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PERFORMANCE ANALYSIS OF PARABOLIC TROUGH CONCENTRATING PHOTOVOLTAIC THERMAL SYSTEM

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Abstract

The electricity and heat produced simultaneously in a photovoltaic thermal (PVT) system from solar energy is about 60-70% efficient. The traditional photovoltaic (PV) system conversion of electricity from solar energy is only about 6-15% efficient, whereas 85% of the incoming solar energy is either reflected or absorbed as heat energy, which are cooled by water or air coolant to utilize the all incoming solar energy on system. The main objectives in this project work is combining two systems; Parabolic Trough as a concentrator and channel PV/T collector as a receiver. The performance study of Parabolic Trough Concentrating PVT is done and evaluated through water flow with concentrating PVT.

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Keywords: solar pvt; parabolic concentrator; reflecting glass; increased thermal efficiency

1. INTRODUCTION

The most important factor consider in electrical efficiency of photovoltaic (PV) cell are related to the band gap. Photon emitted from sun with energy below the band gap energy cannot be absorbed by PV and is transmitted. Photon with energy greater than the band gap energy is absorbed and converted into electricity. But that excess energy is lost to heat in the PV. Due to this heat, some losses are occurring in PV such as ohmic losses. Also PV cell absorb up to 80% of the solar irradiation. However, only 5–20% of the incident energy is converted into electricity. The remaining energy is converted into heat. So here we needed to use remaining 60% to 75% of incident energy to any heat cycle for high efficiency of PV cell. On sunny days PV laminates can reach temperatures as high as 35 o C above ambient temperature. In PV/T system, this heat is extracted from the PV panel and made available for use in a building, e.g., for tap water heating and space heating. With an optimal design, PVT systems can supply buildings

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with 100% renewable electricity and heat in a more cost-effective manner than separate PV and solar thermal systems [1].

1.1. PRINCIPLE OF ELECTRICITY GENERATION BY PHOTOVOLTAIC CELLS

A photovoltaic cell (figure1) comprises P-type and N-type semiconductors with different electrical properties, joined together. The joint between these two semiconductors is called the "P-N junction." Sunlight striking the photovoltaic cell is absorbed by the cell. The energy of the absorbed light generates particles with positive or negative charge (holes and electrons), which move about or shift freely in all directions within the cell. The electrons (-) tend to collect in the N-type semiconductor, and the holes (+) in the P-type semiconductor. Therefore, when an external load, such as an electric bulb or an electric motor, is connected between the front and back electrodes, electricity flows in the cell.

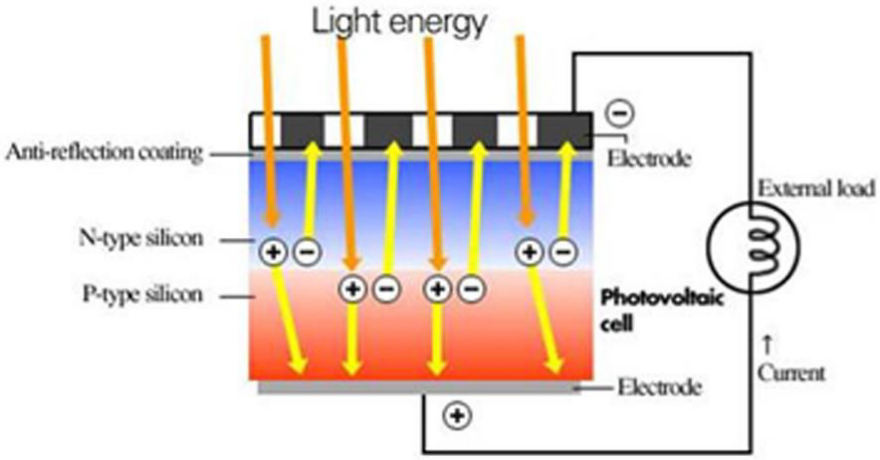

Fig. 1 Photovoltaic cell generates electricity when irradiated by sunlight.

1.2. THERMOPHOTOVOLTAICS:

Thermophotovoltaics (figure2) cell uses different technology to produce electricity. Thermo- means heat, these cells converts heat into electricity; rest of it works as same as photovoltaic cells which converts light into electricity The only difference between thermo-photovoltaic and photovoltaic is that thermo photovoltaic cells uses semiconductor which are designed for long wavelength, invisible light like infrared rays released by hot objects. This way of generating electricity is very neat and clean and also simpler to what we experience in power generation using generators, steam turbines etc.