SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ

Department of Physics and Process Control

25th WORKSHOP ON

ENERGY AND ENVIRONMENT

BOOK OF ABSTRACTS

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November 28-29, 2019

Gödöllő, Hungary

PREFACE

Successful events in the series of the Seminar/Workshop on Energy and Environment (EE) were organised 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.

This is now a call to take part in the above mentioned event along with to submit one page abstract of potential contributing papers falling into the Workshop topic. The Abstract Volume of the Workshop will be published and distributed among the participants during the event. The language of the Workshop is English, no simultaneous translation will be provided.

The deadline of the abstract submission: November 22, 2019

Further information, please, contact:

Prof. I. Farkas
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25th WORKSHOP ON ENERGY AND ENVIRONMENT

November 28-29, 2019, Gödöllő, Hungary

Program

November 28 (Thursday)

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

November 29 (Friday)

08.30-08.40 Opening the Workshop by:

Prof. I. Farkas	Head of Mechanical Engineering PhD School Institute for Environmental Engineering Systems Szent István University, Gödöllő, Hungary
Prof. I. Szabó	Vice rector for Education Szent István University, Gödöllő, Hungary
Prof. L. Kátai	Dean of Faculty of Mechanical Engineering Szent István University, Gödöllő, Hungary

Session 1 *Chairmen: Prof. I. Farkas*
M. Pálfi

08.40-09.00	I. Farkas: Recent developments in solar thermal energy use
09.00-09.10	M. Pálfy: PV in the last 25 years
09.10-09.20	Z. Farkas, A. Ürmös, Á. Nemcsics: Very high efficiency quantum dot based solar cell and its some technological aspects
09.20-09.30	D. Atsu, I. Seres and I. Farkas: Performance analysis of grid connected Si-poly and Si-amorphous photovoltaic systems
09.30-09.40	Ahssan M.A. Alshibil, P. Víg and I. Farkas: Efficiency improvement of the hybrid solar collector systems
09.40-09.50	P. Víg: Examination of a photochatalitic thin layer on solar module
09-50-10.00	B. Varga, Z. Komróczy, Á. Nemcsics: Some aspects of a Hungarian solar cell project
10.00-10.10	I. Seres, D. Atsu, I. Farkas: Voltage-time function measurements of inverters
10.10-10.40	COFFE BREAK

Session 2 *Chairmen: Prof. K. Gottschalk*
Dr. Cs. Mészáros

10.40-11.00 U. Praeger, H. Scaar, I. Truppel, K. Gottschalk and M. Geyer: A low air speed logger for measurements in storage of agricultural products

11.00-11.10 Cs. Mészáros and Á. Bálint: Symmetry analysis of the optical scattering processes relevant for solar cell materials

11.10-11.20 Gy. Ruda: Energetic and environmental effects of concentrated building activity

11.20-11.30 Z. Patonai, R. Kicsiny, G. Géczi: Research the comfort optimum in the military camp

11.30-11.40 P. Hermanucz: Investigation of micro-scale, renevable energy based cogeneration or trigeneration units

11.40-11.50 A. Qor-el-aine, A. Béres, and G. Géczi: The different transmission of air pollutants in Morocco

11.50-12.00 G. Habtay, J. Buzás and I. Farkas: Analysis of the airflow in chimney based indirect solar dryer

12.00-12.10 J. Tóth, V. Erdélyi, L. Jánosi, I. Farkas: On-off and PID control of a small-scale solar system

12.10-13.30 LUNCH BREAK

Session 3 *Chairmen: Prof. P. Weihs*
Dr. I. Seres

13.30-13.50 P. Weihs, H. Trimmel, H. Formayer, C. Gützer, I. Nadeem, S. Oswald, S. Faroux, A. Lemonsu, V. Masson, M. Revesz, K. Hasel: Influence of climate change and urban growth of the city Vienna on the thermal comport of its habitants

13.50-14.00 H. Zsiborács, G. Pintér, N. Hegedűsné Baranyai, K. Máté, P. Weihs: CO_2 reductions of photovoltaic and wind energy technologies in Hungary and in Austria: Perspectives for 2030

14.00-14.10 I.R. Nikolényi, J. Tóth: Hubbard model for efficiency calculations of organic solar cells

14.10-14.20 I. Kocsány, I. Seres and I. Farkas: Effects of absorption on heat transfer process in solar collectors

14.20-14.30 M. Haekal, D. Rusirawan and I. Farkas: Feasibility study of hybrid renewable energy system in Cipatujah, West Java - Indonesia

14.30-14.40 Asaad Yasseen, I. Farkas and I. Seres: Modelling aspects of concentrating solar collectors

14.40-14.50 F.A. Irdam, D. Rusirawan, and I. Farkas: Modelling of photovoltaic's characteristics based on fuzzy time series

14.50-15.00 M.F.A.R. Tisyadi, C. Nugraha, Rispianda and M. Daroczi: Augmented reality based learning aid as a potential alternative for paper based media

15.00-15.10 S. Bartha, L.C. Duarte, F. Carvalheiro, P. Moniz: Sustainable marine biorefinery modell base seaweeds value chain developed for small scale units

15.10-15.30 CLOSING

RECENT DEVELOPMENTS IN SOLAR THERMAL ENERGY USE

I. Farkas

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This paper is dealing with the recent developments of the use of solar thermal energy use in all over the world. The worldwide situation is analysed based on the recent situation discussed intensively at the Solar World Congress organized by the International Solar Energy Society in Santiago, Chile in 2019, and also at the EuroSun 2018 Solar Conference organized in Rapperswil, Switzerland in 2018. Additionally, the most recently published books in this topic served also a basic source to the overview statements.

The main thematic questions, specifically related to the solar thermal, are as follows: solar buildings and architecture, solar thermal heat for industrial processes, solar thermal collectors, solar heating and cooling, solar buildings and architecture, energy storage, solar assisted district heating and cooling and large-scale applications and solar energy market.

The Figure bellow shows the global solar thermal capacity for the period of 2000-2018 (IEA Solar Heating and Cooling Programme, May 2019).

The main characteristics of the recent solar thermal status can be summarized as:

The cumulated solar thermal capacity in operation by end of 2018 was 480 GW_{th} (686 million square meters of collector area) compared to the year 2000 the installed capacity grew by a factor of 7.7.

The corresponding annual solar thermal energy yield in 2018 amounted to 396 TWh, which correlates to savings of 42.6 million tons of oil and 137.5 million tons of CO_2.

Although the global solar thermal market fell by 3.9% in 2018, there are positive growth figures in nine of the top 20 countries. It is supposed that this trend can continue in 2019.

The traditional mass markets for small-scale solar water heating systems for single-family houses are under market pressure from heat pumps and PV systems.

PV IN THE LAST 25 YEARS

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25 years ago (1994): First solar cells already had been developed in the World 40 years ago, as well as in Hungary (VKI)

20 years ago: Efficiency: from 6 to 15%. No more PV activities at VKI and Solarlab but Solart-System is 4 years old. HSES is 11 years old. ISES Solar World Conference in Budapest (1993). Eff.: Si 23.1(1Sun), Si 26,5% (140 Sun) (J. Van Overstraten: GaAs 32,6 (100 Sun)). Si feedstocks are dominant in production. Module costs: 2-4 Ecu (selling price: apprx. double). Global PV production: more than 40 MWp/year. Home: 0. The late 80's 1MWp PV plant in Japan (Saigo). PV installations in Hungary: 10kWp grid off systems. (from the previous PV productions). One or two PV Companies in Hungary. Solar education activity and equipment.

15 years ago (2004): Efficiency: 35% multilayer's and concentrator. In production: Si feedstock is dominant. Big breakthrough in Europe. REA 2000 in Germany, grid on systems and feed-in tariffs: 0,5 Euro/kWh. More than 2 GWp PV installations in the World. 100 kWp PV installations in Hungary (apprx. 75% grid off). Home PV production:0. Dunasolar (est.: 1997) closed. PV module selling price: 4-5 USD/Wp. Quasíautonomous PV power source developed at Solart-System.

5 years ago (2014): Efficiency: 44%. multilayer's and concentrator. Si feedstock is dominant in production. Big modules. Over300 Wp. PV module eff. over 20%. Progress is unbroken. More than 100 GWp PV global. In New EU Member States: 2 GWp PV installation in Czech Republic. Big fall in PV prices: 05-0,7 Euro/Wp. China's leading role. The PV electricity is cheaper in some Countries. (grid parity). Progress at PV in Hungary after 2010. 77,5 MWp PV installations in 2014. Home grid-on systems are in majority. More and more PV Companies: module assembling and installing.

Todays: Si feedstock is dominant. New technologies. Efficiency: over 44%. Thermodynamically limit: over 60%. Global PVs installed are over 500 GWp. Apprx. 1000 MWp PV installations are in Hungary. China taken over the global leading role in PV production and application (over 80 GWp). The World's biggest solar PV plant (1500 MWp) also in China installed in 2016. Some hundred PV Companies work in Hungary. More than 30000 PV equipment installed in Hungary. Home grid-on systems are in majority. Permissions for 2000 MWp. More than 100 solar PV Parks are under projection and construction.

Future: R&Ds focus to new technologies. First of all to the cost effective technologies with low electricity's demands. Further price fall is expected. Cut back of production costs. Wide range automation and application of robot technologies. Powerful R&Ds in energy storage technologies. With spreading the electrical vehicles the utilization of electricity storage capacities. Decentralized, smart-grid systems. Application of local energy storages. Economical continental energy transportation. Electrical distribution systems controlling. Further development of PV application in Hungary. 5% share in electricity production in 2020.

VERY HIGH EFFICIENCY QUANTUM DOT BASED SOLAR CELL AND ITS SOME TECHNOLOGICAL ASPECTS

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The significance of solar cells is on the rise regarding the utilization of solar energy. The efficiency of commercial solar cells rarely exceeds 20 percent. The efficiency of the solar cells matched to solar spectrum, with 100 percent quantum efficiency, is somewhat higher than 30%. The latter finding is well explained by the fact that the solar cell absorbs photons closed to its band gap. The solution of this problem is the utilization of as wide part of solar spectrum as physical laws permit. galliumarsenide must be mentioned first when one considers possible materials for optimal solar cells. The homologue epitaxy of this material and its close relatives enables the user to construct quantum well solar cells the efficiency of which exceeds 40 percent. We go even further in this work. If quantum dots are fabriced inside of solar cell, one can achieve 60, even 80 percent efficiency. At the first sight this technology seems to be quite expensive and does not appear to be ecologic at all. At most it can be considered for space technology utilization. In spite of this, there are terrestrial application with light concentrator as well. The complicated structure does not imply necessarily complicated technology as the inherently present self-organizing feature of the material is capitalized.

In the first part of the presentation, we give an explanation of the operation of quantum dot solar cell, thereafter the technology will be detailed. Our molecular beam epitaxy device will also be presented.

In the second part of the presentation we summarize our recent research. The quantum dot array is fabricated only by self organizing process, no lithography was used. Of course, substantial amount of research was carried out before the implementation of this technology. The kinetics of growth process must be known. In order to set up a preference ranking of main steps of growth process with regard to time, a qunatum dot field with continuous volume distribution was examined. Atomic force microscopy was used for the examination. The lateral sizes and height of quantum dot vs. volume of quantum dot functions were calculated. As a result we concluded that elongation caused by bonding anisotropy was the dominant process during QD formation. The second process according to our ranking, was the endeavoring to reach suficial compactness. The least preferred process was the formation of symmetric side facet. This research and our results were communicated in scientific article which is about to be published.

References

Á. Nemcsics: Solar cells and their developing persectivies; Academic Press, Budapest (2001).
A. Ürmös: Some technological aspects of solar cells, containing III-V-based quantum dots; PhD Theses (2017).
Á. Nemcsics, Z. Farkas, A. Ürmös; Some aspects to the facet evolution of droplet epitaxially grown quantum dot; to be published

PERFORMANCE ANALYSIS OF GRID CONNECTED Si-POLY AND Si-AMORPHOUS PHOTOVOLTAIC SYSTEMS

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The average annual sunshine hours and the average solar radiation received in Hungary portray her as a country with averagely high potential for solar energy exploitation compared with other countries in the sub-region. In terms of favourable conditions for investment in solar PV systems development, Hungary was ranked among the top ten most attractive countries among the Central Eastern European and South-Eastern European countries (CEE & SEE) in the "Attractiveness index for solar photovoltaic (PV) energy investments by the Renewable Market Watch". However, Hungary has experienced a relatively low growth rate in Solar PV systems dissemination over the years.

This study investigated the performance of PV systems in the Hungarian climate, using a 14-year-old 10 kWp grid-connected solar PV system installed at Szent István University, Gödöllő, as a case study. The system, one of the first grid-connected PV systems installed and still in operation in the country. It is made up of two different PV technologies, Polycrystalline silicon (pc-Si) PV technology (ASE-100) and amorphous silicon (a-Si) PV technology (DS-40), divided into three (3) sub-structures and installed on the flat roof of the student dormitory building. The total power of the system is 9.6 kWp, with a total PV surface area of 150 m^2. Each sub-system is connected to a separate inverter.

PVsyst software V6.8.5 was employed to simulate the performance of the systems per its specifications and constraints. The results were analysed and compared with the measured data in assessing the performance of the system. It entailed evaluating the effective energy output of the PV array, energy injected into the grid, performance ratio and the normalized energy productions per installed kWp.

Results show the pc-Si sub-system to generate 4,189.3 kWh energy annually from the array, out of which 3,845.8 kWh is fed into the grid. The annual average performance ratio of the sub system was determined as 79.8% whiles the inverter average efficiency was 91.8%. The a-Si sub-system generated 3040.9 kWh annually from the array and feeds 2845.0 kWh into the grid annually. It recorded a performance ratio of 64.4 % and an average inverter efficiency of 93.6%.

Further study will consider investigating the performance of other PV installations of different capacities and with different module technologies. The quality of the power fed into the grid will also be explored.

Acknowledgements

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EFFICIENCY IMPROVEMENT OF THE HYBRID SOLAR COLLECTOR SYSTEMS

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Solar systems considered as one of the energy production alternatives that do not make the contamination or serious wastes and, in this way, reduce the hazard on condition contamination. Using solar energy as an alternative energy source has high reliability, the fact that there is no cost of fuel or any moving mechanical parts.

Solar energy has two essential systems for utilizing; the first is the solar cell (photovoltaic cells) which produces electricity from the photons of the solar radiation and the other is the solar (collector) which employs the thermal energy of solar radiation.

It is 7% to 16% of the solar radiation falls on the photovoltaic cells is converted to the electrical energy, while a part of residual radiation is reflected, and the significant part is turned into heat. Efficiency and productivity decrease when this heat causes the solar cell temperature to increase and reduce their lifetime.

If this heat absorbed from the solar modules, then can decrease the surface temperature of the PV modules. Thus, the electrical yield turns out to be increasingly ideal and the heat energy gathered can be used in different applications. So, electrical and thermal energy can be extracted from Photovoltaic (PV) module and Thermal (T) collector, or hybrid PV/T solar collector. The combination of the PV/T system includes a PV module, and heat exchanger behind it, the liquid used for cooling is distributed in the heat exchanger it can be water, air or nano particles.

A lot of studies focus on the utilization of photovoltaic/thermal (PV/T) system rather than photovoltaic (PV) alone, this will lessen the space for two separate systems, thus it will reduce materials used in manufacturing and cost and improve system efficiency. Several studies were performed to present a review of the exciting types of hybrid PV/T solar collector and recently published works plainly describe that how the electrical and thermal efficiency was improved of hybrid solar collector systems using various ideas. It is given a key word that can be studied and figure it out.

This study will focus on improving the performance of the PV/T and the efficiency will be discussed and investigated experimentally. The system will be simulated, analysed and modelled.

The general objective of this research is to investigate the performance of the hybrid solar collector systems in enhancement of the conversion efficiency by developing a mathematical model of PV/T collector and validate it by experimental results, study application of a new fluids and materials in PV/T collectors, modelling the hybrid solar collector systems using a suitable software, experimental investigation of hybrid solar collector systems performance, comparison between conventional PV module and solar PV/T collector.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Szent István University, Gödöllő, Hungary.

EXAMINATION OF A PHOTOCHATALITIC THIN LAYER ON SOLAR MODULE

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Nowadays, the practical applications of nanotechnology and new achievements in the field of materials sciences are very important. One such area is the use of self-cleaning nanotechnology coatings for to keep clean the several surfaces. By applying these coatings, cleaning costs can be reduced (e.g. windows, vehicles) and our tools (e.g. solar module, solar collector) can be work more efficiently. One option for the self-cleaning is usage a lotus-effect passive coating, where the nano-sized protrusions from the surface help prevail of the superhydrophobic surface. Another possibility is the use of active coatings with photocatalysis, which activates the self-cleaning process under the influence of light, thus helping to neutralize the contaminations, primarily organic molecules on the surface.

The present study examines some optical properties of a Hungarian-developed self-cleaning thin layer. The photocatalytic layer main components are follows: TiO_2 0.5%, WO_3 0.5% and SiO_2 2% ± 0.1%.

First, the coating effect was investigated on a 4 W power uncoated polycrystalline solar cell with a surface area of 156x156 mm^2. One half of the side of the glass is covered with the layer and the other half is not covered. Thus, it was possible to study the reflected spectrum of the layer by comparing the natural solar cell and the glass covered.

During the further measurements was used a monocrystalline solar module with a 50x50 cm^2 area. The maximum power of the solar module during the coating hardened was examined. Before, immediately after the application of the coating, and afterwards the I-V characteristics of the photovoltaic cell and its maximum power were determined with the same artificial illumination. Based on the results, it can be stated that 2 days after the application of the coating, the performance did not change significantly.

The following series of measurements investigated the antireflective effect of the coating on both cases, direct and diffused radiations. The reflection is direction and wavelength dependent quantity. During the illumination a standard bulb with 40 W electric power was used. The reflected light spectrum on the module was determined by the Ocean Optics spectrometer. Based on the signal coming into the spectrometer via the optical cable, the spectrometer gives intensity every 0.36 nm between 340 and 1026 nm, which can be measured and recorded using the Overture program which run on the connected computer.

The results of the work, which can be important near the solar modules, any other surfaces which require regular cleaning, are detailed in the presentation.

SOME ASPECTS OF A HUNGARIAN SOLAR CELL PROJECT

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In this presentation, we give an introduction to the steps and experiences of installing one of the terrestial solar power plants. The use of solar energy is very important for global environmental protection and energy conservation. Fortunately, more and more solar power generation units are building up in the world. Not only solar technology but the installation technology is constantly evolving. In our work, we will show this aspect of state-of-art solar panel installation through an example.

If one thought that, a solar panel power plant would not be difficult to build, or if he wanted to achieve a single investment grade and get a 25-50-year risk-free cash flow – we have to disillusion everyone. The installation would be highly observable, requires exact construction work and there are so many difficulties and pitfalls. Promote prudent planning and future operations when the site is optimized for the location, tilt angles, and maximum utilization of the area. There are three types of solar panels to choose from when it comes to pros and cons.

The first step is to choose a suitable building site regarding 8 different facts. As a second step, we have to do some preparation works to be able to start building the solar power plant. We set up properly the supporting structure, we circumspective measure the spatial placement of the solar cells in the working field, connect the inverters, AC Boxes, do the cabling, make the grounding system, and place the auxiliary equipment, and this can already work? Well, no, let's take a closer look at the pitfalls of installation!

A surveyor has to determine the exact place of the posts by using GPS and set up the proper horizontal level of the supporting posts by using a rotate laser. After these, ramming of the posts will start. In case of placement inaccuracy of the posts, we cannot fix the PV modules by screw bonding and we have to pull out the post and place a new one. We can encounter the first problem during setting up the proper distance between the posts of the supporting structure. We always face problems during the determination of the proper reference line for which we measure the correct horizontality of the posts. Another main problem is that the right angle (90°) between the bigger post and the row of the smaller post is not properly set up, out of line. Another main problem is that the ramming machine rams the posts by applying too much force to the post. The next difficulty is when we try to follow the terrain, with a non-terrain follower structure. This time, so-called breaking will appear. Another problem arises during the mounting of the PV panels to their holders (vertical rails). A short circuit problem arises during the creation of the string. This problem arises during cable installation when the external insulation of the cable and one vein inside the cable ha can be damaged.

References:

Á. Nemcsics: Operation and types of solar cells and their applications; Kandó College Publisher; Budapest (1999).

B. Varga: Engineering design and installation of a Hungarian Solar Cell Project; BSc Thesis, Budapest (2019).

VOLTAGE-TIME FUNCTION MEASUREMENTS OF INVERTERS

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Nowadays, more and more PV systems are installed even in the households, so beside the quantity of the produced electric energy, the quality of the generated AC voltage get bigger and bigger importance. To show that the problem is realistic: in 5th of September, 2019 at 2:30 pm the total electric power of the Hungarian PV systems was about 511 MW, which is bigger than out of service block of the nuclear power plant in Paks having the power of 50 MW.

For measuring the quality of electric power of the inverters, first the shape of the voltage function has to be checked. For a long time, oscilloscopes were used for checking the signal shape of a fast changing voltage function, but they were able just visualize the signal, and they do not provided data for mathematical analysis.

Recently, the fast development of the high speed data logging makes it possible, that without an expensive digital storage oscilloscope the signal shape can be checked. For this in our case a National Instrument MyDaq and an USB6009 datalogger unit was used, at high sampling frequency of 400 KS/s and 40 kS!s for the two units.

Definitely, such instruments cannot be directly connected to the electric grid, as the Voltage limit of these units are about 50 V. So, for the measurement a Voltage divider had to be built, to protect the analogue input channels of the units. After this the unit could measure the time sequence of the grid voltage.

In case of high frequency voltage measurements from the analysis of the measured data hopefully higher harmonics can also be identified, which can be harmful for some grid controlled equipment, so called sound frequency control signals are send by the grid operator.

During the presentation a real time measurement will be shown for the actual grid voltage, and for the voltage output function of several different inverters, as well.

Acknowledgements

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A LOW AIR SPEED LOGGER FOR MEASUREMENTS IN STORAGE OF AGRICULTURAL PRODUCTS

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In storage areas of agricultural products, air flow is required to dissipate the field heat of the stored material and the respiratory heat in the subsequent storage phase. For best possible quality maintenance, the temperature distribution and air flow in the room should be equalized as possible. High air velocities on the product surface cause high water losses through perspiration. Locally too low air flow can lead to the formation of hot spots and thus to increase quality loss. The fan operation for air circulation is associated with considerable energy consumption. For example, in the case of an apple stock, which is quite comparable to potato storage, it requires about 1/3 of the total energy consumption for cold storage operation.

The newly developed air flow sensor ‘ASL’ for measurement in product heaps is suitable for detecting low air flow in storage of apples or potatoes (see Figs 1-2). In apple bins, very different air velocities were measured in the boxes depending on the position in the room, which is considerably lower than in the gaps between the rows of boxes. Exemplary measurements in potato storage showed immediate adjustment of the air velocity above storage heaps and between potato tubers at changing fan speed. In addition to the fans outside the outflow direction, the speed was significantly lower than measured directly below the fans. In the boxes, the air speed was about 10% of the speed above the boxes. With a reduction of the fan speed by about 50%, no air movement was measurable in the box laterally below the fan.

The results show that it is necessary to distribute the fans as regularly as possible over the wall width to obtain the most uniform possible air flow distribution in the room. Furthermore, taking into account the stability, it is necessary to make the box openings as large as possible in order to keep the air resistance as low as possible and thus to ensure a safe ventilation of the potatoes (or apples, etc).

Fig. 1. The ASL sensor

Fig 2. The ASL sensor placed in potatoes

SYMMETRY ANALYSIS OF THE OPTICAL SCATTERING PROCESSES RELEVANT FOR SOLAR CELL MATERIALS

Cs. Mészáros[1] and Á. Bálint[2]

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Despite of the continuously changing meteorological conditions and the global energy supply problems, the alternative energetic technologies are still far from being applied on sufficiently large scales. One of the most promising branches of the whole alternative energetics is related to use of the solar energy on a much wider scales, than it is characteristic nowadays. The relevant flat-plate solar collectors should play a role of crucial importance from this point of view, because of the intensive, high-rate insolation, which is available in many areas in global sense, too. Therefore, the unsolved solar materials science problems will be put into the focal point of the contemporary condensed matter physics and crystallography. Among them, investigation of the low-dimensional systems and nanostructures will probably be of particular importance. Nevertheless, the basic-type quantum-statistical theoretical models able to give a well-founded description of the functioning of such types of materials are still not elaborated in detail, despite of the very large number and detailed studies about them.

In order to contribute to solving of these important scientific research problems, the basic features and application methods in the condensed matter physics of the so-called line group theory will firstly be reviewed here concisely. After this discussion of the elementary algebraic structural properties of these infinitesimally long, discrete chain-type systems, the basic mathematical tool, the representation theory of such groups will also be introduced and discussed. Finally, as one of the most important field of applications of this advanced mathematical method, the quantum-mechanical selection rules necessary for describing the inelastic light scattering processes in such chain-type microscopic systems will also be presented.

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ENERGETIC AND ENVIRONMENTAL EFFECTS OF CONCENTRATED BUILDING ACTIVITY

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According to the directive (nr. 2018/844) of the EU the building activity is responsible in 36% for the total CO2 emission of the Union. The decarbonisation can only be successful with a complete change in the building practice. Beside concentrated urbanization the decentralized regional development can solve the energetic and environmental (EE) problems.

As a main consequence of centralized urbanization the remote countryside have lost its function, jobs and population. The estimated loss can be a few hundred thousand inhabitants. It means emptying ten thousands of farm buildings and about hundred thousand flats in the last decades.

My earlier investigation was based on detailed exact statistics of the Hungarian Ministry of Agriculture. I also surveyed and analysed several hundred typical structures and farms among some 25.000 abandoned agricultural establishments. Without proper use or reuse their EE load has been considerable with an estimated 10 TWh loss of energy, besides impurity and unfavourable appearance.

These exactly surveyed farm sheds of large scale production have got standard structural frames and use of materials easy to measure, calculate and summarize.

Parallel with this industrial scale development of farms, all around the countryside, however, roughly one million living houses, village flats have been built in the former decades. Their structures can consist prefabricated, uniform elements, occasionally also any kind of local materials.

To look over this combined system of flats and living districts approximately 1.000 village houses, homes, have been surveyed and analysed. In most cases, their function, structure and insulation have to be improved. These expenditures can approach 25% of the value of the whole building in case of professional instructions. It is rather practical instead of demolishing and building new houses, concerning also EE issues.

Among the million regarded living units, with moderate valuation at least hundred thousand can be selected as more or less deserted, useless.

Finding proper use of these 100.000 concerned structures or avoiding such mistaken investments and transport can be resulted in more hundred TWh saving of energy (EE). This can be a considerable step in decarbonisation task of the EU.

The environmental benefit is also essential, the human living-space is considered as well. The countryside should be decentralized again to maintain the multifold production, the local natural and social environment in site.

RESEARCH THE COMFORT OPTIMUM IN THE MILITARY CAMP

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The operation of temporary military camps is a special operation task. In any case, it can be said that it is installed for a specific purpose and for a foreseeable (short) period.

In our work, we study the most characteristic parameter of a complex camp operation: how well the internal environment provided in the installed facility is suitable for the rest of the soldiers. We studied the history of the development of military camps, the structure of the currently used technology and the design needs. Based on all these, the direction of development can be determined, while maintaining functionality, rapid deployment and transport is also important.

In order to determine a reasonable and sustainable energy requirement for camp operation, it is necessary to assess the indoor air conditions under which the performance of the deployed personnel can be maintained at the highest level.

In the light of the experience of the last 20 years, the concept of temporary facilities as military camps should be rethought on the basis of material research. Special attention should be paid to the planning of its operation. The basic design data and requirements that help to build a temporary infrastructure have generally been determined from empirical data that can be considered to be incorrect today. It is therefore necessary to conduct a comprehensive review of temporary installations in order to establish a sound design basis for today's requirements. In line with 21st century environmental engineering practice, energy efficiency and recyclability are an increased requirement for military facilities as well.

Environmental awareness is a major concern today. When operating a military camp in an environmentally conscious manner, special attention must be paid to internal environmental values, the presence of contaminants, and the waste generated during camp operations. Recyclability can be an important factor in closed field operations. This requires knowledge of the requirements of camps, their structure and processing processes, as well as the material- and energy transport during supply.

INVESTIGATION OF MICRO-SCALE, RENEWABLE ENERGY BASED COGENERATION OR TRIGENERATION UNITS

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As small cogeneration units can hardly be met in Hungary at present, I find it important to get to know the equipment of foreign companies. During my work I tried to put a lot of emphasis on getting to know as much as possible the currently available solutions, the operation and the energy features of the equipment. Of course, I try to examine the applications from both technical and economic point of view, and consider the installation possibilities in Hungary as much as possible. Based on these criteria, I choose the type that I will investigate in the near future.

From the micro-scale units, in the present research I choose constructions that can be used in building engineering and can be combined with a heat pump. After reviewing the manufacturers' offerings, I grouped the equipment as can be seen in Fig. 1.

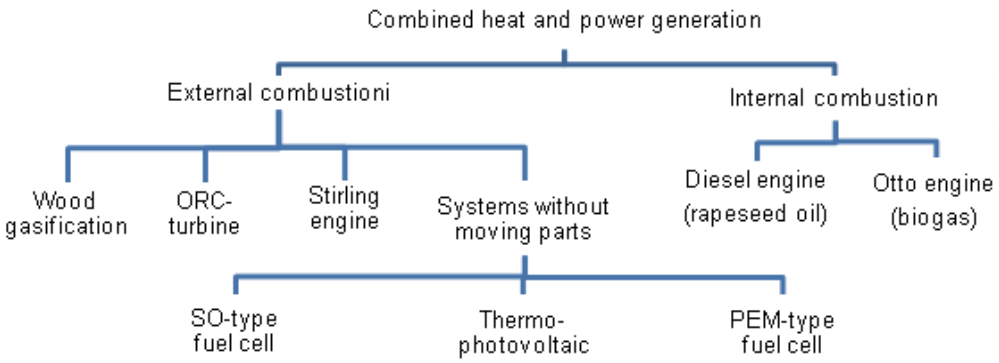

Fig. 1. Grouping the manufacturers' offerings

It can be stated that micro-scale cogeneration (equipment for the combined production of heat and electricity or refrigeration and electricity) has advantages which should be exploited, but their adverse effects can be reduced to an acceptable level by applying appropriate techniques. In the following, I will deal with micro-sized cogeneration units which, under Directive 2004/8 / EC, have an electrical output of up to 50 kW and are powered by a diesel engine. This drive makes it easy to use 100% renewable energy without significantly reducing comfort, as it is available as an option in several manufacturers. (Hassel, 2006).

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THE DIFFERENT TRANSMISSION OF AIR POLLUTANTS IN MOROCCO

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The dispersion of air pollutants in the atmosphere is becoming an obsession for many researchers, and it is one of the most critical issues nowadays. Morocco has been engaged in many international agreements, to decrease the emission of air pollutants. But until now the modelling of the dispersion of air pollutants in Morocco is still an open field for research.

The diversity of the geography in Morocco makes the modelling a challenge for any researcher because it includes different types of nature like oceans, mountains, urban, desert and plains areas that each of those need a different model with many different parameters that control the dispersion of air pollutants.

For this purpose, modeling software will be used and tested for Morocco. The IMMI is software developed by Wölfel Group which is a company that provides overall engineering and system solutions in the fields of vibration, structural mechanics, acoustics and immission control. The software is used for many aspects, for the calculation of industrial noise, traffic noise, Workplace Noise, Aircraft Noise and Air Pollution which is the part that will be used.

Following both TA Luft 1986 (Technical Instructions on Air Quality Control based on Gaussian Plume model) and TA Luft 2002 (Instructions based on the Particle model), the IMMI software operate with two dispersion models, Gaussian model and a long-range particle model, and Lagrangian air dispersion model – AUSTAL2000.

As that Germany represents a diversity of nature and has common points as Morocco, like mountains and coastal regions, besides that the IMMI software is used for modeling the Air pollution in Germany, it represents a good choice to check the results of the software for Morocco based on the available data.

Collecting the emission data and sources, beside the meteorological data illustrate a challenge due to non-availability of an online archive for the public use, but starting with assumptions collected from international and national reports about the air pollution in Morocco will give a general view about the results of the software, and the parameters that should be taken care of and that can influence the results given by the software. However, testing the software for some Industrial cities in Hungary and verified the results will offer a view about the accuracy of the results of the software, and will show some critical parameters.

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ANALYSIS OF THE AIRFLOW IN CHIMNEY BASED INDIRECT SOLAR DRYER

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The progress in renewable energy sources is increasingly becoming a necessity. In this context, solar energy stands out because it is low pollution source of energy and required less area as compared with other renewable energy in terms of the same amount of power output. Solar energy is a very useful energy to dry agricultural products. Chimney in drying application uses solar energy to generate hot airflow to accelerate the airflow inside the dryer. Increasing chimney height improved the thermos-phoning abilities of a solar dryer (Madhlopa et al., 2002). This paper presents numerical analysis of the airflow in the chimney of an indirect solar dryer. Air temperatures were measured at different positions in the dryer.

The indirect passive solar dryer was built with a 4.20 m total height, 2 m height accounted for the chimney. This system composed of a solar air collector, drying chamber and a chimney. The dryer was installed in the Solar Laboratory of Department of Physics and Process Control, Szent István University, Gödöllő, Hungary.

Ambient temperature, collector inlet and outlet temperature, chimney surface temperature, and airflow temperature inside the chimney were measured using 8 channel temperature datalogger. Total global solar radiation was measured between June-July and September-October in 2019 using CM 11 Pyranometer. These data were analysed and discussed to evaluate the chimney performance.

The measured average airflow temperatures along the chimney height and ambient air temperature were plotted over time (for 6 hours). It can be shown that negligible variation observed between the temperature at chimney inlet and outlet. Moreover, the temperature at chimney outlet is greater than the ambient temperature which airflow in the chimney is maintained. During the day, where there is incidence of solar radiation, maximum temperature difference between chimney outlet and ambient temperature occur at approximately 1:30 p.m.

A numerical analysis of the non-steady turbulent flow inside the drying system was performed using CFD commercial software. Flow was modelled through the numeric solution of the conservation equation of mass, momentum and energy.

The results indicated that the dryer with a chimney was consistently more efficient than the standard indirect dryer without a chimney. The airflow rate of air through the dryer were also shows that the dryer with having a chimney enhances airflow and so improves the drying efficiency.

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ON-OFF AND PID CONTROL OF A SMALL-SCALE SOLAR SYSTEM

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This study presents the ongoing research conducted in the field of thermal systems which are commonly used in agriculture and in other fields in order to utilize the solar thermal energy. This paper describes a small-scale physical system that is controlled by hardware-in-the-loop (HIL) method.

The solar thermal input is realized by a heating element, which can provide a 51.15 W power in total. The input energy is controllable via pulse width modulation (PWM) to mimic the stochastic changes in weather. The heat storage unit is a 1 litre in volume isolated tank, which contains also the heat exchanger unit. The working fluid in this system is water which is forced by custom made peristaltic pumps both on the "collector" side and on the output. In this way the mass flow rate of the pump can be controlled on the heat exchanger and on the user side, as well. The user side is modelled by a water-air heat exchanger force-cooled by air with a help of a varying speed fan. The temperatures are measured on several points of the system which are used to control the flow rates of the pumps. Fig. 1 shows the studied system.

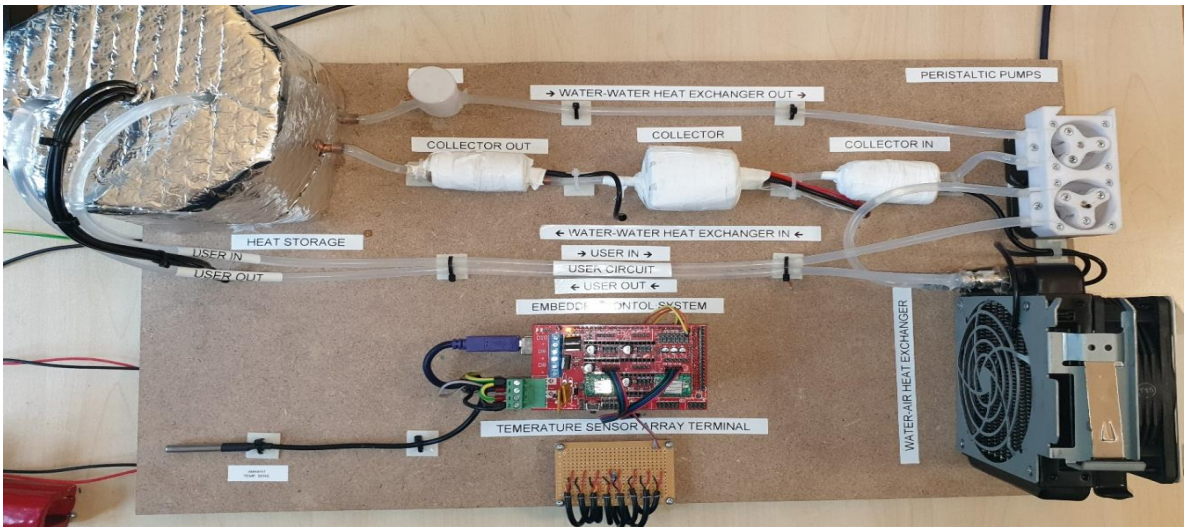

Fig. 1. Studied small-scale solar system

In this study the comparison of different controlling algorithms (on-off, PID) of this small-scale system is presented. The HIL approach enabled the usage of the block-oriented SimSolar library, which contains the mathematical models of the controllers.

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INFLUENCE OF CLIMATE CHANGE AND URBAN GROWTH OF THE CITY VIENNA ON THE THERMAL COMPORT OF ITS HABITANTS

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Until 2030, the population within the metropolitan area of Vienna is expected to increase by 10%. This will cause the living space to be densified. However, already now the population is suffering from heat stress during the summer months.

Within the project URBANIA the influence of urban expansion on the heat island effect in the city of Vienna is investigated. The micro scale model Town Energy Balance (TEB) is coupled online and offline with the meso scale model (WRF). Further, measurements are taken in selected districts of Vienna and are used to validate the coupled model. Then this coupled model is used to simulate selected scenarios of urban expansion with regard to a changing climate in the future. The thermal comfort of the population is estimated by calculating the universal climate index (UTCI).

The meteorological conditions in Vienna already now show inhomogeneous spatial variations. For example, the thermal stress on the scale of UTCI varies by up to 6 °C between different districts, which corresponds to the span of almost one category on the comfort scale.

Simulations of a historical heat period in 2015 show that densification of the living space may result in a slight increase of air temperature by less than 0.1 °C in the city centre. However, optimised growth may result in a decrease of the air temperature by up to 0.1 °C.

Micro-scale simulations show also that vegetation may have a cooling effect on the urban climate and that an increase in surface albedo may on the one hand cause a reduction in air temperature, but on the other hand a slight increase of the thermal stress for the population.

CO_2 REDUCTIONS OF PHOTOVOLTAIC AND WIND ENERGY TECHNOLOGIES IN HUNGARY AND IN AUSTRIA: PERSPECTIVES FOR 2030

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At global level, over the last three decades world energy demands have shown a consistently growing trend, with primary energy growing by 89.5% and CO_2 emissions by 79% in the 1973-2006 period. It is forecasted that this trend will continue, with emerging economies energy use growing at an average annual rate of 3.2%, and developed countries growing at a rate of 1.1%. Since the energy demand of mankind increases continuously, utilization of renewable energy resources is increasingly important besides reducing environmental effects. The cost of renewable energy is now falling so fast that it should be a consistently cheaper source of electricity generation than traditional fossil fuels within just a few years.

By a one-time investment in flexible photovoltaic technology, it is possible to produce CO_2-free, green energy without producing any waste for several decades. Greenhouse gas mitigation strategies are generally considered costly. Decision-makers often engage in debates concerning financial aspects of mitigation and the distribution of costs between different countries. While some of them emphasizes that the financial crisis was a showstopper to mitigation of GHG emissions, others contend that this is a golden opportunity to make these changes and create new jobs that are not based on the notion of abundant fossil fuels.

An interesting question is what future CO_2 reduction prospects will be expected in the future of the variable renewable energy technologies? For answers the EUCO an EU Reference Scenario 2016 scenarios were used, which reports come from the European Commission.

Overall, it can be stated that based on the analysed data by 2030 the Austrian and Hungarian CO_2 reduction potential is expected to be between 2.4 and 4.9 million tonnes cumulatively, which would account for 1.9% to 2.4% of European Union values.

Acknowledgements

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HUBBARD MODEL FOR EFFICIENCY CALCULATIONS OF ORGANIC SOLAR CELLS

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In our presentation we wish to demonstrate the power of the Hubbard model on the theoretical estimations of the maximal efficiency of organic solar cells. These calculations are according to the Minnaert-Burgelmans formula (Minnaert et al., 2007) and based on the band structure technique of the Hubbard model (Gulácsi et al, 2014). By the help of this one we able to study not only some concrete solar cell type but the parametrically characterizable solar cell families for example polythiophene: PCBM-based ones. The obtained diagrams can serve as guidelines for molecula-designers presenting the tendencies of the maximal efficiency on the chosen Hubbard parameters. There are expectations for extending our calculations to study other processes for example the power of the oxygenation and the so-called second-nearest hopping terms.

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EFFECTS OF ABSORPTION ON HEAT TRANSFER PROCESS IN SOLAR COLLECTORS

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In most solar collectors all three heat transfer modes - conduction, convection, and radiation - are important, and the exact calculation of the heat loss can be very complicated. The convective heat loss is caused by the air movement in and around the collector, and because of the circulation the warm absorber is cooled down. This is the reason why evacuated flat plate and vacuum tube collectors were developed. By this solution the amount of the convective heat loss is reduced. Assign a reason to vacuum only to decrease the heat loss, not to influence the properties of the solar radiation absorbing.

In this paper the heat flow from the absorber to fluid through the tube wall is analysed. Usually the conductance of the absorber and tube wall material has good thermal conductivity, but it has to be taken to the account in a correct model. The heat flow from wall to fluid occurs by convection and is described by the convective coefficient. Even though the achievable overall accuracy of a heat loss calculation may be quite low, there are situations where one would like to model certain details with much greater precision.

The calculation of the heat loss can be very complicated, because of the variant components. Usually in practice radiation heat transfer is often negligible. In a thermal collector flux of the solar energy is large-scale smaller than in conventional heat transfer equipment. In addition to required preciseness, one must be taken to account available accuracy.

Emissivity of the absorber plate is specially characterized by the selective coatings where emissivity may have fluctuating between 10-50%. This value is depending on the type and manufacture of the coating. It is difficult to anticipate the convective heat transfer with better than 20% accuracy. In solar collectors the heat is extracted by the heat transfer fluid which flowing through the tubes.

FEASIBILITY STUDY OF HYBRID RENEWABLE ENERGY SYSTEM IN CIPATUJAH, WEST JAVA - INDONESIA

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The uses of renewable energy source are continuously growing all around the world. In its national strategy, Indonesia is planning to have 23% of its electricity is produce by renewable energy sources by 2025. This target is simultaneous with the other commitment i.e. to reduce the green house gas emission to 29% by 2030.

Indonesia is located in the equator line, and therefore it has a constant period of solar radiation period throughout the year, as identified is about 4.80 kWh/m^2/day. The potential of wind energy is about 60,647 MW, and presently only 0.01% is used. Based on this fact, it can be predicted that hybrid renewable energy system between wind and solar energy is potential solution to have a contribution to fulfil the national strategy.

In this study, a feasibility stud of hybrid renewable energy system will be introduced with implementation case study in Cipatujah area, West Java, Indonesia, as can be seen in Fig. 1. Two type of commercial software package i.e. Homer and Retscreen will be used for this evaluation. In this study, wind speed and solar radiation taken from NASA's database were used as main input data. Moreover, some assumption such as operation and maintenance cost of the unit, lifetime, and also derating factor are needed, as the input to the calculation, both of software.

Fig1. Location of Cipatujah in West Java Area

The sequences of the simulation process are as follow: fully of the photovoltaic (100% PV), fully of the wind turbine (100% WECS = wind energy conversion system), and varying of the ratio between solar and wind, as a hybrid system. The expected outcome of this study is try to find the optimal ratio between photovoltaic and wind turbine in hybrid system, in the certain area, for the predetermined of the capacity. As a long term target, a method for optimized the hybrid system will be proposed and also the differences between the existing and suggested method will be found.

MODELLING ASPECTS OF CONCENTRATING SOLAR COLLECTORS

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The parabolic trough solar collector (PTSC) technology is one of the most reliable technology in the field of solar thermal. It is mainly used for power generation such as steam temperature is gotten from high temperature, and also for other technological purposes. Thermal energy is collected from solar radiation in the focus of radiation at certain point. PTSC consists of reflecting surface, absorber tube and the working fluid passing through the tube.

A fluid flowing inside the tube absorbs the heat energy that is generated from focused solar radiation raises its enthalpy and causes an increase in the temperature of the tube wall.

A small prototype of a parabolic trough solar collector was manufactured at the Solar Energy Laboratory, Department of Physics and Process Control, Szent István University, Gödöllő, Hungary. The experiments were performed with parabolic trough solar collector, the system was used producing hot water.

Aluminium reflector with different material and diameter tube (copper and stainless steel), as well as various flow rate was applied during the efficiency of the PTSC system. The temperatures of fluid were measured at inlet and outlet of receiver tube by digital thermocouple sensors. The highest thermal performance was obtained when glass covered copper tube was used as absorber.

The goal of this research is to increase the thermal efficiency of PTSC by enhancing the working fluid passing through the absorber tube. Furthermore, is to be studied how the material of the absorber tube effects the heat transfer between the metal and the working fluid.

Mixing of nanoparticles to the working fluid is an effective method to increase the thermal energy collected and the thermo-physical properties of nanofluid such as the enthalpy, specific heat capacity, thermal conductivity and density.

In this research is to investigate the performance of parabolic trough solar collector based on design, modelling, the fluid in absorber tube and heat transfer analysis. Using ANSYS simulation models describing the heat and mass transfer processes of PTSC system and determines the performance i.e. collector efficiency, and for other design parameters in order to identify the factors related the optimization of the system.

Therefore, the volume fraction of nanoparticles effects on the hydrodynamic and thermal efficiency of the PTSC. It could raise the heat transfer coefficient and lead to enhance the thermal conductivity.

Furthermore, making comparison the operation among different fluids by measurements the different traditional working fluid of the PTSC and the effect of nanoparticles in the working fluid of the system (nanofluid) on the efficiency and for the operation of parameters.

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MODELLING OF PHOTOVOLTAIC'S CHARACTERISTICS BASED ON FUZZY TIME SERIES

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People's demands on energy have increased every year. Fulfilment of energy needs is dominated by utilization of fossil energy. It is fact that the trend of fossil fuels reserves, such as petroleum, natural gas, and coal continue is declining every year. On the other hand, fossil fuel produces carbon gas that make environmental problem in society, so it can affect next live of next generation. To prevent it, researchers began to develop clean energy based on renewable sources, such as solar energy, to produce electricity.

Photovoltaic (PV) is device that converts solar energy into electricity. It is very important to know all parameters, which influences the photovoltaic's characteristics, as basic to analyze of its performance. Such parameters are ambient temperature, irradiation, humidity and wind velocity, as the input parameters, meanwhile cell temperature, voltage, current, and power, as the output parameters. All these parameters can be obtained both by direct measurement or modelling. To simplify in understanding of the PV characteristic, modelling is needed.

In this research modelling of PV characteristic will be shown, using fuzzy time series method. Actually, this method is a basic in order to predict future data, based on previous (historical) data. The focus of our works is modelling of the PV characteristic, particularly some output of the PV parameters, such as voltage (V), current (I) and power (P).

The modelling is based on direct measurement's V, I and P data of which was obtained in December 31, 2018, started from 6 a.m.-6 p.m. There were 721 data pairs for each characteristic. The modelling is initializing by divide the collected data into some classes with same intervals. The voltage is divided into 11 classes at intervals of 3, current is divided into 50 classes at intervals of 0,2 and also divided into 191 classes at intervals of 0,01, and power is divided into 53 classes at intervals of 20 and also divided into 151 classes at intervals of 7. Then, fuzzy sets are created based on the division of the collected data. After that, fuzzy logic processes are done to obtain the modelling results.

Margin of Error (MoE) from each cases is obtained by compare of the modelling results and direct measurement data. They are MoE 3,9% for voltage; MoE 24,7% for current at intervals of 0,05, MoE 33,1% at intervals of 0,2; and MoE 21,5% for power at intervals of 7 and MoE 34,8% at intervals of 20. The voltage has the lowest of MoE. It shows that voltage data is not as fluctuation as current and power data.

It can be seen that the fluctuation in collected data, will influences on the division of data. It can be noted as well that the narrow interval are needed in order to get the lower of MoE.

This modelling is just applicable in the day where the data was obtained, so there is plenty of things that can be developed for further research.

AUGMENTED REALITY BASED LEARNING AID AS A POTENTIAL ALTERNATIVE FOR PAPER BASED MEDIA

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Technology as a digital media can be used as an alternative for traditional paper-based written media. As technologies such as smartphones become more widely spread, the means of using such technologies are easily accessible. One of the technologies that can be used as a replacement for written media is augmented reality (AR). AR is an interactive technology where computer-controlled perceptual information are added to real world objects. Those information comes in the form of visual, auditory, olfactory, and haptic medias.

In Indonesia, the paper still a widely used material. In 2017 about 7 million cubic metres of wood were processed into pulp, which can indicate that the demand for paper is quiet high. That fact can also be seen through empirical observations, it can easily be seen that paper is still commonly used for written media such as books that are used in education. Paper is relatively easy to process after it's use, although the same couldn't be said in regrowing the trees that is used as the raw material for it. Trees grow at a much slower rate than the rate of paper turning into waste, and to produce a single ton of paper requires approximately three tons of wood. This indicates the need for a better forms of media.

An experiment was designed to test the effectiveness of AR technology as an addition to the traditional paper-based media. The implementation of AR program that is used in this research is only used to complement learning materials used in the Fundamentals of Engineering Design course in Institut Teknologi Nasional Bandung. This implementation is based on the need for visualisation in the course material, and the suitability of the technology as AR can provide good visualisation.

The method that was used is effectiveness testing using AR program as a learning aid to test for parameters such as total test scores of students in completing engineering design tasks and time required for students to complete such tasks related to the materials given. In addition, usability questionnaires are also given to participants to measure the effectiveness of the AR program subjectively.

Effectiveness testing results proves statistically that the use of AR program as a learning material both increases the total score of students, and decreases the time needed to complete the exercise. Subjective assessments using usability questionnaires also show that the AR program had helped students in learning the material presented to them.

Results of this research shows the potential of the use of technology, in this case augmented reality, as a substitute for paper-based media, mainly as a learning material. Although results of this research was quite limited in the way of reducing the use of paper as the implementation for AR technology is only used as a complementary element to the written media, it does minimize contents being printed such as figures. Further research using technologies such as AR could potentially reduce the use of paper.

SUSTAINABLE MARINE BIOREFINERY MODELL BASE SEAWEEDS VALUE CHAIN DEVELOPED FOR SMALL SCALE UNITS

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Climate change is a serious concern for the world population, in the last two decades. The effect of global warming process can be reduced with different sustainable industrial and economical models implemented in the real production schemes. The European Commission set its objectives to reduce emissions by 50-95% in 2050. Based on Paris Agreement the members states need to reduce emissions by at least 40% by 2030 compared to level of the emission achieved in 1990. In order to limit temperature increase a net zero CO_2 emission at global level needs to achieve by 2050. In order to reach the established targets for climate agreements the research community need to focus on the development of sustainable technologies and test new natural raw materials, which can be integrated in different biorefinery technologies. In order to alleviate the multiple demands on EU`s land resources improving the productivity, marine biomass resources can be a sustainable way to developed different bioeconomy models in tackling and decrease the climate change effects to the economy. The Black Sea Costal area is reach in seaweeds and up to now this type of biomass are not sufficiently recovered, -the sea is reach in H_2S. To survive in extreme environments, the plant need to produce a variety of natural bioactive compounds such as polysaccharides, polyunsaturated fatty acids, and phlorotannins. Based on statistical data available for the Romanian coast, in the last summer in there were collected and deposited on the landfill around 9000 tonnes green seaweeds, in order to protect the beaches from algae invasion. These algae were decomposed by natural biodegradation process with significant emissions of greenhouse gases.

This work presents a sustainable approach for developing an optimal value and supply chain, for a small scale biorefinery model which is designed to use the fresh harvested seaweeds in the Romanian Coastal area. The model is built based on the experimental data obtained regarding the physical and chemical composition of the collected and naturally dried seaweeds.

The publication presents two technical schemes for the use of the seaweeds, one which describes based on literature data and experimental results, a value and supply chain for production added value products and the extractives resulted from the green seaweed “Ulva rigida”, and in the second task is presented one cogeneration model which uses as fuel the biogas obtained from an anaerobic digestion process of the macroalgae.

The yields of the developed technologies where calculated based on the digestibility studies carried out at lab scale. The cogeneration model is also tested with data for theoretical methane production values which is 431 l CH_4/kg VS and with 51.5% methane content. The developed models can be implemented in energy production and supplying of the small scale remote fish farms, and the resulted slugs at the end of process can be used as fertilizer at the local farms.

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