SMART COOLING SYSTEM FOR SOLAR PHOTOVOLTAIC MODULE

Chandrashekar S[2], Sandeep K[1], Javul Mulla[2], Bharath D[2], Raghavendra R[2]

[1]Assistant Professor, Department of Mechatronics, Acharya Institute of Technology, Bengaluru,
[2]Bachelor of Engineering, Department of Mechatronics, Acharya Institute of Technology, Bangaluru-107, India.

***Abstract*:** Photovoltaic (PV) modules have the capacity to generate electricity when solar radiation is incident on them. But this incident radiation causes an increase in temperature of PV module which results in decrease in its efficiency. This adverse effect invites a necessity to cool the module. In this project, an efficient way has been designed by introducing a smart cooling system consisting of a heat exchanger which helps in extracting the heat generated by the PV module and thus increases its efficiency.
The cooling system used is a combination of active and passive cooling methods. Aluminium alloy 6063 is used as a heatsink material along with the PCM which is fixed to the back side of the PV panel. Here we use a combination of paraffin wax and bee wax as phase changing material (PCM). Smart Cooling system is used to cool both the heatsink and PV module. Experiment will be carried out with the comparison of normal PV module and PV module with Smart cooling system.
Various performance parameter such as current, voltage and power are obtained, the values obtained are compared with a normal PV module. It was found that the PV module with PCM integrated system was more efficient compared to normal PV module. ANASYS CFD analysis shows that the adopted smart cooling system will maintain the PV module with in the required temperature for more efficient performance.

Keywords: Smart cooling system, Solar PV panels with aluminium sheets (6063), Phase Change Material (Paraffin wax and bee wax), Conventional refrigeration system, Solar monitoring and controlling.

I. INTRODUCTION

Energy is very important in today's world. It is necessary and a basic need to all living creature and life. Energy is the quantitative property that must be transferred to an object in order to perform work. We use various types of energy resources to produce electricity which we need in day to day life such as we need for our homes, schools, businesses, and industries. There are two types of energy resources are available, one is renewable energy, and other one is Non-renewable energy. Majority of the energy is derived from fossil fuels, such as coal, natural gas, and petroleum, these all are Non-Renewable sources. Renewable sources of energy can be used often times. Renewable resources comprise of solar energy, wind energy, geothermal energy, biomass and hydropower. The sun is the main and basic source of all the energy available on earth. Among all the renewable energy, solar energy is a best effective solution for utilizing in available renewable energy. Solar power has necessarily become the trend in renewable energy. The most known fact about solar energy is that it represents a clean, safe and green source of energy**.** Basically, solar energy is an energy that comes from the sun which is converted into electricity. To convert solar radiation into electricity we use a solar photovoltaic cell. A solar photovoltaic cell is made of semiconductor material which absorbs photons in solar rays and converts into Direct-Current (DC). About 80 to 85% of solar radiation is converted into electricity by PV panel and 15% to 20% is wasted as heat. Hence increase in PV panel temperature and so decrease in its efficiency. One of the significant issues in the photovoltaic business is solar panel efficiency enhancement, which is reached by its temperature. Therefore, introducing efficient cooling methods with extricate heat from PV panels must be taken into consideration. Until now, many researchers have been completed to lessen the PV panel temperature. A system to increase the electrical efficiency of solar cell by cooling the cell with the help of various heat sinks and wick structure with copper and aluminium fins, and then the heat removed from the back surface of the panel with the help of fins that absorb heat generated by the cells during the day. Therefore, the decreased temperature of PV panel increases the electrical efficiency of solar cell [6]. The recommended procedures for PV panel cooling are arranged into active and passive strategies [1]. In the active techniques, extra energy is required to cool the PV panel. Nevertheless, no energy is required for passive cases. No compelling reason to include power makes the passive cooling techniques progressively mainstream. In our experiment, an efficient way has been designed by introducing a smart cooling system consisting of heat exchanger which helps in extracting the heat generated by the PV module and thus increases its efficiency. The cooling system is used as a combination of both active and passive cooling methods. Aluminium alloy 6063 is used as a heat sink material [2] along with the Phase changing material [3], which is fixed to the back side of the PV module. Smart Cooling system is used to cool both the heat sink and PV module. Experiment will be carried out with the comparison of normal PV module and PV module with Smart cooling system.

II. FACTOR AFFECTING SOLAR PHOTOVOLTAIC EFFICIENCY

One of the main obstacles that is faced by the operation of the PV panel is very low PV cell conversion to electrical efficiency. This is also a key obstacle of scientists and researchers to enhance the electrical efficiency of PV cells. The power output by the PV system depends on factors such as operating temperature of PV module, shading and radiation.