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Development of Self Cooling PV Cell by Phase Change Material

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Abstract-The rapidly growing use of photovoltaic systems depicts its importance in the field of power generation in the near future. Photovoltaic panel absorbs 80% of the incident solar radiation and converts 20% of this absorbed energy into electrical energy depends upon the efficiency of photovoltaic panel, remaining absorbed energy get converted into heat causes surface temperature rise of PV panel. As the temperature of solar panel increases its electrical performance deteriorates. For every degree rise in PV surface temperature efficiency decreases from 0.4 to 0.65%. So, cooling of photovoltaic pane is very essential to have better energy conversion efficiency. Many researchers have investigated the performance of PV panel integrated with phase change materials (PCMs) based cooling technique.

Keywords- PCM , Temperature, Efficiency

I. INTRODUCTION

The concern for environment due to ever increasing use of fossil fuels & rapid depletion of these resources have led to the development of alternative sources of energy, which are renewable & environment friendly. Solar energy can be a major source of power & can be utilized by using thermal and photovoltaic conversion systems. India, receives solar energy equivalent to more than 5,000 trillion KWh per year, which is far more than its total annual consumption. The daily global radiation is around 5 kWh per sq. m per day with sun shine ranging between 2,300 and 3,200 hours per year in most part of India. Though the energy density is low and the availability is not continuous, it has now become possible to harness this abundantly available energy very reliably for many purposes by converting it to usable heat or through direct generation of electricity. Photovoltaic cell / Solar cell has a potential to convert the solar energy into electricity.

II. PCM-BASED PHOTOVOLTAIC SYSTEM

Phase changes Materials (PCMs) are substances that are able to absorb and release large amount of energy as latent heat through a reversible isothermal process at a particular phase transition temperature. Latent heat storage using PCMs is superior to sensible heat storage due to their higher energy storage density within a smaller temperature range. These materials are classified as organics consisting of paraffin wax, and fatty acids, inorganics consisting of salt hydrates, and eutectic mixtures of organic and inorganic PCMs.

Fig.1 Study Area

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III. METHODOLOGY &EXPERIMENTAL SETUP

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. The below block diagram shows the methodology of our experiment.

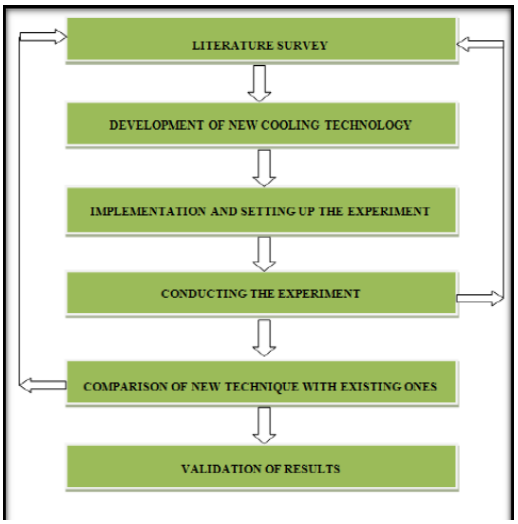

Fig.2 below block diagram shows the methodology of our experiment.

IV. DEVELOPMENT OF NEW COOLING TECHNOLOGY

By consider literature survey so many cooling technique are there for cooling the solar panel but they all required external power to cool the panel but we using the Phase change material for the cool of solar panel it doesn't required any external power

Fig.3 PCM 55 Material.

Phase Change Material

we use phase change materials PCM55 and PARAFFIN WAX for our experiment .this materials are Implementation and Setting up the Experiment.

V. IMPLEMENTATION AND SETTING UP the EXPERIMENT

The Pcm55 Material Can Be Obtained From Chemical Industry, Thane In Rajasthan . We Purchased 2kgs Pcm55 Material Which Cost About 1000rs Per Kg.

Fig.4 Collection of Pcm55 Material.

The above figure shows heating of PCM material in which the PCM taken from solid to liquid. Heater will be removed after the liquid will be obtained.

Fig.5 Heating the PCM55 material

The above figure shows removing the beaker from the heat source and leaves it for 3 to 4 minutes to

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cool the liquid, after cooling then pour the liquid on the back side of the solar panel .

Fig.6 Pouring of PCM to back side of the panel

The above figure shows the two panels which is placed to sun light one is applied PCM55 and another one is without applied PCM55. Next measure the voltage, current and temperature of both the solar panels. The experiment is carried out in GMIT campus, Bharthinagara. The combination of two namely panel coated without phase change material and panel with phase change material

Fig.7 Conducting the experiment

VI. EXPERIMENTAL OBSERVATION

1. Panel without PCM

Time	Ambient Temp^{r} (°C)	Tcell (°C)	Radiation (w/m^2)	Wind Velocity (m^2/s)	V	I	Input Power (w)	Output Power (w)	Efficiency (%)
10:00 AM	29	37.46	490.9	5	20.4	0.12	47.42	2.45	5.16
11:00 AM	30	38.98	562.1	5	20.4	0.14	54.20	2.86	5.27
12:00 PM	32	40.12	615.5	2.77	20.1	0.13	59.54	2.63	4.42
01:00 PM	33	39.36	580	2.77	19.9	0.11	56.0	2.12	3.78
02:00 PM	26	36.15	429.6	3.88	20.1	0.11	41.49	2.22	5.35
03:00 PM	25	35.67	407.05	2.77	20	0.12	39.31	2.4	8.18

2. Panel with Paraffin Wax

Time	Ambient Temp^{r} (°C)	Tcell (°C)	Radiation (w/m^2)	Wind Velocity (m^2/s)	V	I	Input Power (w)	Output Power (w)	Efficiency (%)
10:00 AM	29	47.42	490.9	5	20.8	0.14	47.42	2.92	6.15
11:00 AM	30	54.2	562.1	5	20.5	0.14	54.2	2.87	5.29
12:00 PM	32	59.45	615.5	2.77	19.8	0.13	59.15	2.57	4.34
01:00 PM	33	56	580	2.77	19.7	0.11	56	2.17	3.87
02:00 PM	26	41.49	429.6	3.88	19.6	0.11	41.19	2.15	5.21
03:00 PM	25	39.31	407.05	2.77	19.9	0.11	39.31	2.19	5.57

VII. CONCLUSION

By the experiment conducted, it can be observed that the solar panel coated with Phase change material is providing more output than that of without applied panel. Also it is noticed that the efficiency of panel coated with Phase change material is much higher than that of without applied panel. So from the project work it is concluded that the panel coated with Phase change material is the better cooling system for cooling the solar panel.

Key considerations include:

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