IMPROVING EFFICIENCY OF SOLAR PANEL BY EXTRATION OF HEAT USING PELTIER MODULE

PROJECT REFERENCE NO.:39S_BE_1507

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INTRODUCTION:

The recent energy crisis has forced the world to develop new and alternative energy generation techniques. The increased use of fossil fuel has caused serious problems in the environment. Thus the utilization of solar energy and waste heat recovery must be enhanced in order to meet global energy crisis.

The idea of Solar Peltier System consists of: 1) Photovoltaic cell & 2) Thermoelectric Module / Peltier Module. Photovoltaic cells convert some of the absorbed photon energy to electricity. Peltier modules are used to convert heat energy to electricity.

This idea is a reasonable approach to provide a quiet and easy way to control the temperature of PV panel. PV cells convert some of the absorbed photon energy to electricity, but most of the energy is converted to heat. To utilize this dissipated heat efficiently Peltier module are used to convert heat energy to electricity. Increase in the temperature of solar panel can cause significant damages to the Solar cells. Due to the varying nature of solar radiation, the allowable temperature range is a vital factor which needs to be considered before designing a PV system for a specific application. This is even more important on Concentrating Photo-Voltaic (CPV) Systems when solar radiation could be much higher leading to higher cell temperature. The electrical current crossing the cell structure produces the Peltier effect. This heat captured can be utilized either for domestic purposes or for power generation.

A Thermoelectric element which uses the Peltier effect has advantages such as

1. Eco-friendly
2. Simple structure
3. High reliability
4. Noiseless

OBJECTIVES:

The Primary objective is Integration of Photovoltaic modules and Peltier modules to increase efficiency of a solar panel by maintaining the PV modules at an optimum temperature. A comparative analysis of solar panel with and without Peltier Module for their respective efficiencies will be analyzed. The combination of PV module and Peltier module harnesses waste heat and solar energy. It can be considered as the solution to the existing problem of energy exhaust. It is one of the alternative energy generation techniques.
**METHODOLOGY:**

![Block diagram of Solar Panel with Peltier Module](image)

Solar system with Peltier is as shown in the above Figure. It is placed in North-South direction at $45^\circ$ angle. Sun rays are incident on the Solar panel. Solar panel traps the light energy and converts into electricity. Some of the light energy is converted into heat and gets wasted. This waste heat can be trapped and converted into electricity.

Peltier modules are the devices which convert the heat energy into electric energy. Peltier module works on the basic principle on the temperature difference. 5mm thickness Aluminium sheet is attached behind the Solar panel which gets heated up and the Peltier modules which are attached to it absorbs this waste heat and converts it into electricity. Here hot side of the Peltier module is attached to the Aluminium sheet and heat sink compound is applied on the cold side of the Peltier, it acts as an adhesive material to improve heat conduction so that transfer of heat becomes more easy. Aluminium heat sink is attached to the cooler side of the Peltier and two cooling fans are connected on two sides of the Solar panel. Eight Peltier modules are placed behind the Aluminium sheet of the panel. When there is sufficient heat available behind the panel the Peltier generates electric energy. When temperature is more than $50-55^\circ$C, the output of the Peltier is maximum. As temperature varies the output of the Peltier module also varies.

**RESULTS:**

**Day 1**

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature in ºC</th>
<th>Solar output voltage (Volts) without the Peltier module</th>
<th>Solar-Peltier output voltage (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Solar Voltage</td>
</tr>
</tbody>
</table>

Table 1. Day 1 Readings for the Setup
Day 2

Table 2. Day 2 Readings for the Setup

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature in ºC</th>
<th>Solar output voltage (Volts) without the Peltier module</th>
<th>Solar-Peltier output voltage (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Solar Voltage</td>
</tr>
<tr>
<td>10am</td>
<td>34</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>11am</td>
<td>34.5</td>
<td>17.8</td>
<td>17.8</td>
</tr>
<tr>
<td>12pm</td>
<td>35</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>1pm</td>
<td>37</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>2pm</td>
<td>36</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>3pm</td>
<td>34</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

**GRAPHS: VOLTAGE v/s TEMPERATURE**

**Day 1**
Day 2

CONCLUSION:

A Comparative Analysis of Solar panel with and without Peltier module for their respective efficiencies has been performed. Peltier device is an auxiliary equipment to produce additional voltage in the system, where waste heat obtained is utilized efficiently to generate power and thus bring down the temperature of the solar panel. Hence the life of Solar panel is increased.