developed in the panel to increase the efficiency.MES panel is the modified version of currently existing solar panel. In currently existing solar panel there is white coloured voids to reduce the heat. When we use complete black solar cells in the panel heat developed is very high, to avoid this white voids are provided in the normal solar panel. In the MES panel this voids filled with mirrors whose focuses are concentrated to the steam generator to generate maximum heat in the tube. Solar tracking is used I this to capture maximum sunlight. By this the shadow formed in the panel is concentrated in one position. That area is also used to pass cool water, by this the panel temperature further reduced. When the cool water pass through the panel the temperature of the water increases and it move towards the steam generator. Solenoid valves are used before and after the steam generator. This valve works on the basis of the temperature and pressure. By using this valve complete transfer of water to steam, no reverse flow is takes place. Steam generator is a small black aluminium tube to handle more heat. Using this steam the turbine is works and it connected to the generator. The produced current stored in the battery. The output from the turbine pass to cooler to obtain the cool water this water is again used for cooling and generation of the steam. The output current from the panel obtained from the sunlight is also used to charge the battery. The battery connected to the inverter to obtain the ac. In the normal solar panel the entire space is not used. Voids are provided in between the solar cells to reduce the heat generation .otherwise the heat generation is very high and that affects the efficiency. In the MES panel these white voids are replaced by mirrors, by this the complete utilization of the panel is takes place to avoid the effect of heat cooling is takes place. The same water used to cool the panel is also used to generate the steam. Water is pump through the panel to the steam generator by using the motor. Inlet valve is used to avoid the water flow in the reverse direction.

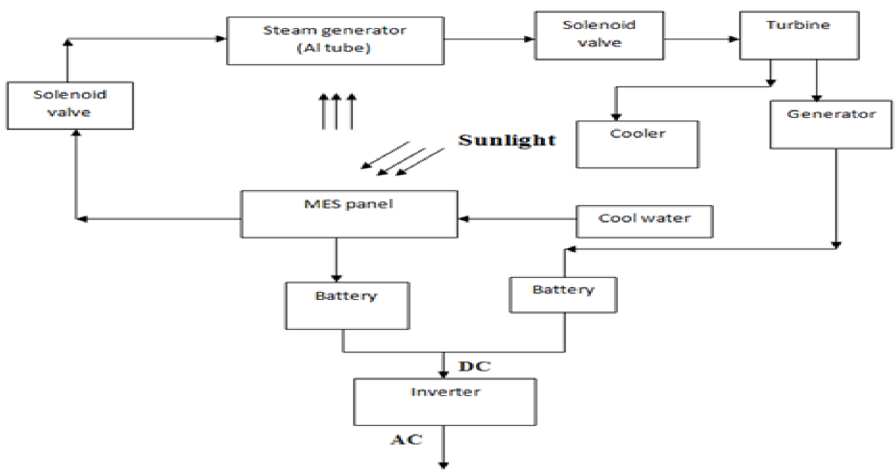

Fig. 1: block diagram of MES energy system

Al tube is used as steam generator. Black colour tank is used, to improve the heat developed. Two sensors are used inside the Al tube, temperature and pressure sensor. By using these opening and closing of the solenoid valve is controlled by the microcontroller. The temperature sensor measure the temperature in the Al tube if this value is greater than 120ºc then the solenoid valve become open and water enter into the Al tube. That is controlled by the microcontroller. The pressure sensor measures the pressure inside the tube, if this value greater than 10KN then the outlet solenoid valve is opened with the help of microcontroller. The temperature inside the tube is increased beyond 100ºc only when complete water is converted into steam. Similarly the pressure inside the tube is increased beyond the limit when amount of steam inside the tube is high.

Fig. 2: experimental setup

Solar tracking is helpful to obtain light at every time .solar tracking is done with the help of the microcontroller and gear motor. At given atmospheric conditions (mainly dependent on temperature and insulation level), photovoltaic (PV) cells supply maximum power at a particular operating point—the maximum power point (MPP). Unlike conventional (fuelled) power sources, it is desirable to operate PV systems at their MPP. However, the MPP locus varies over a wide range, depending on a PV array's temperature and insulation intensity. Instantaneous shading conditions and ageing of PV cells also affect the MPP locus. The problem is further complicated should the load's electrical characteristics also vary. Hence, in order to achieve operation at the MPP, a time varying matching network which interfaces the varying source and the potentially varying load is required. The role of this matching network, called the maximum power point tracking network (MPPT), is to ensure operation of the PV generator (PVG) at its MPP, in the face of changing atmospheric conditions and load variations. [15]By using the MPPT circuit the output voltage is almost constant. A simple maximum power point tracking scheme is used in this current and voltage from the solar cells is evaluated. That is compared with the highest value stored. According to that variation the pwm signal is generated. The buck boost converter is used in which the boosting is depends upon the duty ratio of pwm signal, that is controlled by the microcontroller. When the input is low sufficient boosting is provided and made the output constant. The entire system is controlled by the microcontroller, the opening and closing of the solenoid valve with the help of temperature and pressure sensors. Tracking is controlled by controller with the help of the light sensor. The two motors are also controlled by the controller one for tracking and other for pumping water. Driver circuit is used to provide sufficient supply voltage to the motors. Efficient control and power management is takes place by using the microcontrollers.

IV. EXPERIMENTAL RESULTS

Consider a panel width .65m diameter in which 40 solar cells are placed provide sufficient white voids in order to reduce heat development. The white voids are replaced by mirrors. This panel is cooled by water; the same water is used to generate the steam. The solenoid valve control water and steam flow that is fully controlled by microcontroller. Solar tracking and maximum power point tracking is used to improve the efficiency. Steam generating system and power generation as per the block diagram, which is already discussed. This proposed system is compared with the normal pv power generating system, which contain same number of solar cells. The sensor values are serially transmitted from the microcontrollers to the laptop. These data is imported to the matlab and the comparison of the Power is given as graph:

Fig. 3: comparison of power

V. CONCLUSION

Nowadays the renewable energy recourses are widely used, in that commonly prefer solar energy. PV and CST methods are used to generate energy from the solar. in the proposed system Light and heat energy use at a time. Cooling the panel improve the efficiency; by this reduction in the efficiency by the developed heat in the panel can be avoided. Proper power control using micro controller and MPPT are added advantages. More and efficient usage of space. We can obtain more power from the limited space higher. By these things we get higher power compared to existing systems. Obtain high energy at noon time compared to normal system by usage of the heat. The heat becomes the reason for the efficiency reduction of the photovoltaic systems used effectively.

REFERENCES

[1] Zhou Dongyi, Shi Chu-ping, Yuan Wen-hua Department of Mechanical and energy Engineering, Shaoyang College, Shaoyang, 422000, China. “Research on the Applicability of Solar Energy-Ground Source Heat Pump in Different Regions of China”,2011 Second International Conference on Digital Manufacturing & Automation

[2] A. Yona, Member, IEEE, and T. Senjyu, Senior Member, IEEE “One-Day-Ahead 24-Hours Thermal Energy Collection Forecasting Based on Time Series Analysis Technique for Solar Heat Energy Utilization System” IEEE T&D Asia 2009

[3] Liu yi, Li Bing-xi, Zhou Yi, Fu Zhong-bin, XuXin-hai School of Energy Science and Engineering Harbin Institute of Technology Harbin, China. “Study on Hybrid Solar Energy and Ground-Source Heat Pump System”International Conference on Energy and Environment Technology,2009 IEEE

[4] Dajiang Yang and HuimingYin , “Energy Conversion Efficiency of a Novel Hybrid Solar System for Photovoltaic, Thermoelectric, and Heat Utilization” , IEEE transactions on energy conversion, vol. 26, no. 2, June 2011

[5] Dajiang Yang and HuimingYin , “Energy Conversion Efficiency of a Novel Hybrid Solar System for Photovoltaic, Thermoelectric, and Heat Utilization” , IEEE transactions on energy conversion, vol. 26, no. 2, June 2011

[6] Ibrahim Patel Member IEEE Associate Prof. Dept of ECE Dr. B. R. Raju Inst. of Tech. Narsapur Medak A. P. India. S. Alekhya She is pursuing her Bachelor’s degree in BME Dept Dr. B. R. Raju Inst. of Tech. NarsapurMedak (Dist) A. P India. . D. Aarti She is pursuing her Bachelor’s degree in BME Dept Dr. B. R. Raju Inst. of Tech. NarsapurMedak (Dist) A. P. India. “Sensible heat storage for power generation”, 2013 IEEE.

[7] GelsonOnirPasetti and Julio Elias Normey-Rico Systems and Automation Department Federal University of Santa Catarina Florianopolis, SC, Brazil “Automation and Energy Optimization of a Domestic Solar Heating Unit” The fifth International Renewable Energy Congress IREC , 2014 IEEE

[8] Kameal Mina, Ph.D., Program Coordinator of Energy Systems Technology, Cambrian College, Sudbury, Ontario, Canada “The Heat Battery: Solar Thermal Energy Storage for Heating Loads” IEEE 2012

[9] Yin LIU School of Energy & Environment Zhongyuan University of Technology Zhengzhou, China.Guanghui ZHOU School of Energy & Environment Zhongyuan University of Technology. Jing MA School of Civil and Architecture Henan University of Technology Zhengzhou, China “Feasibility Analysis for a Large Scale Solar Energy Heating in Central Region of China” IEEE 2010

[10] Liping Liu Department of Refrigeration and Air-Condition Engineering Shanghai Ocean University Shanghai, China HuaZhang College of Power Engineering “Energy-exergy analysis of a direct-expansion solar assisted heat pump floor heating system” IEEE 2011

[11] Li Xinguo Department of Mechanical Engineering, Tianjin University Hu Xiaochen1, JiaYanmin, Linyi Design & Research Institute of Architecture, “The Operation Mode and Energy Analyses on Solar-Ground Coupled Heat Pump with Energy Storage” Third International Conference on Measuring Technology and Mechatronics Automation,IEEE 2011

[12] M. Horvath, Member, Student Association of Energy “Analysis of buildings solar heat gain”