جامعة عبد المالك السعدي
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Université Abdelmalek Essaadi

Centre des Etudes Doctorales Sciences et Techniques
&
Sciences Médicales

THESIS DEFENSE

Mrs. Zainab BEN SEDDIK

CANDIDATE FOR DOCTOR SCIENCES AND TECHNIQUES

Study and Optimization of Photovoltaic-Thermal Panel Performance through Diverse Techniques and Solutions

Date :	**Tuesday, December 19th, 2023**
Time :	**10.00 am**
Location :	**Conference Room, Building F, FST - Tangier**

Committe Members		
Pr. Mustapha DIANI	FST- Tangier	Chair
Pr. Said SAADEDDINE	FST - Mohammedia	Reviewer
Pr. Abdellatif BEN ABDELLAH	FST- Tangier	Reviewer
Pr. Ismael RODRIGUEZ MAESTRE	University of Cadiz - Spain	Reviewer
Pr. Souad HERMAND	UPHF – France	Examiner
Pr. Mustapha OUARDOUZ	FST- Tangier	Examiner
Pr. Mohammed AHACHAD	FST- Tangier	Co-Supervisor
Pr. Mustapha MAHDAOUI	FST- Tangier	Supervisor

ABSTRACT

To stabilize the greenhouse gas concentrations in the atmosphere and avoid disastrous climate change consequences while assuring the high and increasing demand for energy, the energy system worldwide should endure a transition from fossil fuel-based energy resources to more sustainable-renewable ones. With one-third of the total energy consumption worldwide and a 1.3% yearly increase in energy demand, the building sector is among the highest energy-consuming sectors. The latter's energy needs generally concern the demand for electricity and heat. Hence, both can be provided through the implementation of renewable solar-based energy systems in the buildings' available areas. Of the main solar energy technologies is photovoltaic/thermal panels. Absorbing solar energy, they can produce at the same time electrical and thermal energies. This dissertation delves deep into the potential of photovoltaic/thermal (PVT) systems, emphasizing their role in addressing the dual energy demands of the building sector. Through a series of comprehensive studies, the research evaluates the performance of various solar systems, including PV, PVT, and Solar Domestic Water Heater (SDWH), specifically in the Moroccan context. Advanced optimization techniques, combining the likes of Taguchi's method and genetic algorithms, were employed to enhance the efficiencies of the PVT system, identifying key parameters that significantly impact its performance. Furthermore, the research explores the integration of various enhancement technologies into photovoltaic systems, such as thermoelectric generators and phase change materials, aiming to provide a holistic evaluation across different climatic conditions. The findings underscore the efficiency of PVT systems, particularly when integrated with phase change materials, achieving total annual energy efficiencies ranging from 75% to 83%. In conclusion, this thesis offers invaluable insights into the potential of PVT systems, emphasizing their significance in the transition toward sustainable energy solutions. The results presented herein not only contribute to the academic understanding of PVT systems but also provide a practical framework for their implementation in diverse climatic conditions.

Keywords : Photovoltaic/thermal (PVT) panels, Solar energy systems Building sector, Energy consumption, Moroccan climatic conditions, Optimization techniques, Taguchi's method, Genetic algorithms, Electrical efficiency, Thermal efficiency, Solar Domestic Water Heater (SDWH), Phase change materials (PCM), Thermoelectric Generators (TEGs), Renewable energy, Sustainable energy solutions, Energy transition, Environmental preservation, Energy demand.