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Fabrication of Photovoltaic Cell Active Cooling Method with Nano Fluids

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Abstract: Solar radiance reaching Earth is plentiful and can be harnessed to provide electricity through solar PV panels. The main focus of this project is to analyse the temperature distribution on non -concentrating PV module with and without cooling and its effect on efficiency of PV panel. The efficiency of the PV panel is inversely proportional to its temperature. Current research is discussed and limited to two areas. The first is developing an accurate thermal model for solar panels. The second is on mechanisms that decrease the temperature of the cells. Cooling of photovoltaic cells is one of the main concerns when designing PV panel. Cells may experience both short-term (efficiency loss) and long-term (irreversible damage) degradation due to excess temperatures. The Active type of cooling a PV panel the rear surface of the panel is investigated. Forced convection through the copper tubes is assumed. Nano fluids have unique features different from conventional solid-liquid mixtures in which mm or µm sized particles of metals and non-metals are dispersed. Due to their excellent characteristics, Nano fluids find wide applications in enhancing heat transfer. Temperature of the PV panel and its Efficiency is found to vary with (H_2O, ZnO and $Al_2O_{3)}$ and without cooling.
Keywords: photovoltaic cell, cooling, efficiency, Nano fluids).

I. INTRODUCTION

The first and foremost aim of this work is to study the effect of Temperature over the efficiency of the PV panel electrical effect, analyse the temperature distribution over the PV panel and to implement a active technique for cooling the PV panel for maintaining an optimum working temperature. The next step is to increase the efficiency of the PV panel by reducing the operating temperature of the panel.

The irreversible damages caused by the overheating of PV panel is undesirable, it makes the panel lose its efficiency to a greater extent. Hence the damage of PV panel should be prevented which could increase the life time of the panel.

Current energy demands are met mostly by fossil fuels and non-renewable sources which are depleting at a fast rate besides being greenhouse gas emitters therefore solutions based on renewable energy sources are being used to meet the current energy challenges. Solar energy is one of such clean and inexhaustible renewable energy resources with no carbon dioxide emissions and zero waste generation.

Research efforts are being made over the years to effectively utilize the vast solar resources using photovoltaic panels but the efficiency is still low as a major part of solar energy is converted into heat energy. This not only reduces the electricity generation efficiency but also affects the life time of pv panels.it is found that pv performance falls with the increases in module temperature. The efficiency of crystalline silicon solar cells fall by 0.5% for every 1degree Celsius rise in solar cell temperature and this decrease in efficiency varies with the type of cell.

The temperature of solar cell is a function of various parameters, most significant being the isolation received, and wind speed over the surface of the pv panel, direction of the flow of wind and ambient temperature.

The temperature of the front and the back surfaces of the pv panel vary with the degree of orientation due to convection, conduction and radiation effects.

As the solar radiation falling on the pv panel, wind speed and ambient temperatures, are not under human control. Research is focused to develop new materials and ways to reduce the solar cell temperature without adding much to the system cost. One technique is cooling by sprinkling water at the front or circulating at back of the pv panels. This method however consumes a lot of pump power.

Another technique is the use of ventilated pv panels which is a current research focus. But this technique suffer from poor heat transfer rates and insufficient cooling. Further it become ineffective if the temperature rises too high.

Also the heat removed cannot be very effectively stored or refused which could otherwise have helped in reducing the system cost as well as raising the overall efficiency of the system. Water and air based cooling provide immediate use of the heat stored so the flexibility of extending the time of stored energy use is limited.

Phase change materials offer an attractive solution since they have several times more heat capacity than water and air based systems. Further the heat stored can then be used during night without significant heat losses. The heat stored can then be used for air conditioning or water heating which raises the overall efficiency of the system and reduces its effective cost.

A. Components

1) *Storage Tank:* A water tank is a container for storing liquid. In our project, we have made a small tank like structure for showing the effective purpose of the water filling and filtration system.
2) *DC Pump:* Charge pumps use some form of switching device(s) to control the connection of voltages to the capacitor. For instance, a two-stage cycle can be used to generate a higher pulsed voltage from a lower-voltage supply. In the first stage of the cycle, a capacitor is connected across the supply, Another way to explain the operation of a charge pump is to consider it as the combination of a DC to AC converter (the switches) followed by a voltage multiplier.
3) *Solar Panel:* A Solar cell works on the principle of photo-voltaic principle, the photo-voltaic solar energy conversion is one of the most attractive non-conventional energy sources of proven reliability from the micro to the Mega watt level.

a) Specification Of Solar Panel
b) Material : silicon
c) Maximum power : 10watts
d) Voltage : 12volts
e) No.of cells : 36

4) *Condenser:* Condenser is a device or unit used to condenses substance from its gaseous to its liquid state, by cooling it.in so doing, the latent heat is given up by the substance and transferred to the surrounding environment.

a) Design Calculation Of Condenser

Length of the condenser= 22.5 cm (or) 0.225m

Breath of the condenser=22.5 cm (or) 0.225 m

Thickness of the condenser=10 cm (or) 0.1m

Area of the condenser =l*b

=0.225*0.225

A=0.0506 m^2

Heat transfer rate,Q/A = $mc_p(T_0 - T_1)$

=1x1.005(36-30)

Q/A =6.03w/m^2

5) *Nano Fluids:* Nanofluids have novel properties that make them potentially useful in many applications in heat transfer. They exhibit enhanced thermal conductivity and the convective heat transfer coefficient compared to the base fluid. Nanofluids improve the heat transfer rate, as well as the optical properties, thermal properties, efficiency, and transmission and extinction coefficients of solar system.

a) Zinc Oxide: Heat transfer application of aqueous based ZnO Nano fluid was tested and it was observed that, the presence of ZnO Nano fluid effectively reduces the temperature propagation in a sono-chemically heated system. It is observed that the heat absorption capacity was increased by about 30-40% for the ZnO containing Nano fluid.

6) *Copper Tube:* Copper tube is most often used for the supply of hot and cold tap water, and as a refrigerant line in HVAC systems. Copper tube does not react with water, but it does slowly react with atmospheric oxygen which, unlike the rust that forms on iron in moist air, protects the underlying metal from further corrosion.
7) *Temperature Sensor:* Temperature sensors surround us. They are in our buildings and homes measuring temperature for HVAC systems, refrigerators, freezers, and computers. Industrial applications such as motor controls, assembly lines, processing, and manufacturing all require constant monitoring and control of temperature. Consequently, many different types of temperature sensors exist to accommodate this wide variety of temperature sensing needs and applications.

a) Working: The solar panel otherwise photovoltaic panel will be placed to the sun source. As the photovoltaic panel absorbs the light source, the heat source will also be took a part in the atmosphere. This heat will affect the effectiveness of the solar panel. We have PU tubes set behind the PV panels as a latent heat exchanger. The tube arrangement will have a inlet and outlet port. The inlet port connected with the pump inside the tank will circulate the water or other cooling fluid we poured in the tank. This will control the heat resistance of the solar panel. Then the outlet port of the panel will be connected to condenser which is to cool the cooling fluid. Thus the total circuit will be in a closed circuit.

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II. DESIGN DIAGRAM

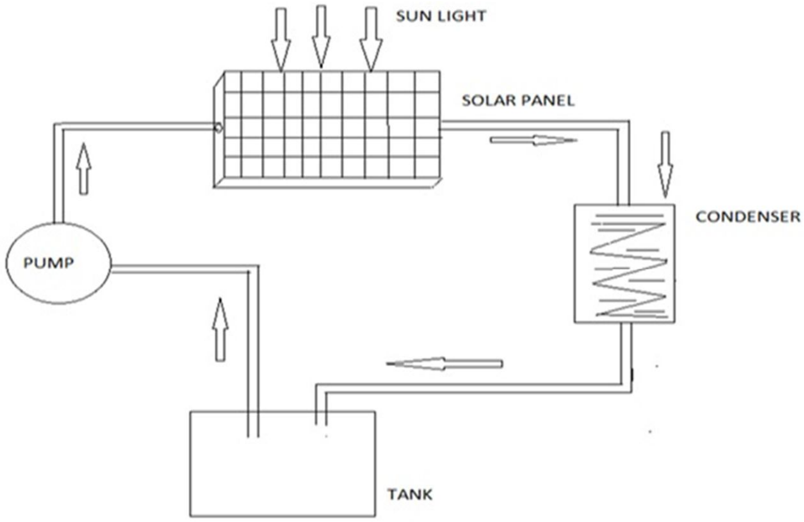

Fig 1 schematic diagram

A. Advantages

1) No need of manual effort to heat reduction in solar power plants.
2) Periodic maintenance in automation.
3) Maintenance cost is less.
4) Efficiency should be increases.
5) Solar panel life should be increases.

B. Disadvantages

1) Nano fluids cost is high.
2) Required for skilled workers.

C. Applications

1) Solar power plants.
2) Home appliances.

D. Photography

Fig 2 Photography

III. RESULT

A. *Without Cooling*

Si no	time	Temperature of panel	Power output
units	(IST)	(^oC)	(Volt)
1	10	30	19.5
2	11	36	19
3	12	40	16
4	1	45	12
5	2	48	10

Table 1

B. *Water Cooling*

S. No	Time	Temperature of panel	Power output in panel
Units	(Min)	(^oC)	(Volt)
1	0	30	19.7
2	30	36	19
3	60	34	19.5
4	90	37	19.5
5	120	35	19

Table 2

C. *Znic Oxide*

S. No	Time	Temperature of panel	Power output in panel
Units	(Min)	(^oC)	(Volt)
1	0	30	20
2	30	36	19
3	60	32	21
4	90	35	20.6
5	120	33	19.7

Table 3

D. *Aluminium Oxide*

C	Time	Temperature of panel	Power output in panel
Units	(Min)	(^oC)	(Volt)
1	0	30	20.6
2	30	36	19.3
3	60	32	21
4	90	35	20.6
5	120	33	20.4

Table 4

E. Comparison Of Water With Cooling, Water Without Cooling,Nano Fluids

Time	Without circulation	Water	Zinc oxide	Aluminium oxide
0	19.5	19.7	20	20.6
30	19	19	19	19.3
60	16	19.5	21	21
90	12	19.5	20.6	20.6
120	10	19	19.7	20.4

Table 5

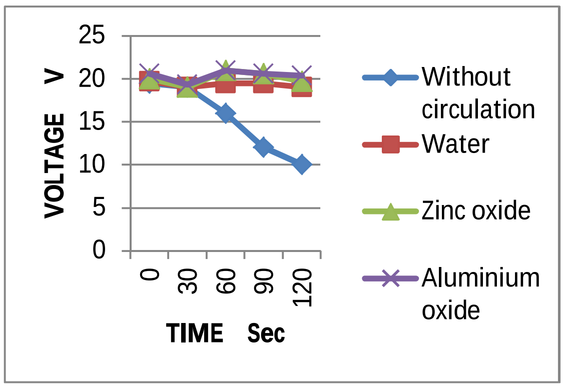

Fig 3 output characteristic curve

IV. CONCLUSION

It is conclude that the heat resistance formed by the sun has to be controlled to achieve the effective power production from solar panel. This can be achieved by circulating the cooling water to the solar panel periodically. Thus automatic cooling system is suggested for improvity the efficiency of the solar panels. Power output further increased by adding Nano additives such as zinc oxide and aluminium oxide.1v is increased in a single panel by adding aluminium oxide in the water when compared with non water circularity.

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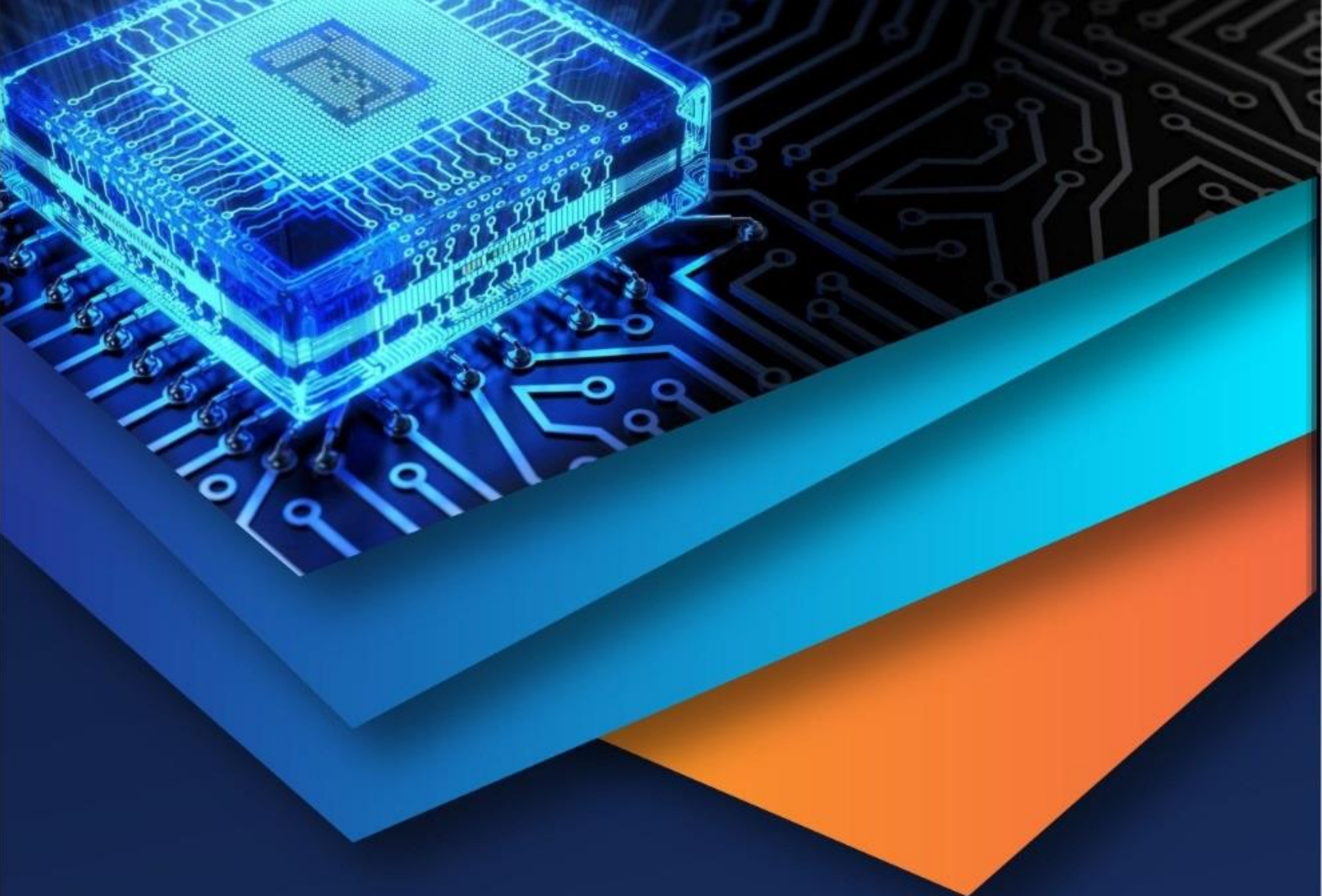

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