



SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ

Department of Physics and Process Control

19th WORKSHOP ON
ENERGY AND ENVIRONMENT
BOOK OF ABSTRACTS

ISBN 978-963-269-381-1

October 24-25, 2013
Gödöllő, Hungary

PREFACE

Successful events in the series of the Seminar/Workshop on Energy and Environment (EE) were organized yearly since 1995 under the auspices of the Department of Physics and Process Control, Institute for Environmental Engineering Systems, Szent István University Gödöllő, Hungary including active participation also from foreign institutions working in the field of the application possibilities of renewable energy resources.

The aim of the Workshop is provide a forum for the presentation of new results in research, development and applications in connection with the issues of energy and environment. In one part of the Meeting the participants had presentations on the different aspects of energy and environment, the abstracts of which are included in this booklet.

During the Workshop it was possible for the participants to visit the new developments of solar installation at the Department of Physics and Process Control as meteorological station, PV units, solar water collectors, transparent insulation wall, solar operated greenhouse, solar dryer, solar data logging/monitoring system, solar heated swimming pool, mobile PV kit, and the 10 kWp grid connected photovoltaic system.

Beside the presentations a discussion was held on the future steps and further project possibilities concerning energy and environment issues. The outcome of this session was that the participants confirmed their willingness to set up projects which is beneficial for the co-operating partners and also serves the development of the dissemination of appropriate technologies to fulfil the requirement of energy and environment.

The organisers are highly appreciated for support of projects OTKA K 84150, PV Enlargement and TÁMOP-4.2.2.B-10/1-2010-0011. Thanks also for the support of the Hungarian Solar Energy Society.

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19th WORKSHOP ON ENERGY AND ENVIRONMENT

October 24-25, 2013, Gödöllő, Hungary

Program

October 24 (Thursday)

- 14.30-17.00 Registration
Visiting the Department of Physics and Process Control
Visiting the exhibition of the solar installations of the Department

October 25 (Friday)

09.00-09.15 Opening the Workshop by:

Prof. I. Farkas Director of Institute
 Institute for Environmental Engineering Systems
 Szent István University, Gödöllő, Hungary

Prof. I. Szabó Dean of Faculty
 Faculty of Mechanical Engineering
 Szent István University, Gödöllő, Hungary

Session 1 Chairman: Prof. I. Farkas

09.15-09.30 I. Farkas: Recent market demands in photovoltaic applications

09.30-09.45 I. Seres, K. Hegyi, I. Farkas: Degradation of the energy production of a medium size PV system

09.45-10.00 Z. Kapros: The significance of modelling by operation of PV systems with an outlook on smart grid systems

10.00-10.15 I. Réti, I. Farkas: Molecular beam epitaxy technology for high efficiency GaAs based solar cell preparation

10.15-10.30 P. Víg, I. Farkas: ANN modelling of the transient thermal behaviour of vacuum tube solar collector

10.30-10.45 I. Kocsány, I. Seres: Thermal effects on efficiency of a PV module and PV/T collector

10.45-11.15 COFFEE BREAK

Session 2 Chairman: Dr. I. Seres

11.15-11.30 B. Brachtl: Actual trends in photovoltaic area traditional concepts and new visions

11.30-11.45 Z. Dodog: Influence of building boundaries on energy consumption

11.45-12.00 M. Czikkely: Environmental safety and sustainability in water management

- 12.00-12.15 M. Czikkely, B. Klemencz, Cs. Mészáros, Á. Bálint: Testing the Cu and Zn adsorption capacity of compost by Shaking method using polluted waters
- 12.15-12.25 R. Castanheria: Advantages of the use of hybrid solar collector systems
- 12.25-12.35 O. Sayginer: Solar energy harvesting on microelectromechanical systems
- 12.35-12.45 M. Lima: Comparison of different types of solar collectors

12.45-14.00 LUNCH BREAK

Session 3 Chairman: Dr. S. Bartha

- 14.00-14.15 K. Yuksel: Greenhouse solar heating system
- 14.15-14.30 F. Gurbuz: Solar drying as a tool for food preservation
- 14.30-14.45 D. Rusirawan, I. Farkas: Single diode model of photovoltaic modules and its parameters
- 14.45-15.00 S. Bartha: Evaluation of the quality of photovoltaic powered lighting systems
- 15.00-15.15 CLOSING

RECENT MARKET DEMANDS IN PHOTOVOLTAIC APPLICATIONS

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In spite of the recent economical situation all over the world the around 60% yearly increase of photovoltaic module production and their installation were performed in last couple of year period. However it can be observed sensitivity of the market change on the photovoltaic industry.

Accordingly, there are some very important points which are characterising and influencing the PV manufacturing and applications industry: The most important standpoint could be summarized as follows:

- 20% to 30% of the part of the renewables in the energy mix,
- 40% yearly decrease of the PV cell, module prices,
- the cell efficiency in market products does not improve in a great extent,
- strong competition between the crystalline and the thin film technologies,
- multi-Gigawatts applications,
- widening the feed-in tariff system,
- presence of the Chinese PV products in the European Union market.

Due to the growing market demand of the solar photovoltaic applications several new specific issues came to the light. These include factors include new type of modules, wide range application of thin film technologies, colouring of the modules, transparency of the modules, extra size of modules and new type of fixation systems.

At the Department of Physics and Process Control at Szent István University Gödöllő, Hungary as a part of research activities there were performed several solar installations. Among them the biggest solar photovoltaic application is a 10 kWp capacity grid-connected system including two different module technologies as polycrystalline and amorphous silicon ones. That serves for demonstration, educational and also for research purposes. During the new photovoltaic installation plans at the campus the above mentioned factors are also taking seriously consideration.

This paper is evaluating the influence of the market demand on the production and installation of the photovoltaic units.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

DEGRADATION OF THE ENERGY PRODUCTION OF A MEDIUM SIZE PV SYSTEM

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A 10 kWp photovoltaic system was installed in the framework of the PV Enlargement Project of the European Union at the campus of the Szent István University, Gödöllő, Hungary in 2005. The system was planned to consist of different type of photovoltaic modules (polycrystalline and amorphous silicon technologies are used) to be able to compare their operations. The different technologies are working in separate subsystems, in this way their energy production is recorded separately.

During the 8 years of operation a large amount of operational data were collected, among them energy production properties as voltage, current and power, together with the solar irradiation and temperature data. The collected data can be sufficiently enough to determine the power degradation of the system, if it (already) exists. Naturally the energy production shows very high differences between the years, but these differences mainly are coming from the changes of the environmental properties (temperature, solar irradiation).

To see, if there is any degradation of the energy production, the collected energy data had to be compared to the energy income from the solar radiation, which analysis was carried out separately for the polycrystalline and the amorphous silicon modules.

From the analysis described above can not be taken categorical conclusion that the degradation exist, however with some statistical calculations the effect can be recognized. The results are separately for the each installed photovoltaic technologies, but summarized results for the whole system is also presented.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

THE SIGNIFICANCE OF MODELLING BY OPERATION OF PV SYSTEMS WITH AN OUTLOOK ON SMART GRID SYSTEMS

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International, but somewhat domestic efforts are also being made to decentralize the smart grid power systems could spread. Partly related to the spreading of smart metering technology is in the focus. Some opinions it cannot be avoided that in the case of PV systems be installed on-line measuring, monitoring and data transmission systems.

The measurement and data processing costs could be significant by smaller PV systems. The measurement, data acquisition and transmission are an energy-intensive process that reduces the amount of electricity produced can be used, reduces the performance factor.

More research has moved toward the development of smart grid systems with PV's, these are briefly described in the performance PV GRID Intelligent Energy project probably is one of the most important.

In the presentation a short review will be given about the current domestic smart metering attempts, and the smart-grid – PV systems integrations in view of the possible future role of the modelling.

One of the challenges in the engineering sciences is by reducing the number of measurements to establish cheaper and more efficient PV systems.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

MOLECULAR BEAM EPITAXY TECHNOLOGY FOR HIGH EFFICIENCY GaAs BASED
SOLAR CELL PREPARATIONI. Réti¹ and I. Farkas²

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The molecular beam epitaxy (MBE) is the most sophisticated method for producing nanostructures. The growth of the nano structures is achieved with the help of molecular beam in ultra high vacuum. The use of the nano structures revolutionized inter alia material science and electronics - for instance solar cells (PV modules).

MBE is the most versatile technique for preparing clean and well-defined surfaces, interfaces, layers and nanostructures of different semiconductors. The most usable systems are for III-V semiconductors like GaAs. The GaAs based solar cells can reach high efficiency by using nano structures. MBE allows a controlled growth of films with sharp doping profiles and different composition.

This work represents the mechatronical control-system of the molecular beam regulation connected to this technology.

This work is about to create a regulated vacuum technics out-heating. For the free path and small residual impurity in the molecular beam epitaxy, 10^{-10} – 10^{-11} mbar vacuum should be attained. The chambers must be fumigated by controlled heating.

The strict, according to plan dosage of molecular beam has an important role in the programming layer-growth. It happens with the heating of the current source (Knudsen cell), then conducting the leaving molecules through a cryogenic pipe section. Our molecular beam epitaxial machine has four Knudsen-cells (Ga, In, Al, As). The regulation of these four molecular sources of the cells is carried out partly mechanically and partly electronically. The mechanical control is realized with the help of an DC electro engine through a transmission, which moves the shutters over the sources.

For the packing of the very complicated developed vacuum chamber, for the producing the emission of several components and introspection windows, a full computational documentation has to be created. The temperature measurement is done with the observance of the background's partial pressure. The control happens with PLC. The operator surface completion is made with the help of WinCC flexible program. The realization of these mechatronical systems are helped by students' work.

The molecular beam epitaxy system is equipment for crystal growth, which machine opens the door to preparation of low-dimensional systems under controlled circumstance. The experimental setup described in this paper is the only one presently in whole Hungary.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

ANN MODELLING OF THE TRANSIENT THERMAL BEHAVIOR OF VACUUM TUBE SOLAR COLLECTOR

P. Víg and I. Farkas

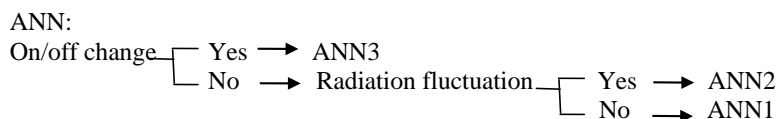
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Description of thermal behaviour of the vacuum tube solar collector with physically based model is rather difficult as because there are nonlinear thermodynamic and hydrodynamic processes in the background. In this case, to create artificial neural network (ANN) model could be an alternative solution, which can be used effectively at the control and optimization processes of the system. The aim of this work is to develop such model.

The inputs of the model are solar radiation, mass flow rate of solar fluid, collector ambient and solar fluid collector inlet temperature, the output is the solar fluid collector outlet temperature. The measured data were gathered at June-August, 2011. During the modelling the Matlab software along with Neural Network Toolbox was used.

From the measured per minute data there were used 27039 data rows during the developing and identifying the model and 2703 data rows at the validation process. During the training process several ANN models (several layer number, neuron number, transfer function) were tested. At the transient periods the difference between the measured and ANN generated outputs were significantly larger than the normal operating periods, so with an ordinary model the error can not be reduced at an acceptable level. The reduction of the error was tried to solve by using separate model.

The training and validation sets are separated in 3 parts: normal periods, radiation fluctuations and on/off transient periods. The ANN1 used to the normal periods contains one hidden layer with 21 tangent-sigmoid transfer function and one neuron with linear transfer function in the output layer. To the radiation fluctuation periods (in the next minute the radiation value change larger than 100 W/m^2) and to the on/off periods (the next 5 minutes change the on/off state) the governing ANN2 and ANN3 are similar, the only one difference is that the hidden layer contains 25-25 neurons with several weights. The operation of the separated model is the following:



Using the separated model the average deviation between the measured and ANN generated outlet temperature was $1,84 \text{ }^\circ\text{C}$ during the training, and $2,29 \text{ }^\circ\text{C}$ during the validation.

On the based of the results it can be said that the developed separate ANN model for describing the thermal behavior of the vacuum tube solar collector gives good estimation, and it provides also an acceptable accuracy in transient periods, as well. The presentation shows the details of the modelling results.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

THERMAL EFFECTS ON EFFICIENCY OF A PV MODULE AND PV/T COLLECTOR

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Flat plate collectors and PV modules are the most commonly used equipment of solar energy. The solar market has shown an effective 33% growth per year since 1997 until today. As a result of developing the photovoltaic solar energy system the hybrid photovoltaic/thermal system was developed. The term PV/T refers to solar thermal collectors that use PV cells as an integral part of the absorber plate. This part of my work advances and disadvantages of hybrid photovoltaic collector were analyzed. After explain about detailed efficiency analysis, the further section is focused on analytical models of water PV/T collector. Initially the solar system which was installed in the Department of Physics and Process Control, Szent István University is presented. The aim of this work is to study the behaviour of a hybrid collector and a polycrystalline PV module under the same conditions. Based on the measurement data analysis was elaborated for understanding the performance of different technologies. In this overview operation and behaviour of water PV/T collector under different circumstances were examined. There are many modules which influenced the performance of the solar equipment.

In this paper, the performance assessment of a PV/T collector was carried out. A detailed performance analysis was carried out to get a complete view of the utilized solar power of hybrid solar collectors, thermal and electrical parameters, and efficiency of different parts of PV/T collectors. From the investigation it can be concluded, that the thermal characteristic of the adhesive and working fluid flow rate has a considerable impact on the overall efficiency. In the frame work it can be concluded that the hybrid flat plate collector can be used to overcome the overheat problem of the PV system. From our examination on hybrid collector, based on measurement data it can be concluded that about 10 °C temperature drops on the collector cause one percent efficiency increase.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

ACTUAL TRENDS IN PHOTOVOLTAIC AREA TRADITIONAL CONCEPTS AND NEW VISIONS

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Photovoltaic (PV) sector has strong participation in energetic mix almost in each European country. Strong environmental impact and not data intensive technical solutions are the one of reasons why PV industry reach dimensions in 1Q 2013 of 71.4 GW installed capacity in Europe. As the technology reaches its level of implementation, there have been several concepts. These approaches determinate, the way of legislative and then technical systems which have been implemented in regions.

Having the position of strong international photovoltaic company, there are interesting overviews and perceptions. Martifer Solar is fully-integrated global player in the photovoltaic market. Formed in 2006,. Nowadays with over 400 employees worldwide with wide experience in ground mounted, rooftop, BIPV, small generation and off-grid solutions.

From technical point of view there come concepts with wide ground mounted installations, where the sizes of each projects reached MWs and dozens of MWs. Intersecting this concept there have been approaches to open markets for built-up areas, mainly for wide warehouses and large and semi large production centres. Nowadays there come initiatives to focus more on self-consumption strategy. For this trends are more accurate projects in small sizes mainly for small companies and householders, where the way of consumption reflects the daily irradiation curve.

Regarding the legislative impacts into markets we have been facing several type of modules. The one most efficient and most common is system of Feed in Tariff (FiT), which gives I easy way of support scheme. The other concepts fractionate the market to levels of installed capacities, which reflected the motivation of each government. The deep decreasing of cost of PV installation we are now facing new trends, where we see open market approach. There is one of the goal to minimize the system of support, but without influence of level of demand to this already traditional source of energy. This reflects the system of reversed auctions, where renewable source has specific position.

Understanding of our energetic needs and the advantages of new each technology should be in line with long term strategic documents, where position of PV is nowadays unavoidable.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

INFLUENCE OF BUILDING BOUNDARIES ON ENERGY CONSUMPTION

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This paper deals with the thermal behaviour of different exterior building boundaries. The trend aiming to increase the thermal insulation capability of exterior building boundaries in order to reduce the energy consumption of buildings has existed since the 70's. Today in the case of certain boundary constructions the thickness of the insulation layer already exceeds the thickness of bearing structures (constructions).

In addition to applying an insulation layer upon the framework there are other alternatives to reduce energy loss, including, for instance, the so-called active heat insulation, which means getting low enthalpy heat carrying materials inside the structure. The essence of this solution is that by increasing the temperature of the expediently selected layer of the wall structure we get to reduce the heat flow bringing on heat loss from the interior.

Evaluating the usage of active heat insulation from an energetic point of view necessitates a thorough survey. Based on the values of temperature of exterior and interior spaces correlating to the temperature of the environmental heat source we can distinguish several typical operational statuses, where the main energy flow rates and directions inside the structure are different in each of these statuses. None of these named cases are of a steady state condition.

The most important disturbing factor is the daily and seasonal changes in external temperature but there are several other factors that influence energy flows inside the structures. In this paper examination focus on itself the boundary construction and looks for different factors which refer to the change of energy flows between these constructions and their environment.

This research was mainly focusing on the definition of the energy flows between the exterior boundaries of buildings and their environment when energy input as well as energy removal are applied to such constructions. As a matter of fact, there are only specific design methods for these structures.

The current paper analyses the different criteria by which the boundary constructions of different energy input abilities could be compared with another one, and looks for response factors which refer to the change of energy flows between boundary constructions of dissimilar structure and their environment.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

ENVIRONMENTAL SAFETY AND SUSTAINABILITY IN WATER MANAGEMENT

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The Budapest Water Summit was held by the Hungarian Government and United Nations between 8th and 11th of October in 2013. I was a participant of this Summit as a young researcher. This was one of the biggest meetings of such character all over the world. There were experts and scientist form South-America to Asia. During the Budapest Water Summit were several Forums e.g. Scientific Forum, Youth Forum and Business Forum. On the closing day a common statement was founded, which contains the principal goals of sustainable water management and water supply (e.g. research, education and policy). That study intends to introduce this statement focusing on the main points.

Water is a unique, which was brought together the people among and across generations, nations and cultures and is a source of cooperation. All the globe and ecosystem functions will put everyone and everything at risk if water is not governed properly by the human right to safe and clean drinking water and sanitation. Safeguarding and rehabilitating ecosystems in 21st century water resources development approaches will be an important shift towards sustainability. The dedicated water goal would be accompanied by Smart targets addressing the following main water-related issues: To achieve universal access to safe drinking water and sanitation, as well as gender responsible sanitation and hygiene services as part of human rights in all households, schools, workplaces and emergency contexts including refugee camps.

To improve integrated and cross-sectorial approaches to water resources management. To manage freshwater resources in an integrated way at the basin level including in transboundary river basins to maximise benefits across sectors in an equitable and sustainable way, foster food and energy security, protect ecosystems and increase water productivity.

To reduce pollution and increase collection, treatment and re-use of water. To protect human health and the environment from municipal, agricultural and industrial water pollutions by reducing the pollutions, collecting and treating wastewaters and maximising their re-use.

The capacity development for water means lessons of water and sanitation related development goals show the critical need for a sound scientific underpinning, socio-economical, technical, financial and engineering capacity. The critical nature of water for human populations and the planet, conditioning any future sustainable development agenda, requires a robust intergovernmental process to monitor regularly, review and assess progress of the implementation of the future water goal. It is recommended, that appropriate institutional mechanisms to be put soon in place to review regularly and assess progress in an integrated manner.

Acknowledgements: The authors would like to thank the support of our study for “Research Centre of Excellence- 17586-4/2013/TUDPOL” project.

TESTING THE Cu AND Zn ADSORPTION CAPACITY OF COMPOST BY SHAKING METHOD USING POLLUTED WATERS

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During the wastewater treatment process the aim is to reduce the concentration of heavy metals and other chemical pollutants. There are several technologies to do that, but it is necessary to develop the existing methods further. In this study we would like to introduce a new and alternative method. It is a laboratory experiment and our plan for the future is to make it on the wastewater treatment plant in a real environment.

Our samples are obtained from a compost produce company. The pH value of its was 6.9. It had 65% water contents and several important chemical elements (e.g. N, P, K, Ca and Mg). The wastewater (polluted water) samples were made by us in the laboratory. Cu and Zn solutions were prepared from $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and $\text{ZnSO}_4 \cdot 5\text{H}_2\text{O}$ in the following concentrations: 100 mg/dm^3 , 50 mg/dm^3 and 25 mg/dm^3 , respectively.

The method used is a new technique, which is continuously developed by the research staff of the Department of Chemistry and Biochemistry. This method was the next: the 10 g of compost and 30 cm^3 solutions (Cu and Zn contaminated, respectively) were shaken together by the machine (Yellow line OS5 basic, Ika Werke GMBH and CO KG, Germany) by 480 c/min and in 50 minutes. All of the compost solution samples were shaken by this setup. All measurements were done in three replicates. All of the samples were digested using 5 ml HNO_3 and 1 ml H_2O_2 . After shaking and digestion, the concentrations of Cu and Zn were measured by an atomic absorption spectrometer at the Department.

The measurement showed that the 100 mg/dm^3 and 50 mg/dm^3 concentrations of solution order are better than the 25 mg/dm^3 because the lowest concentration (after the destruction) was below of the detection limit. We measured several concentration of Cu and Zn amount and have made adsorption diagram of the adsorption capacity of compost. This was a mathematical representation of our results. We will show at the presentation all the results in detail using this adsorption diagrams.

Acknowledgements: The authors would like to thank the support of our study for “Research Centre of Excellence- 17586-4/2013/TUDPOL” project.

ADVANTAGES OF THE USE OF HYBRID SOLAR COLLECTOR SYSTEMS

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In a world in continuous technological development there is a huge need in utilizing all the types of self-sustainable energy and in abandon the traditional energetic resources. For that reason, the Department of Physics and Process Control from Faculty of Mechanical Engineering, Szent István University, Gödöllő installed various solar applications for educational, demonstrational and research purposes, such as PV and solar thermal units, transparent wall insulation and solar dryer unit.

In countries with a very favourable solar exposition it is frequent the use of PV (photovoltaic technology) to transform solar radiation into electricity. The advantages of solar energy is quite important such as, low maintenance costs, do not pollute the environment and it is continuously energy. The system life cycle is between 20-30 years however, it has a long payback time period, what is the main disadvantage of it.

A simple PV module is converted the incoming solar radiation into electricity with around 10-15% efficiency. This is due to the fact that solar radiation increases the temperature of PV modules, resulting in a drop of their electrical efficiency. To solve this problem of low electrical efficiency the hybrid PV/T collector was developed.

The PV/T collector can be separate into two parts: the thermal solar technology (converts the solar energy into heat) and the photovoltaic technology (converts the solar radiation into electricity). A complete flat plate PV/T collector should be composed by a glass cover, solar cells, insulation, copper splitter and an absorber plate underneath. The absorber plate plays an important function in PV/T collector. It cools down the PV cell or module, simultaneously collecting the thermal energy produced in the form of hot water or hot air. There are several types of PV/T collectors such as, air PV/T collector, water PV/T collector, and a combination of water-air PV/T collector.

Several authors developed analytical model of flat plate collectors to made analytical calculations on PV/T collectors. The model estimated PV/T efficiency (thermal and electrical) to be about 60–80%. In the Physics and Process Control Department on Szent István University a study was made for measuring the efficiency of the PV/T collector, and based on the result it was concluded that, about 10 °C of drop in the temperature in the module caused about 1% of efficiency increase. It is important to mention that the PV/T can be used to overcome the PV module overheat problems and also, to keep the system efficiency at satisfactory values.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

SOLAR ENERGY HARVESTING ON MICROELECTROMECHANICAL SYSTEMS

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Developing cheap, renewable, green energy is arguably the greatest challenge facing society. Solar energy offers clean, renewable energy; however, power produced with photovoltaic (PV) solar cells is currently about four times the cost of power from conventional energy sources. In addition, efficiency improvements in PV technology have become incremental.

Researchers from Sandia National Laboratories have performed a preliminary investigation of a new approach for generating electrical power with solar energy that does not rely on the photovoltaic effect. This approach was inspired from previous Sandia research where MEMS (Microelectromechanical Systems) devices were caused to resonate by laser (coherent) illumination. They have also used a similar interaction that they have conceived that will cause mechanical resonance with illumination by solar light. This approach takes advantage of a unique interaction between a mechanically resonant device and optical illumination. Once the solar energy is converted to mechanical energy, the energy can be readily converted to electrical energy by using either capacitive or piezoelectric energy harvesting techniques.

Such type of solar energy conversion technique utilizes a thermal energy conversion process that allows all wavelengths to be fully utilized. In PV cells, only the wavelengths that match the band gap energy of the semiconductor are utilized fully for electricity generation (this is the fundamental limit on PV cell efficiencies). If this technique is able to achieve a level of efficiency that is competitive with PV cells (i.e. at least 5-10%), it will offer significant cost savings. The cost savings will come from a direct displacement of the high-cost semiconductor material required for PV cells and possible secondary savings through the elimination of the inverter required in a PV system (the power coming from the mechanical resonant structure would be AC). These two costs alone represent nearly 50% of the costs of current PV power systems.

In that study introduced a radically new approach to solar energy harvesting. This approach uses an effect where optical illumination induces mechanical resonance in micromechanical structures.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

COMPARISON OF DIFFERENT TYPES OF SOLAR COLLECTORS

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There are several types of solar collectors, which are becoming more popular and more efficient, according to our needs, each day. A solar collector is a device that absorbs solar radiation for use as an energy source, usually to heat water or for heating systems. This paper presents all types of solar collectors and their main characteristics that distinguish them from one another, making them more or less suitable for different situations.

Flat-plate collectors – possibly the most popular, these function as follows: sunlight passes through the glazing and strikes the absorber plate, which heats up and transferring the heat into the liquid passing through the pipes attached to the absorber plate. The advantages of this system are that it absorbs sunlight from all directions above, not needing to track the sun and there is a large production rate, which makes them inexpensive. But, it has been confirmed that the insulation of this type of collector is worse than vacuum tube collector.

Evacuated tube collectors are composed of multiple evacuated glass tubes, each containing an absorber coat merged to a heat pipe. The absorber converts the sunlight to heat. Inside of the inner tube a heat pipe is built-in, which promotes the transferring process for the produced heat energy up to the manifold, and then to the storage tank. The vacuum between the tubes reduces convection and conduction heat losses, which makes these more efficient than flat plate collectors in colder conditions. The gaps between the tubes has an important advantage, that allow for snow to fall through the collector. Based on some studies made in SZIE this type of collector has a higher usage of its absorber surface compared to flat-plate collectors in winter. However, even in areas without much sunshine, some low cost flat plate collectors can be more cost efficient. Also, since the evacuated tube collectors are relatively new, they still need to demonstrate competitive lifetimes.

Solar air heat collectors are one of the most efficient and economical solar technologies available. The glazed systems have a transparent top sheet and insulated side and back panels. For these types, air passes along the front or back of the absorber plate while scrubbing heat directly from it. The unglazed systems consist of an absorber plate which air passes through while it takes heat from the absorber.

Parabolic trough is also a type of solar thermal collector. That is curved as a parabola lined with a polished metal mirror. The sunlight enters the mirror and is focused along the focal line, where objects are positioned to be heated. The trough usually rotates to track the sun during the day. This system is beneficial because it provides the least cost solar generated electricity, and provides firm renewable daytime peaks. The problems are that it occupies a big amount of land and only uses direct radiation. Besides, it spends a lot of water.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

GREENHOUSE SOLAR HEATING SYSTEM

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A greenhouse has one purpose: to provide and maintain the environment that will result in optimum crop production or maximum profit. This includes an environment for work efficiency as well as for crop growth.

Making a literature overview it can be stated that several authors made studies to explain the limitations to equipment and methods used to control or maintain desirable temperature and other environmental conditions in a greenhouse during those periods when supplemental heat is required.

Obviously there are many ways this can be accomplished from the standpoint of equipment used, types of fuel used, type of construction, and management practices followed.

In the recent economical and environmental issues require a great attention of the use of renewable energy resources in the heating and cooling processes of different greenhouse technologies.

In the last period one of the greatest consideration was given to the use of solar energy resources.

Because each operation usually has some unique characteristics such as types of plants produced, level of quality of production strived for, type(s) of house(s) used and management procedures followed, it is important that all of these factors be considered when selecting and installing a heating system.

In the recent study the recent development and achievement in greenhouse heating systems will be evaluated.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

SOLAR DRYING AS A TOOL FOR FOOD PRESERVATION

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Solar radiation use for drying is one of the oldest applications of solar energy. It was used since the dawn of mankind mainly for food preservation but also for drying other useful materials as cloths, construction materials, etc.

The first installation for drying by solar energy was found in South France and is dated at about 8000 BC. Solar heat was the only available energy source to mankind until the discovery and use of wood and biomass. Until today in remote small communities, not only in the so-called third world regions, but also in the western countries, people take advantage of solar radiation to dry and preserve small amounts of food.

Solar drying has not yet widely commercialized. Solar dryers are equipment, generally of small capacity and based rather on empirical and semi-empirical data than in theoretical designs. The majority of the numerous solar dryer designs, which are available, are used mainly for drying of various crops either for family use or for small-scale industrial production.

In this presentation on "Solar Drying" various direct and indirect solar drying applications and some of the numerous solar dryers are described. A very short historical description of solar drying through the centuries is also given.

Special solar collectors used in drying and methods of coupling to the various solar dryers are described as an indirect solar thermal energy source. Finally, an example of drying of grapes to produce black current raisins by indirect solar radiation is given as well.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

SINGLE DIODE MODEL OF PHOTOVOLTAIC MODULES AND ITS PARAMETERS

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Photovoltaic (PV) is the technology that generates direct current (DC) electrical power from semiconductor material when they are illuminated by photons (light). As long as light is shining (with enough of energy) on the PV solar cell/PV cell, as the smallest system of the individual PV, it generates electrical power.

A PV cell's characteristic under solar irradiance (G) is given in terms of PV cell output currents (I) and PV cell voltage (V). A PV solar cell is the building block of a PV module/panel/array. A PV module is formed by connecting many PV solar cells in series and parallel.

Modeling of the PV system performance is very complicated and influenced by a variety of interactive factors related to the environment and solar cell physics (material technology).

A simplified equivalent circuit model of PV cell is used since it is quite simple to implement and is compatible with the electrical characteristic of the actual PV cell. Presently, many equivalent circuit models have been developed and proposed to describe the PV cell's characteristics. Considering only a single PV solar cell, it can be modeled by utilizing a current source, a diode and two resistors. Furthermore, this model is known as a single diode model of solar cell. In a single diode model, a complete characteristic of a PV cell's can be described by five model parameters i.e.: light generated current (I_l), leakage or reverse saturation current (I_o), diode quality factor (n), series resistance (R_s) and shunt resistance (R_{sh}). Light generated current and reverse saturation current can be said as external influences meanwhile the others are internal influences.

Accuracy of the PV system modelling is depending on the correct calculation of the internal influences. A research preliminary in order to identify internal influences have been performed. As a research subject, polycrystalline silicon (wafer based crystalline silicon technology) and amorphous silicon (thin film technology) modules, as components of grid-connected PV array system at Szent István University (SZIU), were used under Gödöllő climatic conditions. As an initial step, simulation results based on software packages (associated with the PV characteristics) and some calculation methods to identify internal influences are shown here. As a long term outcome of this research, internal parameters of both modules can be predicted, and furthermore a single diode model of both PV modules can be developed.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

EVALUATION OF THE QUALTY OF PHOTOVOLTAIC POWERD LIGHTING SYSTEMS

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The Romanian solar energy market, especially a photovoltaic energy conversion represents a stabile investment environment in South East Europe with clear rules and green certificate schemes. The current cumulative installed PV capacity is around 60-80 MW_p, but in the next two years that can reach more than 431 MW_p. This installed application represents in general the PV Parks with 1-5 Megawatt installed power capacity, built in different regions of the country. In general these applications are grid connected and have been developed by the local authorities and private investors. In the last period thousands of photovoltaic – powered lighting systems has been installed in different location in Romania. The majority of these are in the 50-200 W_p range and are used in urban area. Some of the current urban application for photovoltaic lighting include: billboards, security lighting, public transport shelters, emergency warning lights, area lighting like race tracks, streets and parks. This photovoltaic-powered lighting application is generally a stand- alone systems and operate at 12 or 24 V dc and use white LED lamps, they can work with very low energy requirements. Is typical the lighting system is functioning after sundown and the energy requirements, the energy demands is provided by a deep cycling batteries.

The new installed photovoltaic powered street lighting units performance requirements are drawn up by CEN TC 169/226 JWG in standard EN 13201-2. Based on this standard the requirements for the lighting level is classified in six classes and referring to lighting the streets, roads, residential areas, parking places, etc.

The present paper describes a case study and evaluation technique and equipment indicated to use for of the quality classification of the photovoltaic –powered street lighting. The used equipment has been built from Nova data loggers connected to one Light multi range sensor “DT009-4 type, designed to measure three ranges of light, 0-600 lx, 0-6lx and 0-150 Klux values that is an ideal sensor for indoor and outdoor measurements. The NOVA family data loggers, used in experiments were chosen for the following reasons: competitive price, windows based graphical user interface which made them easier to use, the large screen available for manipulating data. The case study presents the street lighting quality in a small Romanian town. Analysing the measured data we established the level of the lighting in the studied streets are corresponding to class *P 2*- especial for *Streets with pedestrian or cyclist traffic*. In case of the measurements realized in a small park where the lighting elements are solar street lamps the results are corresponding to *P 6* class - Streets with very little pedestrian traffic. That indicated the photovoltaic – powered lighting technologies implemented in this region, with low solar energy potential, it is not an ideal technical solution to lighting the urban area with high traffic.

Acknowledgement: The research was supported/subsidized by the TÁMOP-4.2.2.B-10/1-2010-0011 „Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.

19th WORKSHOP ON ENERGY AND ENVIRONMENT

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