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A Review Paper On Active And Passive Air Cooling Techniques For Solar Panels

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Abstract

Efficient use of free energy to get maximum output is one of the most important topics in the world. Because of the vast amount of solar energy available, it is a very appealing source of electricity. The performance of a electrical phenomenon module depends on the environmental conditions, majorly on the worldwide incident irradiance G on the module plane . the other major factor that affects the efficiency of a pv module is the temperature of the module surface.Hence ,we have studied several research papers to give an abstract idea of the air cooling techniques that can be used to achieve maximum efficiency from the solar cells.

Keywords: Irradiance,Module,PV Cells:Photovoltaic cells,

1. Introduction

Solar energy is the radiant light and heat from the Sun that's captured and used in a variety of technologies, including solar power to induce electricity, solar thermal energy, including solar water heating, and solar armature. It's an important source of renewable energy, and its technologies are astronomically classified as either unresistant solar or active solar, depending on how they capture, distribute, or convert solar energy into solar power. To harness the energy, active solar ways similar as photovoltaic systems, concentrated solar power, and solar water heating are used.Passive solar ways include orientating a structure to the Sun, opting accouterments with favorable thermal mass or light- dispersing parcels, and designing spaces that naturally circulate air. At the upper atmosphere, the Earth receives 174 petawatts (PW) of incoming solar radiation (insolation). Roughly 30 is reflected back into space, with the remainder absorbed by shadows, abysses, and landmasses.Photovoltaic cells convert light into an electric current by utilising the photovoltaic effect. As the mortal population grows and environmental enterprises grow, the use

of renewable energy is getting more common. Concentrated solar power systems concentrate a large area of sun into a small ray using lenses or glasses and solar shadowing systems. Using the photovoltaic effect, photovoltaic cells convert light into an electric current. The operation of renewable energy is getting decreasingly common as the mortal population grows and environmental enterprises grow. Solar energy is one of the most
important types of renewable energy sources, and it has piqued the interest of numerous scholars each over the world.
Solar energy may be converted into two different types of energy a source of electricity
as well as thermal energy Photovoltaic energy can be used to induce electricity (PV) cells. The incident solar irradiance is incontinently converted to energy by the PV cell. The maturity of PV modules, which convert modest quantities of sun into electricity, are effective, sustainable, and environmentally friendly systems. Bit of the solar irradiation that's converted to electricity The remainder of the solar irradiation is also used turns to heat, which raises the temperature of the cells while lowering the pressure, temperature. The temperature measure was plant to be negative for the filler factor, open circuit voltage, and maximum affair power, but positive for the short circuit current. Zubair has stressed different cooling ways to reduce the operating temperature of PV cells in exploration paper.
In his paper Filip Cabo has bandied about current advances in cooling ways and temperature control of photovoltaic panels.
In his paper Pushpende Dwivedi has presented details of of colorful visible cooling styles including new and advanced results for PV panel and indicates unborn trends of exploration.
Chander et al. investigated experimentally the impact of the temperature of the cell on the performance of mono-crystalline silicon photovoltaic. A remarkable effect on the performance of the photovoltaic was presented by the cell. They noticed that the temperature measure was negative for the filler factor, open circuit voltage and maximum affair power whilst was positive for the short circuit current.
Ike reported that the affair power of the photovoltaic and the ambient temperature of the point are laterally commensurable. Thus, the affair power produced by the photovoltaic is advanced for the low ambient temperature interval than the high ambient temperature interval.Hence, we have studied several exploration papers to give an abstract idea of the air cooling ways that can be used to achieve maximum effectiveness from the solar cells.

2.Literature review :

Pushpendu Dwivedi classified the cooling techniques for solar panel as shown in the figure :

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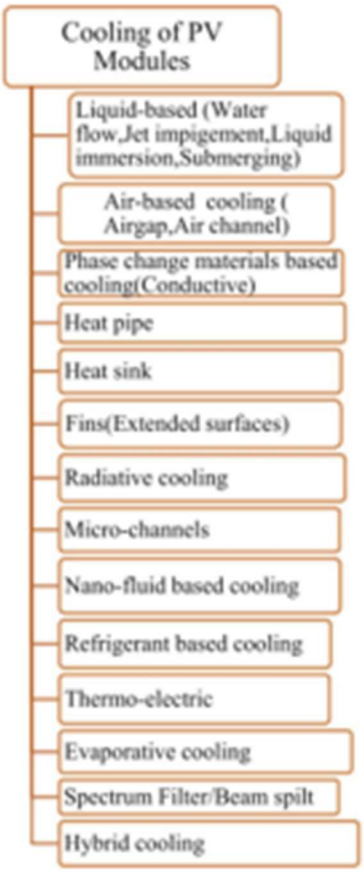

A unresistant system of cooling PV panels and system balance by air is carried out naturally without the use of any mechanical technique.We're going to concentrate only on the air cooling ways.

Natural convection is maybe the most popular system forP.V. Module Cooling due to its simplicity; no fresh accouterments are needed, and the cost is fairly low. The passage of air over the PV panels removes heat via convection, and the passage of air over the PV panels removes heat via convection.

The panel outperforms the air moving beneath the PV panels. As preliminarily stated, the most abecedarian type of cooling is active air-cooling.Active air- cooling systems induce tailwind through the use of suckers or other means. These systems can be designed in such a way that the waste heat is reclaimed.

As a result, the cooling of photovoltaic panels can be bettered by installing metallic accouterments with fins on the reverse face of the panels to increase air rotation. By furnishing an air gap between the walls and the PV system, the photovoltaic temperature can be kept below 40 degrees Celsius. Open- air channels, essence frames, fins, and tubes beneath PV panels are exemplifications of forced tailwind strategies. Teo use array tubes to significantly lower the temperature of solar panels while adding their effectiveness by 12 to 14 percent.

Swar Zabeer has presented different air cooling ways to keep the low temperature of pvpanels.One system of cooling that uses a high thermal conductivity essence to remove heat from the photovoltaic cell is the heat Gomorrah. Popovici etal. used a numerical model to probe the temperature reduction of PV panels on a clear summer day.

Air heat sink arrangements with roasted walls and unresistant cooling It was discovered that the maximum temperature of the panel was lower for the angle 45 ° than for the angle 135 °. The study discovered that the maximum power produced by a PV panel when a heat

Gomorrah is used. When compared to the reference case, the angles of the caricatures increased by6.97 and7.55, compared to the reference case, for angles of the caricatures independently. 90 ° and 45 ° degrees.

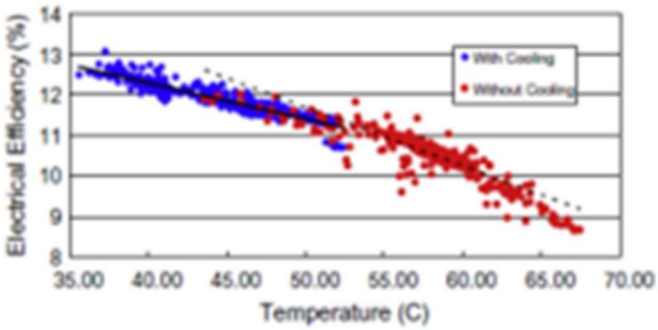

Fig 1

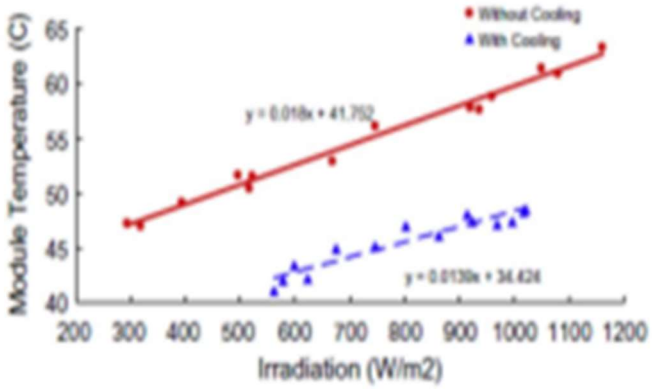

Fig 2

The air channel was modified in two ways to improve heat transfer from the channel walls to the airflow. The first involved inserting a thin flat metallic sheet in the channel's centre and the second was connecting rectangular fins at the channel's back end. According to the findings of the study, the modified Air systems would make a significant contribution to improving the performance of larger PV applications systems.To improve heat transfer from the channel walls to the airflow, the air channel was modified in two ways.The first involved inserting a thin flat metallic sheet into the centre of the channel and the second involved connecting rectangular fins at the back end of the channel. According to the study's findings, the modified PVT/Air systems would significantly help to improve the performance of larger PV applications systems. In his case study Pushpendu Dwivedi has discussed, Efficiency of solar panels particularly decreases as the temperature increases Increase in temperature solar panel due to sunlight absorbed which converted into heat Resulting in low efficiency of photovoltaic panels. the use of cooling techniques can reduce the excessive heat and help optimum efficiency. this paper presents details of various visible cooling methods including novel and advanced solutions for PV panels and indicate future Trends of research. scientist are working on cooling system for reducing solar cell working temperature active cooling

requires a coolant, air or water which involves fan or pump power. vacuum pulling requires no extra power. Alison Gray discussed the,Considerations for cooling of photovoltaic cells; cell temperature, temperature uniformity, reliability ,Usability of thermal energy, pumping power and cost. the passive cooling system remove waste heat as effective as possible to insure Lower cell temperature and the removal of waste heat from the back of cell area.By improving the passive cooling system which decrease cell Temperature in the field, improve temperature uniformity, cell efficiency and increased cell reliability.PV cell performance dependant on cell temperature as
shown in which illustrate that cell decrease in efficiency when temperature are increased o to 2% for a 20 C increase in some cases.

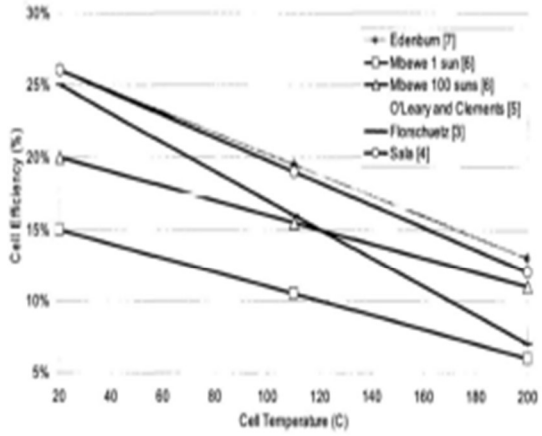

Figure 2. Comparison of different cell efficiencies at different cell temperatures. [1]

Fig 3

G.Hetsroni has performed an experimental disquisition of a heat Gomorrah for cooling of electronicdevices.The ideal was to keep the temperature as low as possible of about 323-333K.Temperature distribution on the heated wall depends on the material and design of the module it in the microchannel the heat flux and the type of working fluid the infrared images of the heated side of the test module as shown. In this figure the bottom is from the bottom to eclipse the area is easily shown and the thermal image analysis is confined to this square area of 10 X 10 mm2.

Disquisition of a heat for electronic cooling at relative Low flux was performed. the cooling fluid utilized in this study made it possible to maintain the temperature on the heated face in the range 323 to 333k.Inflow insecurity in slightly hotted microchannels was delved experimentally the growth and collapse of the vapour bit has been analyzed it was plant that the temporal geste of temperature change corresponds to that of pressure oscillations. The maximum values of the pressure change didn't differ significantly from the pressure drop across the channel.

For cooling by Vertrel XF, the maximum temperature difference on the face didn't exceed 4 – 5 K, whereas for cooling by water this difference was about 20 K, at similar inflow rates
.

R. Senguptaa,R. Chakraborty has perform an logical study of semi-circular fins subordinated to forced convection. The expression for its effectiveness has been deduced by working a two dimensional thermal energy balance equation and the reckoned effectiveness has been compared with an equal volume indirect fin.

In the present study, Schedule 40 pipes with nominal compasses ranging from 25 mm to 90

mm have been considered (6), (7). The ambient air temperature is taken as 250 C. A relative study for SF and CF has been presented in this section. For a given pipe size, the volume of fin material used for both SF and CF is same. The diameters of the SF and CF for the range of pipe size considered have been presented in Table 1. The two cases which were modeled, i.e., fins at one sampling of the pipe, and fins on a mound of tubes are now illustrated independently.

The effectiveness of the semi-circular fin is plant to be lesser than the indirect fin, under the conditions studied. As similar, the thermal effectiveness of the fin increases when the number of semi-circular fins at a sampling increase and the thermal conductivity of the fin material increases. The effectiveness increases hardly on adding the base temperature. The thermal performance decreases on adding the pipe size and the air haste.

Cătălin George Popovici presents a numerical approach of the reduction of temperature of the photovoltaic panels by using the air cooled heat cesspools. The typical outside values of the effectiveness are reached between 14 and 17, in case of mono-crystalline silicon solar cells. The solar radiation that isn't converted into electricity is nearly entirely converted into heat. The paper studies the influence of the operating temperature of a photovoltaic panel during a clear day of summer. The position of the panel is considered perpendicular, integrated into a voiced double skin façade (DSF). In this thesis, the PV panel is a part of surface glazing of the double skin façade. The study presents also a result to enhance the cooling of photovoltaic panel, by attaching a heat Gomorrah on its reverse. The range of double skin façade channel is considered constant, of0.1 m. The photovoltaic panel studied in this paper has the following confines L (length) = H (height) = 0.5 m. The cooling of the PV panel is estimated in case of using a heat Gomorrah with caricatures, for different heights and angles of the caricatures. The heat Gomorrah that's attached at the reverse of PV panel is realized from a essence with high thermal conductivity, like bobby or aluminum.

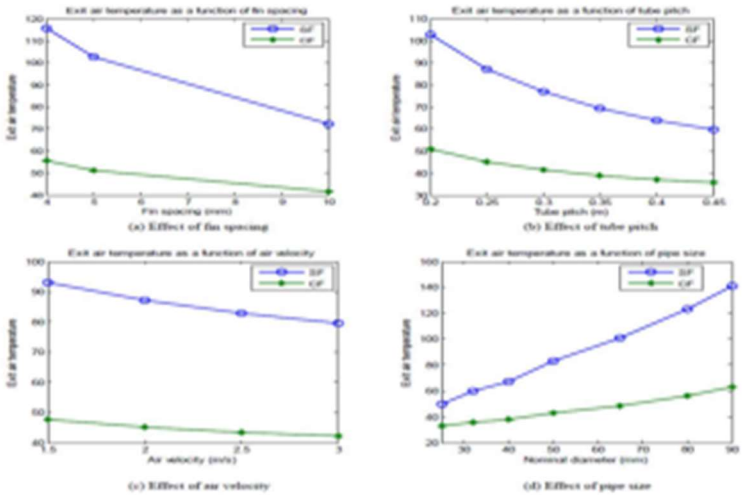

Fig 4

A. Fattahpour Moazzez aimed to to determine the quantum of air chamber cooling using three thermoelectrics. For this purpose, air cooling system was originally developed and also dissembled by ANSYS CFX software. The system was tested at three different tailwind (0.18,0.35 and0.7 m s − 1) and three different bay air temperatures (31, 40 and 50 °C). The temperatures of the four points

were recorded.Experimental setup consists two main corridor including an bay temperature control chamber and an air cooling system. In this study, after thermoelectric and addict turned on, the first bay temperature was acclimated. Also, the temperature was recorded at two points (the middle of the coolant chamber (C1) and the affair of the coolant chamber (C2)).

In the new model, with the change of the central champaign Gomorrah, the air temperature also dropped above the conduit. As a result, the temperature at the outlet of the new model was reduced compared to the former model.

M A Elias in his study, the PV systems were retrofitted by two types of cooling system which are unresistant cooling and active cooling systems. The results of panel temperatures were measured against the control system without the cooling mechanism.The disquisition was conducted direct sun in real operating condition. Active cooling system reduced the temperature of the PV system and bettered the electrical affair by4.9 while the swish unresistant cooling system bettered the affair by 3.

Out of the four cooling technology installed, the results of this study show that the active cooling system (System 2) has a better overall performance than the other cooling systems installed with the reduction of temperature position up to11.1 that improves the electrical power affair by4.9. System 5 has the stylish results for the unresistant cooling system with over to 3 electrical affair enhancement and can be nominated as the stylish cooling system for build on the being solar PV system as the installation of the heat Gomorrah finishes much easier and bring lower than System 2.

Conclusions :

First the readings for the simulated setup are taken . After that graphs of Wattage VS Surface Temperature for both natural and passive cooling were plotted .And after carefully observing the readings and the graphs for simulated setup , following conclusions were made:

The Surface temperature of aluminium heater plate for passive cooling using heat sink was about 100 degree C and for Natural cooling was about 140 degree C , showing a drastic difference of about 40 degree celsius.

Then after performing the investigation and plotting the graphs on the actual concentrator cell , following conclusions were made:

As the sun reaches the peak hour the direct normal irradiation value increases.

As the value of DNI increases , the value of Open Circuit Voltage increases.

But due to increase in temperature ,the increase in VOC rate decreases.

After applying a heat sink the temperature difference of about 28 degree celsius is observed .

And after using a heat sink the output VOC also increases.

Therefore , the Conclusions are:

Tsc Natural > Tsc Passive

VOC Natural < VOC Passive.

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