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Literature Review on Thermal Absorber Design in Photovoltaic Thermal System

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Abstract- This paper concerned with work performed by the various researchers in the field of solar energy. A literature survey was performed considering design, material, performance, economics, and application of solar energy with the different solar collector. Literature deals with thermal performance improvement technique and application of photovoltaic in the field of solar energy were included in the paper.

Keywords- Solar energy, Photovoltaic, Cooling, Co-generation, Renewable energy.

I. INTRODUCTION

Photovoltaic thermal collector (pvt) can be categorized into two popular types; water-based pvt and air-based pvt in accordance with the fluid used in the system. Recently, numerous studies were conducted in developing pvt collector based on water or air. in this section, pvt collectors will be examined with a focus on water-based pvt collector.

II. PAGE LAYOUT

1. Type of Collector:

1.1 PVT Air Collector:

The performances of the photovoltaic–thermal air collectors have been studied extensively by researchers. The behavior of single-pass and double-pass joined PV/T were analyzed with steady state conditions. The outcomes indicated that the double-pass PV/T collector had superior behavior over the single-pass PV/T collector. At a length of 1m, a mass flow rate of 200–300 kg/h, and pack factor of 0.5, the thermal, PV, and PV/T efficiencies were 24–28%, 6–7%, and 30–35% respectively for the single-pass PV/T. The thermal, PV, and PV/T efficiencies were 32–34%, 8–9%, and 40–45% respectively for the double-pass PV/T. To enhance thermal extraction from the PV cell as a PV/T based air by natural flowing, a thinner metal sheet was placed at the center or fins were placed to the rear wall of the air-channel.

REF module contains a basic air channel placed at the back of the PV cells, whereas the TMS has a thinner metal sheet placed at the center of the air channel and the FIN model contains fins of rectangular shapes placed on the other side of the wall to the PV back surface parallel to a flowing direction. The enhanced model showed good workability than the normal type. For the glazed enhanced model, the TMS possessed about 41°C and FIN possessed about 10°C less thermal rate than that of the REF module at a channel depth of 15cm and showed, accordingly, about 4% and 10% enhancement in output energy.

1.2 PVT Water Collector:

The performances of a Photovoltaic Thermal (PV/T) solar water heater were recorded from February until April 2007. It was noticed that the storage tank water thermal rate in February 2007 changed from a minimum of 29°C at 10:00 to a maximum of 59°C at 14:00; from 32°C at 10:00 to 80°C at 15:00 in March 2007; and from 34°C at 9:00 to 62°C at 16:00 in April 2007. Figure 2 presents the hourly changes in cell thermal rate and cell efficiency. It can be seen in the figure that the increase in the cell thermal rate reduced the cell effectiveness. When the cell thermal rate at 10:00 was about 34°C, the cell effectiveness was about 11.6%. When the cell thermal rate at 13:00 was about 50°C, the cell effectiveness was about 10.7%.

The heat, electricity and energy gains of combined photovoltaic thermal (PVT) water- based separate fixed collected thermal type for two distinguished models referred to as condition A (collector partly wrapped by the PV cell) and condition B (collector totally wrapped by the PV cell) were investigated. It was found that condition A was much preferable for hot water generation, whereas condition B was better for electrical energy generation. The outcomes showed that the yearly thermal power utilization was 4167.3 kWh and 1023.7 kWh, and the total yearly electricity utilization was 320.65 kWh a 1377.63 kWh for condition A and B respectively. The yearly total thermal power gains were reduced by 9.48% and the yearly total exergy gain was reduced by 39.16% from condition A to condition B.

2. The behavior of facade-integrated combined:

PV/T models with EPV (film cell) and BPV (single silicon cell) cells for usage in the resident houses of Hong Kong were accomplished. The outcomes indicated that the yearly electrical effectiveness of the combined EPV/T and BPV/T models were 4.3% and 10.3% for a west-facing panel, and the yearly total heat effectiveness were 58.9% and 70.3% respectively. The yearly effectiveness of the water heater models were 47.6% (for EPV) and 43.2% (for BPV). The equivalent amount of days in a year if the water thermal in the storage tank gets 45°C and more were 195 and 217. The decrease of space-heating utilization via the two types of combined PV/T collector's wall was recorded at 53.0% and 59.2% respectively, in comparison to the normal concrete wall.

The thermal and PV effectiveness of two types of thermal collectors in a commercial system PV/T model were investigated in a tropical weather situation of Singapore. Type A is thermal collectors with mono-crystalline Si solar panels and combined with a tube and sheet. Type B is thermal collectors with multi-crystalline Si solar panels and combined with a parallel plate. Figure 3 shows the cross-sectional areas of the flow channels for the two types of PV/T.

The electrical and thermal behaviors of the heat- pipe Photovoltaic/Thermal (HP-PV/T) models were analyzed in Hong Kong, Lhasa, and Beijing; three places representing the different weather conditions in China. A part of aluminum plate was selected as the base panel. The evaporator part of the heating pipes was attached to the rear of the aluminum plate and the condenser part was attached to a water tank. It was observed that the yearly thermal power was 1665.05–1872.22 MJ/m2, 2939.67–3328.25 MJ/m2, and 2111.07-2352.95 MJ/m2 when the model with an auxiliary heating system was used in Hong Kong, Lhasa, and Beijing respectively. The yearly electricity generated were 261.32–264.98 MJ/m2, 462.14–466.1 MJ/m2, and 322.84–328.15 MJ/m2 in Hong Kong, Lhasa, and Beijing respectively. It can be concluded that the solar thermal production primarily relied on the existing solar radiations and the hot-water load per unit collection area (Mw/Ac). With the Mw/Ac at 64.5kg/m2, the yearly solar thermal production of the HP-PV/T model in Hong Kong, Lhasa, and Beijing were recorded at 68.5%, 80.5%, and 64.7% respectively.

The PV/T water heater model was developed with a normal circulation and experimental tests were carried out with various water masses and various primary water thermal rates in an outside environment. Figure 4 illustrates the setup of the combined PV/T water collector. The hardware setup was implemented from 15 battens, with an overall heat-collection area of 1.76m2. The overall PV/T design was covered in an Al-alloy framework, obtaining the total dimension of 1.33m and 1.5m.

The outcomes showed that as the heated water load per unit heat-collection area was more than 80kg/m2, the diurnal electrical effectiveness was about 10.15%, the features diurnal thermal effectiveness was more than 45%, the features diurnal overall effectiveness was more than 52%, and the features diurnal initial energy saved was about 65%, for this model with a PV panel covering factor of 0.63 and a front-glazing.

III. CONCLUSION

The present study concludes that photovoltaic thermal collectors are promising technology to generate electrical and thermal energy simultaneously. In the study various designs of photovoltaic thermal collectors are investigated and operating and performance parameters are discussed.

It was observed that air and water based photovoltaic thermal collectors are very popular due to ease and lost fluid and have multiple applications. It is also important to note that fluid must be selected considering its thermo physical properties and area of application.

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