SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ

Department of Physics and Process Control

24th WORKSHOP ON

ENERGY AND ENVIRONMENT

BOOK OF ABSTRACTS

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December 6-7, 2018

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 30, 2018

Further information, please, contact:

Prof. I. Farkas
Founding Chairman of the Workshop

Department of Physics and Process Control
Institute for Environmental Engineering Systems
Faculty of Mechanical Engineering
Szent István University
Gödöllő, Páter K. u. 1. H-2100 Hungary

E-mail: Farkas.Istvan@gek.szie.hu Tel: +36 28 522055 http://fft.szie.hu/ee2018.htm

24th WORKSHOP ON ENERGY AND ENVIRONMENT

December 6-7, 2018, Gödöllő, Hungary

Program

December 6 (Thursday)

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

December 7 (Friday)

09.00-09.10 Opening the Workshop by:

Prof. I. Farkas — Head of Mechanical Engineering PhD School
Institute for Environmental Engineering Systems
Szent István University, Gödöllő, Hungary

Prof. L. Kátai — Dean of Faculty
Faculty of Mechanical Engineering
Szent István University, Gödöllő, Hungary

Session 1 — *Chairmen: Prof. I. Farkas, Dr. D. Rusirawan*

09.10-09.25 I. Farkas: New achievements in solar PV industry

09.25-09.40 D. Rusirawan and I. Farkas: Characteristics comparison of the first and the second generation of photovoltaic module technologies – a perspective for Indonesian weathers

09.40-09.50 L. Szulyovszky and Gy. Ruda: Controlling harmfull building materials and radiation in environmental economy

09.50-10.00 Z. Kapros: Engineering-oriented approach for the general definition of small-scale systems

10.00-10.10 M.A. Al-Neama and I. Farkas: Air mass flow rate effect on the performance of double-pass solar air heater

10.10-10.20 I.R. Nikolényi, Cs. Mészáros and Á. Bálint: Theoretical study of conjugated polymers for solar cell applications

10.20-10.50 COFFE BREAK

Session 2 — *Chairmen: Dr. I. Seres, Dr. L. Hartawan*

10.50-11.05 L. Hartawan, T. Shantika, D. Rusirawan and I. Farkas: Wireless monitoring system for mobile hybrid PV – PICO hydro power plant using nRF24L01 and Arduino

11.05-11.15 I. Seres and I. Kocsány and I. Farkas: Operational experiences with a small-scale transparent photovoltaic system

11.15-11.25	S. Gubán and P. Víg: Heat storage at high temperature with phase change materials
11.25-11.35	B. Bokor, D. Eryener, H. Akhan and L. Kajtár: Cooling load reduction with transpared solar collectors
11.35-11.45	H. Zsiborács, G. Pintér, N. Hegedűsné Baranyai: Photovoltaic capacity change in the future based on EUCO scenarios in EU
11.45-11.55	Sz. Bődi, P. Víg and I. Farkas: Use of paraffin vax and water for heat storage in solar systems
11.55-12.05	G. Bencsik, I. E. Háber and I. Farkas: Preparing climate data and city model for computational fluid dynamics simulation
12.05-13.30	LUNCH BREAK
	Session 3 — *Chairmen: Prof. I. Farkas, Dr. P. Víg*
13.30-13.40	A. Szilágyi, I. Farkas, I. Seres: Application of evaporation cooling with solar energy
13.40-13.50	J. Tóth and I. Farkas: Implementing database support for SIMULINK applied for solar thermal systems
13.50-14.00	W.M.A Elmagid, I. Keppler and I. Molnár: Blade calculation for turbine working solar chimney updraft tower
14.00-14.10	D. Alok and L. Tóth: A New methodology for solving biomass pyrolysis problem
14.10-14.20	D. Atsu, I. Seres and I. Farkas: Investigation of the thermal behaviour of solar PV modules
14.20-14.30	G. Habtay and I. Farkas: Effect of types of chimney in an indirect passive solar dryer
14.30-14.40	M. Haekal, D. Rusirawan and I. Farkas: Design of wind turbine blade under Indonesian wind conditions
14.40-15.00	COFFE BREAK
	Session 4 — *Chairmen: Dr. S. Bartha, Dr. Cs. Mészáros*
15.00-15.15	S. Bartha, F. Carvalheiro, P. Moniz, L.C. Duarte: Selective fractionation of energy crops within the biorefinery
15.15-15.25	A. Barczi, G. Géczi: Analysis of energy reed growing on wastewater
15.25-15.35	P. Hermanucz, G. Géczi, I. Barótfi: Analysis of multi resources heat pump
15.35-15.45	Z. Patonai and G. Géczi: Waste management of a temporary facility
15.45-16.00	CLOSING

NEW ACHIEVEMENTS IN SOLAR PV INDUSTRY

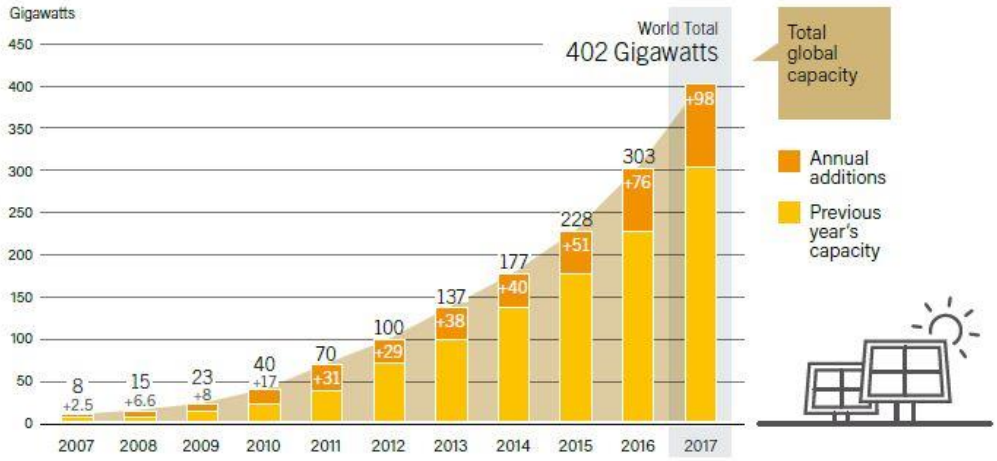
I. Farkas

Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, Fax: + 36 28 410804, Email: Farkas.Istvan@gek.szie.hu

The recent paper gives an overview of the solar energy application fields worldwide, specifically related to the photovoltaic (PV) technologies. The new trends are analysed and providing information on the solutions methods. A few examples are also given.

Despite the recent economic situation all over the world a significant 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, the PV technologies still show increasingly high priority.

The solar photovoltaic global capacity (reached 402 GWpv in 2017) and the annual additions worldwide are indicated in the following figure for the period 2007-2017 (Renewables 2018). In 2017, the increased amount of 98 GWpv is equivalent to the production of about 40 thousand modules every hour.



Making a comparison of the different total renewable energy capacities in operation and their produced energy in 2017 along with their growth rate of for the period of 2010-2017 it can be also justified the increasing importance of the solar photovoltaic technology compared to the other ones (Weiss and Spörk-Dür, 2018).

Due to the growing market demand of the solar photovoltaic applications several new features to the light. Such factors include the new, third generation of modules along with wide range application of technologies (thin film, organic, perovskite, etc), colouring, transparency and extra size of modules along with the new type of fixation systems.

References

Renewables 2018 - Global Status Report, REN 21, Renewable Energy Policy Network for the 21th Century.
Weiss, W., Spörk-Dür, M., 2018. Solar heat worldwide, Global market developments and trends in 2017, SHC - Solar Heating and Cooling Programme, International Energy Agency.

CHARACTERISTICS COMPARISON OF THE FIRST AND THE SECON GENERATION OF PHOTOVOLTAIC MODULE TECHNOLOGIES - A PERSPECTIVE FOR INDONESIAN WEATHERS

D. Rusirawan[1] and I. Farkas[2]

[1]Department of Mechanical Engineering, Faculty of Industrial Technology
Institut Teknologi Nasional (ITENAS) Bandung, West Java Indonesia
Jl. PKHH. Mustapa No 23 Bandung 40124, Email: danir@itenas.ac.id

[2]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary

Solar energy is such a vast energy resource that it can be used for any of our everyday needs, including electrical power, heating and cooling, water heating, industrial process heat, cooking, transportation, fuel production and even environmental clean-up. It comes to us as radiation which is pure energy (no mass associated with it), which is the highest form of energy and can be converted to many other forms for our everyday use.

Related to utilize of photovoltaic (PV) as a electrical power plant, presently, the most commonly used of the PV technologies are crystalline silicon (wafer based) and thin film. Some literatures have mentioned and stated that crystalline silicon technology has been the preferred choice of the PV marketplace rather than the thin film technology due to its higher energy conversion efficiencies. The efficiencies of PV modules for crystalline silicon, both mono-crystalline (mc-Si) and poly-crystalline (pc-Si) range between 11-17%, meanwhile the efficiency averages of amorphous silicon (a-Si) thin film is 6-8%. However, in spite of the lower conversion efficiency, a-Si has better real world performances, especially in terms of electricity production per watt of installation.

The three contributing factors for higher performance i.e. low temperature coefficient, blue light absorption, and thermal annealing (relating to the surface morphology of material), help a-Si outperform other technologies under a variety of climates.

The mono-crystalline PV modules typically have a temperature coefficient of –0.45%/^{o}C. It's mean that for increase of temperature one degree above 25^{o}C, the output power is decreasing by 0.45%. Poly-crystalline Modules typically have a temperature coefficient of –0.5%/^{o}C. Thin film Modules have a different temperature characteristic resulting in a lower co-efficient typically around 0%/°C to - 0.25%/°C.

In this paper, comparison of performances of two type PV modules technologies will be elaborated and shown based on field practical experiences, in several places in the world. The evaluation will be emphasized on both PV modules performances, especially in hot weather condition. Furthermore, some effort of our university related to practical experiences information above will be introduce, as well. At the present, a PV power plant 1 kWp has been installed at our campus, for research purpose. Some research topics have been performed, as a sequenced of our works to increase of understanding about the first and second generation of PV module technology.

As an outcome of this work, deep and mature consideration can be acquired by countries in tropical region, such as Indonesia, in order to develop and build of the PV power plants.

CONTROLLING HARMFULL BUILDING MATERIALS AND RADIATION IN ENVIRONMENTAL ECONOMY

L. Szulyovszky[1] and Gy. Ruda[2]

[1]CROSS Institute of Construction Biology
Bartók B. u. 106-110, H-1115 Budapest, Hungary, expertus110@gmail.com
[2]Department. of Environmental Technics, Szent István University,
Páter K. u. 1., H-2100 Gödöllő, Hungary, dr.rudagyozo@gmail.com

In our concentrated world the environmental conditions turn already intolerable. Human health is specially regarded according to striking statistics: in the rates of cancer related death Hungary is in leading position, in spite of having the best quality soil and practices in the traditionally flourishing countryside. Mortality rate has been multiplied just in last century of industrial revolution and urbanization. These, initially positive, steps have soon resulted in crowded concentrations and depopulated countryside.

It is high time to restore the balance of the total environment. The building activity has a remarkable pressure on environment with is largest values and energy demands. The whole activity and life of people are spent mainly in buildings. Constructions have therefore direct effects on human health or illnesses. Harmful changes have taken place just in these last hundred years. Instead of natural materials, stone, clay, wood, artificial products have been introduced, concrete, slag, metallic and synthetic structures, with risks of radiation and other harms. This paper summarises the investigations and results in this field of Construction Biology. During the last 16 years more than 700 buildings, mainly flats have been controlled with detailed analysis, measurement on radiation and other physical damages.

Buildings erected from 1960 usually contain slag filling under the floors, at times walls made of slag bricks, in a total quantity of 15 million tons, contaminated by uranium isotope. After more than 6500 exact measurements of gamma rays, in 35-40% of the cases, the doses highly surpassed the tolerance limit of inhabitants (1mSv/year). Approximately 1,25 million inhabitants are endangered permanently in some 500.000 flats. The radon concentration is extremely increasing in new buildings without cellars and proper ventilation but with airtight windows and doors. The radon alpha rays have twenty-fivefold cancerogenic effect as gamma rays do. Though, harmful gamma doses have been found in 70 flats among the measured 240.

In the countryside the asbestos sheets are specially cancerogenic with their fraying fibre fractions also in the distant future. The potentially contaminated area is huge it might be the whole country. Surveying the endangered areas, about 1.000 farm buildings have been analysed and measured around the country. Numerical data were also available from the Ministry of Agriculture. It could be well estimated that the total surface of the corrugated asbestos roofing is at least 1 M m^2. It means an increasing harm as these critical structures are standing just in the food producing areas which risk cannot be tolerated.

Urgent solution is needed for all of these environmental problems. The slag has to be taken away from the people's closeness to proper industrial use. Expenses can be compensated just from the profit of reuse for new function. Asbestos materials however are found mainly in the abandoned countryside where the revitalization is the only way of solution. Only a new functional reuse of buildings can compensate the expenses of removing the harmful materials. This is the task of the environmental economy. Finally, it is up to date to use also the natural local materials again in site with a matter-of-course control.

ENGINEERING-ORIENTED APPROACH FOR THE GENERAL DEFINITION OF SMALL-SCALE SYSTEMS

Z. Kapros

Ministry for Innovation and Technology
Fő utca 44-50., Budapest, H-1011 Hungary
Tel.: +36 30 6127854, E-mail: zkapros@gmail.com

The exact engineering specification of small scale in building or on building small power plant systems is currently missing. The importance of the precise definition is necessary because the EU's new Energy Efficiency Directive recast strengthens the integrated approach between the energy efficiency improvement in buildings and the establishing of small scale systems.

In Hungary, the household scale small plant (HMKE) is close to the small scale concept, but this is rather a result of a legal and traditional non-engineering approach. At the end of 2008 it reached the 241.4 MW by 0.51 MW at the end of 2008. After the low increase in 2016, the capacity of new HMKE equipment grew to the highest extent in 2017, by 76.4 MW, where the solar photovoltaic systems gave the biggest share (99.4%) with the 240 MW.

For the small-scale systems the farmyard (háztáji) definition is also referred, which is similar approach as it is used by the agricultural small farm activity for the PROSUMER production for own purposes. However, there is no real engineering approach either, although it is correct expectation, that the small-scale systems are need to near the consumption, but not necessary to require the own consumptions.

Developing energy efficiency in buildings is a great challenge for achieve the Paris Agreement goal where the consistency and integrated views with the solar photovoltaic system developments requires. From engineering approaches the small scale system can be defined by some special criterion based on grid integrability (installation mode), required - sufficient capacity compliances and the existence of additional devices (e.g. butteries, demand sized management connection). The presentation draws the frame a possible assessment approach reflecting on one of my last year saved doctoral thesis, which was made by the Department of Physics and Process Control Szent István University. The lecture contains only personal, non-governmental engineering views.

AIR MASS FLOW RATE EFFECT ON THE PERFORMANCE OF DOUBLE-PASS SOLAR AIR HEATER

M.A. Al-Neama[1] and I. Farkas[2]

[1]Mechanical Engineering Doctoral School
[2]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: Farkas.Istvan@gek.szie.hu

The value of air mass flow rate has a very significant effect on the thermal performance of solar air collector. In order to estimate the effect of air flow rate, the flat plate double-pass solar air collector examined experimentally with different values of air mass flow rates. The effect of air mass flow rate has been studied in the previous studies, and our results showed a good agreement with the published results. The experimental published results showed that the collector efficiency increases with increasing the solar radiation intensity and mass flow rate. The increasing of airspeed through the solar air collector increases the turbulence which leads to higher friction forces between flowed air and absorbing surface. The higher air velocity results decreasing of absorbing surface temperatures which minimize the thermal losses of the solar collector to the ambient.

For the forced air circulation, the solar air collector investigated with four values of air mass flow rate 0.0175, 0.0198, 0.0228 and 0.025 kg/s. The efficiency of double-pass solar collector increased significantly by increasing the flow rate of air. The highest value of thermal efficiency was about 59% at 0.0251 kg/s air mass flow rate, while the lowest was approximately 45.5% at 0.0175 kg/s. The flow rate can be affected by some flow losses due to some uncontrolled leakages in an air duct or solar collector, but the value of flow rate has been measured in inlet and outlet of the solar collector to keep it constant.

For natural air movement by chimney effect, the solar drying system has been tested under free air movement with and without chimney by using single-pass solar air collector. The chimney increases the amount of air flow, through the solar dryer by speeding up the flow of the exhaust air. The integrated chimney has a circular cross-section and 1.5 m length. The experimental results are collected in 9 of October 2017 with free air velocity. The variation air speed in the chimney was tested for five hours. The speed of air stream increased with the time due to solar radiation and temperature increase. The results show an indirect relation between speed and solar radiation. The speeds increased sharply at the beginning of experiment due to temperature increase.

According to the theoretical analysis, the velocity is a function of temperature change across the chimney. The experimental results showed that the increasing of absorber temperature leads to the more useful heat gained to the air. The temperature rise of air decrease the density of air which results a bouncy force. The density difference or bouncy force produce the needed flow in the solar chimney. The design of solar chimney plays important rule to increase the speed of air due to the angle of entrance and length. The little slope which done in the top of drying chamber leads to smooth movement of air flow.

Acknowledgements

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THEORETICAL STUDY OF CONJUGATED POLYMERS FOR SOLAR CELL APPLICATIONS

I.R. Nikolényi[1], Cs. Mészáros[1], Á. Bálint[2]

[1]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Nikolenyi.Istvan@gek.szie.hu
[2]Institute of Environmental Engineering, Óbuda University
Sándor Rejtő Faculty of Light Industry and Environmental Engineering
Doberdó u. 6, Budapest, H-1034 Hungary

Research works on the investigations of conjugated polymers are in the front of the field of solar cells projects both experimentally and theoretically nowadays. The possibility of the applications of them for solar cell industry had turned in 1977 after the doping procedure of the polyacethylene and became for today in spite of their lower efficiency (~10%) - the one of the best competitors of the silicon based ones thanks to their cheaper and environment friendly technologies.

After photoexcitation in polymer, based (for example polymer/fullerene-type) solar cells the Coulomb correlated electron-hole pair (exciton) diffuses to the Donor-Acceptor interface. The so-called triplet excitons have greater chance to avoiding the recombination before reaching this one thanks to their greater lifetime. However in polymers triplet excitons are cannot be photoexcited directly from the ground state (this transition is spin-forbidden) with help of some procedure, for example embedding heavy atoms (Platinium) into the backbone of the polymer can increase the triplet-singlet ratio due to the so-called spin-orbit coupling.

Our goal is to study this procedure theoretically in the frame of the Hubbard-Model and to deduce the ground state of the system extending the earlier developed and presented method for hexagon-type polymer chains (Methode of the Positive Semidefinite Operators) in such way that the Hamilton operator of the system will contain such hopping terms too which are modelling the spin-orbit coupling-effect. Other future plans will be mentioned too.

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Acknowledgements

The authors would like to express their thanks to Réka Trencsényi and Zsolt Gulácsi for this theme and the helpful discussions.

WIRELESS MONITORING SYSTEM FOR MOBILE HYBRID PV – PICO HYDRO POWER PLANT USING nRF24L01 AND ARDUINO

L. Hartawan[1], T. Shantika[1], D. Rusirawan[1] and I. Farkas[2]

[1]Department of Mechanical Engineering, Faculty of Industrial Technology
Institut Teknologi Nasional (ITENAS) Bandung
Jl. PKHH. Mustapa No. 23 Bandung 40124, West Java - Indonesia

[2]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: Farkas.Istvan@gek.szie.hu

Indonesia has target of having renewable energy account for 23% of Indonesia's energy mix for electricity and transportation by 2025. To achieve this target, several regulations have been taken, such as using B20 in fossil fuel for every sector, and the new rule is to use photovoltaic module on roof top, in order to decrease of electricity bills, which have an impact to speed up transfer technology for manufacturing photovoltaic module in Indonesia.

Department of Mechanical Engineering ITENAS which has core of research about new and renewable energy has several research topics in photovoltaic area. One of them is mobile hybrid PV-Pico hydro power plant. This system is still under development, and it is combined low head pico hydro system which can generate about 7 Watt (14 V, 0.52 Amps) at 600 rpm, and two photovoltaic module with specification 100 Wp polycrystalline 5.69 Amps each. The dimension of hybrid system is 160x120x120 cm.

To support this research, wireless monitoring system has been developed to take voltage and current data from photovoltaic and pico hydro generator. This monitoring system will replace wired monitoring system, which have been design before.

The wireless monitoring system using Arduino with nRF24L01 module, because the long distance between hybrid system to monitoring system room is about 30-40 m.

The instrumentation component which is used for this system consisted of:

No	Components	Specifications	Qty
1	Arduino UNO (SMD)	ATmega328. 14 digital input/output pins (of which 6 can be used as PWM outputs), and 6 analog inputs.	2
2	nRF24L01 module & adapter	2.4 GHz RF transceiver Module, Range : 50-200 feet, Baud Rate: 250 kbps - 2 Mbps, Maximum Pipelines/node : 6, Low cost wireless solution	2
3	Voltage Sensor module	Divider ratio: 5:1, Resistor Tolerance: 1%, Max input voltage: 25V, Resistor Value: 30K/7.5K Ohm	2
4	ACS712-30A Currents sensor	Measurement Range -30 to +30 Amps, Voltage at 0A VCC/2 (nominally 2.5 VDC), Scale Factor 66 mV per Amp	1
5	ACS712-5A Currents sensor	Measurement Range -30 to +30 Amps, Voltage at 0A VCC/2 (nominally 2.5VDC), Scale Factor 185 mV per Amp	1

For reading and processing the data is using LabVIEW with VISA software, and for the arduino programming is using Arduino IDE software.

Before implementing this wireless monitoring system to hybrid power system, the series test have been done using power supply and DC motor as load. The result shows that the wireless monitoring system can get the voltage and current data from test equipment.

OPERATIONAL EXPERIENCES WITH A SMALL-SCALE TRANSPARENT PHOTOVOLTAIC SYSTEM

I. Seres, I. Kocsány and I. Farkas

Department of Physics and Process Control, Szent István University
Páter K. u. 1., Gödöllő, H-2100 Hungary
E-mail: Seres.Istvan@gek.szie.hu

At the Department of Physics and Process Control numerous different research topics were carried out connected to the solar energy, among them for the solar thermal and for the photovoltaic technologies, too. As the in the last period the photovoltaic (PV) technologies were coming to the front instead of the solar thermal applications, the research topics of the Department were focusing on the different aspects of the PV technologies, from the different behaviour of the different modules to the quality aspects of the produced electric energy.

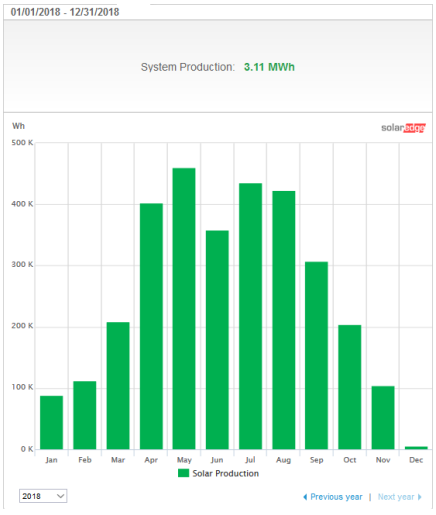
Until the last year mainly the polycrystalline technology and the thin film modules (amorphous silicon technology) were used, but in the summer of 2017 in the framework of a project we ha the possibility to develop a new photovoltaic system consisting of monocrystalline, but semi-transparent modules.

Beside the usage of new technology another important point of view was changed with this system as well. Until now, all of our PV systems were set up at the optional locations (e.g. in flat roofs under optimal inclination angle), but such sites are generally far away from the students, they can visit these systems just in special occasions (e.g. Researcher Night).

But we the new system we told, that this semitransparent system (which is very attractive) should be developed in a site where everybody can see it every day, however its location is not ideal for the energy production. Finally, the air wells in front of the Aula building was chosen, as a very busy location of the University.

The system is divided into two subsystems, each of them partly covering the air wells. Each subsystem is formed from 10 identical 165 Wp modules, so the total nominal power of the system is 3,3 kW_p.

In the presentation some analyses will be provided about the operation of the new system (e.g. the energy production in monthly values are shown in the figure below), about the inequalities of the energy production of the theoretically identical modules, through the analysis of the more than one year of operation data.



Beside the analysis of the energy production data, these values will be compared with the energy data of our other PV systems, located at the university, too, and it is shown, that however the orientation and the inclination angle is not ideal for the transparent system, its energy production is comparable with energy production of the ideally located older systems.

HEAT STORAGE AT HIGH TEMPERATURE WITH PHASE CHANGE MATERIALS

S. Gubán and P. Víg

Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Vig.Piroska@gek.szie.hu

Based on the tendencies of changes in our environment, we must say that in the future there will be more and more need to keep sustainable development in mind. Thus, it is expected that the local production of both electricity and heat with solar cells, solar collectors and solar power plants will be greater than ever. In many cases, the energy and heat generated by solar systems are not used at the time of production. With the spread of solar systems, the question of how to efficiently store energy is getting more and more important. The present research intends to contribute to this storage part.

An alternative way for efficiently heat storage is to use phase change material (PCM). The various phase change materials which have high melting heat working efficiency at several temperature ranges, because their melting points are different. By temporarily storing the heat generated by solar power plants, their operation time can be extended.

To achieve the best efficiency of the heat storage at these plants the optimal temperature is in the interval of 200 and 350 °C. The melting point of nitrates are in this interval. Among them, in the present work, the $NaNO_3$-KNO_3 system is in the focus, this system and different compositions of it are examined.

The eutectic melting point of the mixture is 220-227 °C, but with these components can be reach above 300 °C phase change temperature, which can make it possible to store generated heat by solar power plants. These materials are known in the literature as base materials (Yu-ting et al., 2017). However, their application requires improving the thermal conductivity and increasing phase change cycles. From the base materials, in structurally, the application of capsules and honeycomb structure and for better conductivity auxiliary materials (metal fiber, metal powder, carbon nanotube) are necessary. For the development of an optimal mixture, determination of the thermal properties of the several mixtures (melting point, specific heats, melting heat, conductivity) are needed. The bases of the thermal properties measuring are simple calorimetric equations, but the measurements at high temperature require special challenges.

The results with the use of the selected mixture achieved so far obtained are detailed in the presentation.

COOLING LOAD REDUCTION WITH TRANSPIRED SOLAR COLLECTORS

B. Bokor[1], D. Eryener[2], H. Akhan[2] and L. Kajtár[1]

[1]Budapest University of Technology and Economics, Faculty of Mechanical Engineering,
Department of Building Service and Process Engineering
Műegyetem. rkp. 3-9, Budapest, H-1111, Hungary
Tel.: +36 1 463 2535, E-mail: bokor@epgep.bme.hu
[2]Trakya University, Faculty of Engineering, Department of Mechanical Engineering
Ahmet Karadeniz Yerleskesi, Edirne, TR-22030, Turkey
E-mail: deryener@trakya.edu.tr

When considering energy reduction issues of the building sector, one cannot overlook the importance of cooling load reduction. Depending on a country's primary energy conversion factor, producing one unit of cooling energy with a chiller can require three times as much primary energy, than producing one unit of heating energy with a boiler. A remarkable amount of the cooling load of a building reaches the interior through the roof, as roofs can be as hot as 70 °C under strong solar radiation. Roof ventilation with double-layer structures offers a reliable temperature reduction between the solar exposed upper layer and the lower one, which is the actual building roof.

The transpired solar collector (TSC) is a proven technology for solar air heating with numerous installed and successfully operated systems around the world. The presentation reflects on its daytime passive cooling potential, when the perforated metal plate absorber is installed on a building's roof. A 5 m^2 experimental setup was used during the summer of 2016 to investigate the cooling load reduction between the exposed absorber plate and the back plate. The TSC is able to reduce the temperature between the two plates by 30 K. A mathematical model of the energy flows in the system has been used to evaluate measurement results. The natural ventilation through the perforated plates is also visualised by thermal images of the measurement setup. Results reflect on a novel application of the transpired solar collector, which therefore can be used for the reduction of building energy consumption over the entire year.

Roof-mounted transpired solar collectors offer further cooling load reduction with their night-time operation. Free cooling systems are gaining increased attention as air conditioners are responsible for a remarkable amount of the electric peak load in summer. Several studies have shown that night ventilation of buildings reduces peak loads of the following day. Its effect can be increased by a free cooling system based on nocturnal longwave radiation, which cools the air below ambient temperature. The roof-mounted transpired solar collector, functions as a radiating shield in this case. The collector plate cools down below ambient temperature under clear sky conditions. The air can reach temperatures below ambient as it passes the plate further increasing the free cooling's potential. A mathematical model has been set up to describe the cooling process. It has been validated with measurements carried out on the same experimental setup, located in the campus of Trakya University, Engineering Faculty, Edirne, Turkey.

PHOTOVOLTAIC CAPACITY CHANGE IN THE FUTURE BASED ON EUCO SCENARIOS IN EU

H. Zsiborács, G. Pintér, N. Hegedűsné Baranyai

Department of Economic Methodology
University of Pannonia, Georgikon Faculty, Deák F. u. 16., Keszthely, H-8360 Hungary
Tel.: +36 83 545-391, E-mail: ifj.zsiboracs.henrik@gmail.com

Due the ever-increasing energy usage of the humanity and the reduction of negative environmental effects have an increasing role the renewable energy sources in global energy usage. By 2020, the European Union (EU) has set itself a 20% energy savings goal, therefore all EU countries will need to use energy more efficiently at all energy fields. To reach the goals, solar energy is a clean and environmentally friendly solution, which is available in enormous quantities for humanity.

The solar-powered photovoltaic technology converts the sun's rays into electricity which technology has an increasing role in global energy usage. In 2017 the photovoltaic technology was the top source of new power generating capacity. The share of photovoltaic electricity production showed 1.9% of all electricity produced globally in 2017, which represented 402 GW global PV capacity, of which 26.9% located in the EU (REN21, 2018 and Zsiborács et al., 2018).

An interesting question is what future prospects will be expected in the future of this technology? For answers the EUCO scenarios were used which document is a part of the European Commission's impact assessment work. The EUCO scenarios modelling the achievement of energy efficiency targets (till or above 30%) in 2030 (Zsiborács et al., 2018, European Comission, 2016).

Overall, it can be stated that based on EUCO scenarios data by 2030 the net PV production capacity in the EU will be about +126-155 GW higher than in 2015 (97.4 GW).

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USE OF PARAFFIN VAX AND WATER FOR HEAT STORAGE IN SOLAR SYSTEMS

Sz. Bődi, P. Víg and I. Farkas

Mechanical Engineering Doctoral School
Szent István University, Páter K. u.1. Gödöllő, H-2100 Hungary
Department of Natural Sciences and Engineering
Neumann János University, Izsáki út 10. Kecskemét, H-6000 Hungary
Tel.: +36 76 516 338, E-mail: bodi.szabolcs@gamf.uni-neumann.hu

Heat accumulated by solar energy is not evenly distributed, with weather change strongly influencing. However, for the purpose of use, the basic goal is to be available in a given amount and at a given time, so the heat must be stored (Gyenis et al., 2014). There are two main types of heat storage: sensitive and latent heat storages.

Phase change materials (PCM) are able to store heat not only sensitively but latently, and thus have a significantly larger capacity for unit volume than traditional building materials. When the ambient temperature rises, the solid phase change consistency becomes liquid. During this time, the substance absorbs heat meanwhile the process is endothermic. If, the ambient temperature drops, the phase-change material outputs and solidifies the heat recorded in the previous cycle.

Based on the above mentioned facts, it is obvious to use the PCMs in solar systems where the storage is an essential problem. Initially, water is the most commonly used storage material in the applications. There are many trials to apply another type of materials for heat storages, especially in solar systems.

It is an idea to study the features of phase change materials and their use for substitution of water in order to improve efficiency of the entire system.

In this paper, the amount of heat stored before the melting of paraffin wax (Paraffinum solidum) is compared to the amount of heat stored by the same amount of water, based on the performed measurements.

A calorimeter was used to measure the temperature of solid paraffin and change in the temperature of hot water as a function of time, from which the paraffin melting heat was determined. Subsequently, the hot water in the calorimeter was exchanged for cold water, from which the specific heat of the solid phase of paraffin was determined. By presenting our experimental and theoretical results, we highlight the influencing parameters affecting the thermal behaviour of paraffin.

Based on the results we achieved so far, it is proposed to improve the thermal conductivity during heat storage, as paraffin is a poor thermal insulation and the speed of heat transfer is important during application.

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PREPARING CLIMATE DATA AND CITY MODEL FOR COMPUTATIONAL FLUID DYNAMICS SIMULATION

G. Bencsik[1], I. E. Háber[2] and I. Farkas[3]

[1]Mechanical Engineering Doctoral School
Tel.: +36 30 9642039, E-mail: becsegergely@gmail.com
[2]Department of Mechanical Engineering
University of Pécs, Boszorkány u. 2., Pécs, H-7624 Hungary
[3]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary

In the past decades installing photovoltaic modules or wind turbines in urban or rural environment gone viral. In the European Union's energy strategy to 2020 there is a goal about every member state has to reach at least 20% share of renewable energy in their consumption. Civil and residential renewable energy production are indispensable to integrate into a state's energetic system. 20% share of a state's energy consumption is a very large part and it is plannability and controllability are critical points to keep the consumption stable.

Renewable energy production is far less controllable and plannable but more progressive in scaling than coal-fuelled or nuclear power production. Forecasting the efficiency and the production potential depends on the actual environment's climatic features and it is also necessary to make a prediction to meso-scale, local-scale and micro-scale climate.

The present work introduces a simulation preparation focused on data collection and 3D model preparation to computational fluid dynamics simulation with a detailed model of the city Pécs. The goal is to make a CFD simulation to get climatic modifier features by the air movement. Air movement in the observed area makes effect on even the wind turbines and photovoltaic modules' production efficiency.

Actual air temperature, wind velocity, wind direction and solar radiation collected by a pair of customized autonomous mobile weather monitoring stations. Aiding the simulation with multi-scale, meso-scale and local-scale climatic data been collected (provided by other institutes) and fitted to the detailed, micro-scale data. Fitting and pre-processing of data sets made with Python big-data library pandas.

For the computational fluid dynamics simulation the final, closed 3D mesh model been resampled with a ray-casting like parallel computational algorithm that makes a new mesh by wrapping the opened and incorrect one. The given 3D model's condition was not technically satisfying for a CFD simulation because of the overlapping and missing faces.

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APPLICATION OF EVAPORATION COOLING WITH SOLAR ENERGY

A. Szilágyi[1], I. Farkas[2], I. Seres[2]

[1]Department of Vehicle and Agricultural Engineering, University of Nyíregyháza,
Sóstói u. 31/B., Nyíregyháza, H-4400 Hungary
Tel.: +36 42 599400 /2482 Email: szilagyi.attila@nye.hu
[2]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2103 Hungary
Tel.: +36 28 522055 E-mail: farkas.istvan@gek.szie.hu, seres.istvan@gek.szie.hu

Nowadays the climate change put to test our adaptability, for example with variable weather and with hot summers. For the human body have to be ensured the optimal temperature in buildings in this extremist climatic period, too. This changing is given by solar energy that we can use for cooling our buildings. In this period mainly some kind of air-conditioning systems are used, which work with electrical energy or heat energy.
So, solar photovoltaic cells or solar collectors can be used for this energy demands. The low energy consumption and the environmentally friendly cooling system are more important for us. A simple way of solar cooling is the water evaporation utilizing with the porous materials working by solar energy.

The cooling system can be successfully operated with solar photovoltaic cells, which means zero emissions and an independently energy system for electrical grid. By the utilization of solar energy for cooling we do not need energy storage mainly, because the consumption and the heat wave is in the same time.

By evaporation cooling we can use simplest water like working fluid. Both, direct and indirect evaporations can be used. By direct evaporative cooling the inside air is humidified. For evaporation we can use ceramic pots filled with water. The evaporation mass flow depends on air velocity, porous materials quantity, air humidity and air pressure mainly. The outside air can be moved by fan and the cooled water by pump. The cooled working fluid can be utilized with a heat exchanger. The energy demand for fan and pump can be ensured by solar photovoltaic cells.

The studied experimental cooling system was installed at the Department of Physics and Process Control, Szent István University, Gödöllő, Hungary. The cooling performance had been calculated according to our measuring. The temperatures' changings were measured by infrared camera. The available temperature difference is fairly good for the human body by cooling.

According to our measuring the solar photovoltaic cells are able to ensure the energy needed directly in the necessary time for the cooler's devices. Based on our measuring it can be calculated the evaporation surface for a required cooling performance. Evaporation cooling with ceramics is an environmentally friendly cooling technology, which we can use for a cooling system with low energy consumption and costs.

IMPLEMENTING DATABASE SUPPORT FOR SIMULINK APPLIED FOR SOLAR THERMAL SYSTEMS

J. Tóth and I. Farkas

Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522000, E-mail: toth-janos@outlook.com

The base of the scientific work are measurements. They provide validations, ideas for models, they can proof theorems. The proper storage of the measured data is a really important subject, it must be available, reliable, well-structured and easily searchable. The measured data is an important input in case of simulation and control problems in solar thermal systems as it is discussed in the recent paper.

The traditional way of the data storage is the offline solution, it means that the collected data is stored either in a built-in device or in a separate storage device, typically a pendrive. This method is easy to implement, but the availability of the data is not reliable.

The development trend of the world is heading to the fully connected networks, such as the IoT systems and the Industry 4.0. This approach is useful in the scientific world as well. The results of the measurements done worldwide can be used everywhere with a properly formed infrastructure.

The databases are present since the middle of 1960s to provide a structured way to store data. The development of the information technology allows the extension of the database networks to be used in the everyday life. One type of the databases is the relational database what is used by the MySQL system which is an open source relational database management system used worldwide. The use of the MySQL system provides a reliable support for the data storage. This is a perfect solution for the storage of the data of the measurements.

The development of the information technology also led to the development of the block-oriented modelling solutions. This modelling method grants many advantages over the classical, analytic models, but it's done by computers, so it is a numerical method. There are many software built with the support for the block-oriented modelling, one of them is the MATLAB+Simulink software package. The Simulink package allows us to model and simulate block-oriented systems.

The main goal of this work was to combine the previously mentioned two ideas, namely the database-driven measurements and the block-oriented simulation. This was done by a custom-made MySQL database-driver for Simulink. This way the results of the measurements, stored in a database, can be used as an input for the simulation.

The database-driver is used in a framework, called SimSolar, which is a simulation framework for solar thermal systems. It provides the input for the simulation using previously measured data.

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BLADE CALCULATION FOR TURBINE WORKING SOLAR CHIMNEY UPDRAFT TOWER

W.M.A Elmagid[1], I. Keppler[2] and I. Molnár[3]

[1]Institute of Environmental Systems,
[2]Institute of Mechanics and Machinery
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
[3]Institute of Mechatronics and Vehicle Engineering, Óbuda University
Népszínház Street 8, Budapest, 1081, Hungary.
Tel.: +36 70 237 8834, E-mail: w.abdelmaged@Aswu.edu.eg

Nowadays, the primary source of energy used in the globe is obtained from petroleum products and this kind of energy will soon be depleted. Then again, energy from petroleum and natural gas produces corrosive rains, poisonous gases, and ecological pollutions. Among different forms of sustainable power sources, solar energy is the safest and very reliable option. The solar updraft tower (SUT) (otherwise called as solar chimney power plant, SCPP) is one of the new means to deliver electrical power and this has been improved in the last two decades.

Turbine has enormous influence in the SUT performance, however, few studies contributed on the turbine of SUT plant. For extracting maximum power output from the air inside SUT, it is very important that the blades of a wind turbine should have a suitable design to achieve it propose. This study presents a new approach to design the blade of SUT turbine. A new design of the SCPP turbine based on the aerodynamic optimization approach of a wind turbine with a diffuser (Diffuser-Augmented Wind Turbines, DAWT).

Recently, the development of wind turbines has been the focus of many researchers. A shrouded wind turbine is one of the improvements, which helps to increase power coefficient of the wind turbine by surrounding a rotor of the wind turbine with a diffuser duct. The researcher aimed to modify the classic aerodynamic theories. Consequently, the design theory takes into account the effect of the surrounding diffuser duct that makes the shape of the blade more suitable for surrounding duct and produces more output power in the same diameter. DAWT approach may be capable of exceeding the Betz limit, which has been usually considered as the limit of power performance coefficient of the bare wind turbines.

In this work, a new design of axial flow turbine is presented based the Blade Element Theory (BET), which is modified to improve the performance of the wind turbine by the concept of Argument diffuse wind turbine (ADWT). The speed ratio, γ, and tip speed ratio, λ, are the main parameters that control of the blade shape and make the blade more suitable for its enclosure. To calculate the required design parameters, a comprehensive mathematical model is developed, which has an ability to describe the flow inside solar chimneys. An iteration algorithm is implemented using MATLAB to obtain optimization of the turbine blade chord and twist angle distributions in the presence of a diffuser. The present design suggests that the power output could be increased by 15%. Our conclusion is that Blade Element Theory with diffuser has an ability to design efficient turbine suitable for working within SCPP.

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A NEW METHODOLOGY FOR SOLVING BIOMASS PYROLYSIS PROBLEM

D. Alok and L. Tóth

Institute of Process Engineering
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522000, E-mail: Toth.Laszlo@gek.szie.hu

In this study the kinetic parameters of thermal decomposition of biomass are determined by using the Monte Carlo scheme. The Monte Carlo method is a computational technique used to obtain an unknown parameter. It is a fundamental tool to calculate and simulate a set of maps which is independent and identically distributed with the same distribution as the set of all maps.

The evolution of bonds in pyrolysis could be simulated by combining the Boltzmann- Monte-Carlo algorithm with the percolation theory. In pyrolysis problem of coal, the Monte Carlo algorithm delineates the bond formation by using coupling or collision of radical fragment. The concept of Monte-Carlo analysis is to understand the uncertainty in the system through a random sampling. The random number generator assigns a random value to each variable within the demarcated limit, and thus, it helps to develop a robust scheme to solve the inverse problem. Mainly, the performance of any given model is carried out by the deterministic value of parameters, but the Monte Carlo is very effective for those models which have no analytical solutions. Modelling scheme of biomass pyrolysis can be performed on the basis of the single reaction and the multi-reaction models. The latest and up-to-date approach of describing the biomass pyrolysis pivots around the distributed activation energy model (DAEM). For the pyrolysis of pine waste, the DAEM is converted into an inverse problem so that the realistic results can be derived. As the trade-off relationship between the material decomposition and the mathematical model is unable to predict and the predicted solution, therefore the Monte Carlo scheme is adopted to make the solution a bit pragmatic.

The primary objective of this paper is to introduce a new method of solving non- analytical integral equation encountered while solving the solid-state kinetic models. It is assumed that the approximated solution forms an injective set. The Gaussian function is considered as the initial distribution function. Only with the help of the derivative thermogravimetric (DTG) analysis, the kinetic parameters of the thermal degradation of forest waste is obtained.

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INVESTIGATION OF THE THERMAL BEHAVIOUR OF SOLAR PV MODULES

D. Atsu[1], I. Seres[2] and I. Farkas[2]

[1]Mechanical Engineering Doctoral School, Szent István University
Pater K. u. 1, H-2100, Gödöllő, Hungary
atsud22@yahoo.com
[2]Department of Physics and Process Control
Szent István University, Páter K. u. 1, Gödöllő, H-2100 Hungary
Tel.: +36 308982434, E-mail: Seres.Istvan@gek.szie.hu, Farkas.Istvan@gek.szie.hu

One of the critical factors in the photovoltaic conversion process of solar modules is the module temperature. Therefore, the accurate prediction of the temperature of solar modules helps to correctly foretell the output of a solar PV system since the temperature of the module is a determining factor in the performance of the PV system, and hence assist in the energy prediction and the economic assessment of solar PV systems.
Several measuring techniques have been used to measure the temperature of PV modules in literature. These measurements are taken at discrete points on the module which does not reflect the entirety of the thermal conduct of PV modules. This work aims at studying the thermal behaviour of four different solar PV modules (amorphous silicon glass-glass (a-Si (G-G)), monocrystalline silicon glass-glass (mc-Si (G-G)), polycrystalline silicon glass to Tedlar (pc-Si 60Wp), polycrystalline silicon glass to Tedlar (pc-Si 105Wp) exposed to the same ambient conditions. The infrared camera is employed in the determination of the temperatures of the modules. Measurements were taken at the forecourt of the solar laboratory of Szent Istvan University, on the 23rd June 2018. Captured infrared images were processed using the Report Generator Lite software.

The results were compared with selected theoretical models which are widely used for the prediction of module temperatures. Discussion of the accuracy of various methods is presented. The temperature dissimilarity between the maximum and minimum temperatures of the modules were 0.107, 0.103, 0.101, and 0.113 for a-Si (G-G), mc-Si (G-G), (pc-Si 60Wp) and (pc-Si 105Wp) respectively. The Mean Bias Error of the predicted temperatures showed the underestimation of the maximum and average module temperatures for the studied models (Homer, Ross, PVsyst, and Sandia). Homer and Ross's models overestimated the minimum module temperatures while PVsyst and the Sandia models underestimated the minimum temperatures.

The highest module temperature at a certain level of irradiation was recorded for the a-Si (G-G) module followed by the pc-Si (105Wp), mc-Si (G-G), and pc-Si (60Wp). The Root Mean Square Errors show a relatively accurate prediction of the models' for the measured average temperatures of all modules studied than the minimum and maximum temperatures.

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EFFECT OF TYPES OF CHIMNEY IN AN INDIRECT PASSIVE SOLAR DRYER

G. Habtay[1] and I. Farkas[2]

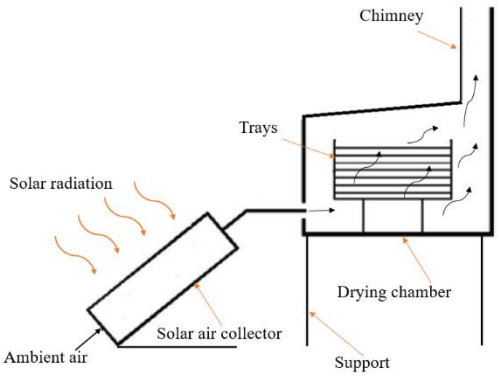
[1]Mechanical Engineering Doctoral School
[2]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 20 4360719, E-mail: gedion.habaty@gmail.com

Solar dryers can be separated into two categories, namely passive and active type of equipment. The difference is based on the flow of air in the dryer. Dryer passively rely on convection currents obtained from heat to move air. Active dryer has a fan to circulate air from the inside to the outside of dryer. Low air flow rate in a passive-type solar dryer is a great loss achieving efficient performance of the system (Ekechukwu, Norton, 1997). When the air flow rate is low, it will cause the temperature inside the drying chamber high enough.

The presence of a chimney in natural convective solar dryer has proven its benefit in accelerated transport of moist air from the drying compartment and thus shortening the drying time for intended products. Natural convection indirect solar dryer comprises of air heater collector, drying chamber and chimney. This paper is going to present the theoretical results of types of chimney with given height and maximum draft, which would improve the airflow in the drying system.

The proposed chimney types in this study: normal cylindrical shape, normal cylinder shape with black painted and conical circular type with the given height. To predict the air velocity in the chimney the total pressure drop is to be calculated, which is a direct approach to determine the air flow in the system. Total pressure drop is the sum of the pressure drop in solar air heater (single pass), drying chamber and chimney.

In the recent study, the following main components were taken: single pass solar collector which provides higher temperature in case of natural ventilation and the cabinet dryer with thin layer drying. In addition to that the system assumed to be airtight.



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DESIGN OF WIND TURBINE BLADE UNDER INDONESIAN WIND CONDITIONS

M. Haekal[2], D. Rusirawan[1] and I. Farkas[2]

[1]Department of Mechanical Engineering, Faculty of Industrial Technology
Institut Teknologi Nasional (ITENAS) Bandung, West Java Indonesia
Jl. PKHH. Mustapa No 23 Bandung 40124
[2]Department of Physics and Process Control
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
E-mail: mhaekalt@gmail.com

Renewable energy started to be known since 1970s, as efforts to balance the fossil fuel energy and nuclear energy development. The source of renewable energy must be able to be restored naturally and the process is sustainable.

The potential of new and renewable energy (NRE) in Indonesia is considered large with various types of energy. However, this potential has not been optimally developed due to various constraints in its application, for instances high investment costs, relatively low technology efficiency, geographical location, and social factors of the community as energy users

Presently, source of energy in Indonesia is still predominated by fossil energy. Since fossil energy is limited and not environmentally friendly, alternative of energy should be considered to be implemented. As consequences, research in renewable energy field has developed.

One of renewable energy source is wind energy. The potential of wind energy in Indonesia is estimate d 970 MW, and presently, the installed capacity of wind energy conversion system (WECS) approximately is 1.96 MW. Nevertheless, there is problem in development and utilization of WECS in Indonesia, due to most of the WECS, which available in market, are not designed for Indonesia wind condition.

Based on this fact, it is reasonable if the WECS which operated in Indonesia not working properly (in performance point of view). Blades in a WECS are the main components which have major influence on the performance of WECS. In addition, the turbine can run in the low wind velocity if it used light material such as wood. Hence, a calculation of blade dimension need to be calculated based on the load or stress occurred in the blade.

In this research, design of blades was carried out based on predetermined power capacity, using wind velocity condition in Indonesia. As an outcome this research, 3D documentation of blade based on aerodynamic design have been proposed and ready to produce and tested.

SELECTIVE FRACTIONATION OF ENERGY CROPS WITHIN THE BIOREFINERY

S. Bartha[1], F. Carvalheiro[2], P. Moniz[2], L.C. Duarte[2]

[1]BIO-C Green Energy Association, 4 Presei Street, 520064 Sf. Gheorghe, Romania
Tel: +40722250725, E-mail: sbarthacv@yahoo.ro
[2]LNEG - The National Laboratory of Energy and Geology, Bioenergy Unit, Estrada do Paço do Lumiar, 22, 1649-038 Lisbon, Portugal

The bioeconomy will have to grow rapidly during the next decade, as it is a major tool to help to meet the United Nations Sustainable Development Goals by 2030. However, scientific, technical, economic, social and environmental developments are still needed to achieve a truly sustainable and circular bioeconomy.

An example of the required change is related to the evolution from first to second generation ethanol (and beyond), changing from traditional glucose-based (sugarcane, corn) to lignocellulosic feedstocks and others. Actually, e.g. the current supply of fuel ethanol for producing E5 and E85 standardized fuels is still mainly produced from first generation feedstock, a situation with limited sustainability that must evolve.

One way to increase the biofuels (e.g. bioethanol) production on second-generation industrial installations can be focused to use the energy crops as feedstock, which are preferably cultivated on marginal lands that do not compete with the classical agricultural production and land used change directives.

In this work, the chemical composition of several land and aquatic energy crops are presented, and compared, to agriculture and forestry residues, discussing their potential (dis)advantages as biorefinery feedstock.

Special attention is then given to the selection of the proper fractionation technologies that enable the selective recovery and valorization of the structural macromolecular constituents. These include physical, physico-chemical and chemical processes or combinations of them. For the two first categories the technical aspects related to milling and grinding process, hydrothermal processes such as liquid hot water (autohydrolysis) treatments, high pressure steaming steam-explosion, and the used of high energy radiation will be discussed.

For the chemical processes, mass balances are presented for the optimal dilute acid treatments comparing the efficiency of the fractionation process based on experimental data obtained for diverse feedstock at lab-scale, namely comparing sugar yields and mass loss of the treated biomass. Finally, it is presented and discussed the product family tree for producing added-value chemicals from these feedstock together with biofuels within the biorefinery framework.

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ANALYSIS OF ENERGY REED GROWING ON WASTEWATER

A. Barczi and G. Géczi

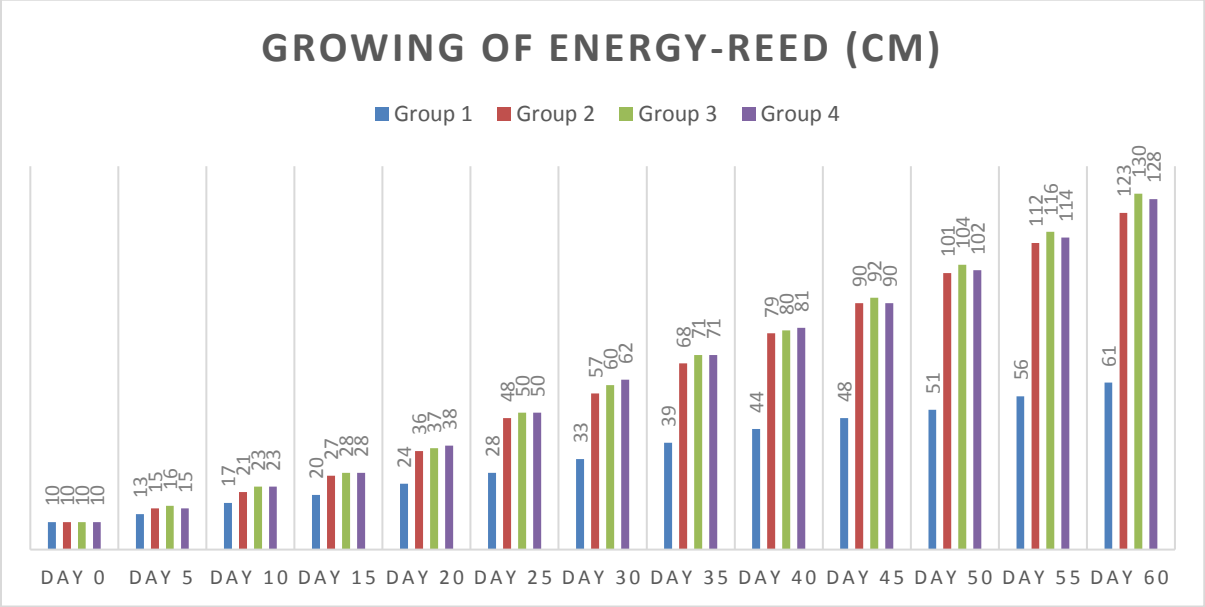
Institute for Environmental Engineering Systems
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 70 3695297, E-mail: andrisbarczi@gmail.com

In the beginning of 21th century, humanity discovered, that in a short term, we are going to run out of fossils, or at least these energy sources are going to be so rare, that their extraction will be very un–economic. We have to mention also their loads to the environment, many pollutants even during the mining, many flying particles, many by–products. The reproduction of these energy sources is much slower, than the needs, so it was clear that, new resources are needed. Biomass is not the best source if we are counting only the implanted calories, but it is easy to handle, it is easy to store, the quality levels of these products are not high, because of incineration, all these materials will be burned.

In the wastewater industry there are many options these days, considering the climate options, the data of raw water, the amount of raw water, and even financial options. Plants, trees, bushes, flowers are included nowadays in most technologies, but it is always hard to find a proper plant, because of the wastewater environment, which is very similar to a swamp, to a marsh. Reeds are naturally part of this environment, so energy–reed (*Miscanthus sinensis*) can be a participant of the technology. While there are many nutrients in the wastewater, these plants can grow faster, and the production can be increased.

We measured growing at 4 groups, every group had 10 reeds, and there was an average counting in each group. 1st group was the control, it was planted outside, beside a small creek. The other groups were planted to wastewater, using clay bubbles, to exclude other nutrient options.

The figure shows the Growing chart of energy reed.



As we see in figure, the starting point was the same (10 cm), but the plants with wastewater base grew almost two times faster. It means maybe two time more harvests, so efficiency can grow, without any addition of fertilizers, it can be a decent option for developing countries, to connect energy to wastewater management.

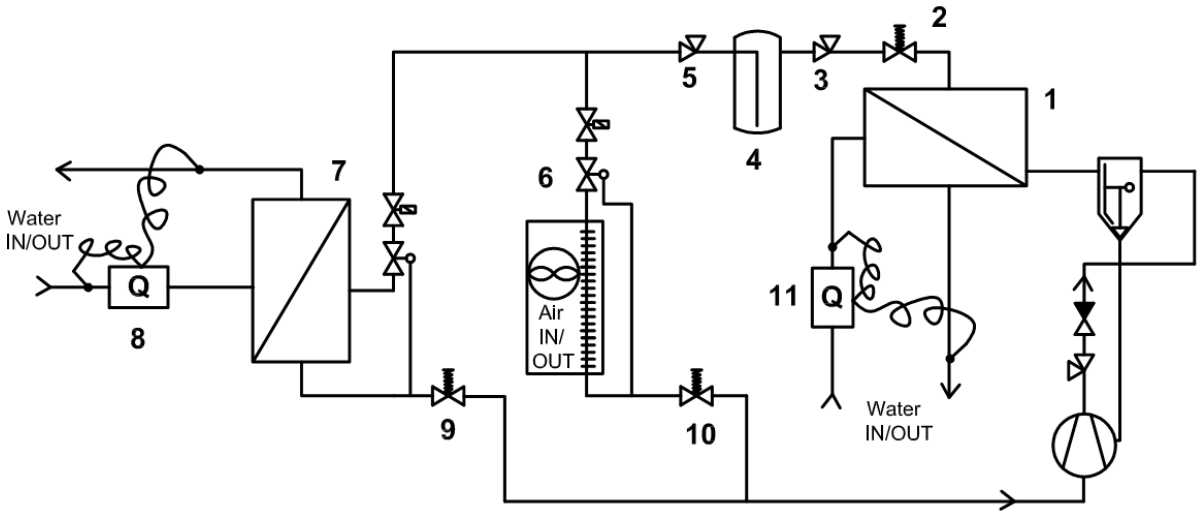
ANALYSIS OF MULTI RESOURCES HEAT PUMP

P. Hermanucz, G. Géczi, I. Barótfi

Institute for Environmental Engineering Systems
Szent István University, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 30 981 5135, E-mail: hermanucz.peter@gek.szie.hu

The examination of the applicability of natural refrigerants is justified by the decision to phase-out the current HFC refrigerants, according to 517/2014/EU. The phase down means that by 2021 the annual quantity of HFCs placed on the market and available to operators of equipment containing HFC will be reduced by 55% when compared to 2015. In some case, HFC's could be replaced by natural refrigerants, especially by hydrocarbon based ones. Replacement can also taken directly (drop-in), but some investigation needed on the thermodynamical and safety properties of the given refrigeration cycle.

According to my research topic, I have initiated the design of a heat pump using environmental friendly natural hydrocarbon-type refrigerant, which has very low Global Warming Potential (GWP) and zero Ozone Depletion Potential (ODP). However, the previously constructed experimental equipment must be modified according to the purpose of the investigation: Two heat flow meters (8, 11) will be installed to the condenser with coaxial-design (1), as well as the water-heated evaporator (7). The pressure, therefore the temperature of the phase change will be controlled by pressure regulator valves (2, 9, 10). In this manner the most important properties of the refrigeration cycle could be set and maintain at a desired value, according to the measurement plan. Nearly all of the refrigerant can be trapped in the liquid receiver (4) installed after the condenser, by actuating valves (3, 5). The figure shows schematic diagram of the experimental heat pump system.



The refrigerants I'm planning to use allows the system to operate at high evaporating (5…50 ºC) temperatures but much lower pressures, compared to the HFC-type refrigerants such as R404 used today. They are hydrocarbon based natural refrigerants. These are flammable, therefore some special regulations must be take in account, for example the EN 378 standard. The limit for systems working in a space with supervised occupancy (eg. in laboratories) is 5kg flammable refrigerant in a single refrigerant cycle. The refrigerant charge of the experimental heat pump system is far below this limit, therefore it could be operated without serious risk of fire or explosion.

WASTE MANAGEMENT OF A TEMPORARY FACILITY

Z. Patonai and G. Géczi

Institute for Environmental Engineering System, Szent István University, Gödöllő
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail:patonaizoltan77@gmail.com

In our study we conducted a communal and hazardous waste generated during the operation of a Temporary Facility. The aim of our study is to assess the type, composition and quality of the maintenance materials which was entered by the current trends of the logistical support and the facility management in order to determine the environmental load indicator of the facility and the waste management activity in the operational task system.

During the study, we examined the characteristics of municipal waste in order assess the potential of the disposal of waste, as an opportunity for the utilization of tertiary biomass. It was necessary to know the characteristics of temporary facilities, especially from a military point of view, as the investigated temporary facility was located at the southern border of Hungary with 4 Border Protection Bases (hereinafter BPB).

As a result of the environmental impact assessment of the temporary facilities, four BPB operating and supply systems emerged in the waste disposal sites on the material transport outlets, according to the responsibilities of separate independent technical supporter system. Particular attention was paid to the inspection of public utilities operational tasks, the resulting 1406 m^3/month sewage and 225 m^3/month municipal waste data. After evaluating the results, we recommend the waste management plan taking into account the existing operating system by calculating the collection capacity and frequency of the transport.

We evaluated the output of material transport from the measured data, as well as assessing the possibility of waste disposal on site, such as sewage treatment and solid waste incineration. In line with the relevant results of the study, more than 75% of the total transported amount of waste from the facility can be reduced. In addition, evaluating the composition of wastes can be said that the conscious supply of materials can reduce the volume of waste to be transported by up to 95%. By doing so, 95% of the terrorist attack can be reduced against the military camp on the operation area.

24th WORKSHOP ON ENERGY AND ENVIRONMENT

December 6-7, 2018, Gödöllő, Hungary

List of participants

Al-Neama, M.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Akhan, H.
Department of Mechanical Engineering
Trakya University
Edirne, Turkey

Alok, D.
Institute of Process Engineering
Szent István University
Gödöllő, Hungary

Atsu, D.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Bálint, Á.
Óbuda University, Institute of
Environmental Engineering
Budapest, Hungary

Barczi, A.
Institute for Environmental Engineering
Systems, Szent István University
Gödöllő, Hungary

Barótfi, I.
Institute for Environmental Engineering
Systems, Szent István University
Gödöllő, Hungary

Bartha, S.
Green Energy Association,
Sfintu Gheorghe
Romania

Bencsik, G.
Department of Mechanical Engineering
University of Pécs
Hungary

Bokor, B.
Budapest University of Technology
Faculty of Mechanical Engineering
Budapest, Hungary

Bődi, Sz.
Mechanical Engineering Doctoral School
Szent István University
Gödöllő, Hungary

Carvalheiro, F.
National Laboratory of Energy and Geology
LNEG, Departamento de Biotechnologia,
Lisbon, Portugal

Duarte, L. C.
National Laboratory of Energy and Geology,
LNEG, Departamento de Biotechnologia,
Lisbon, Portugal

Elmagid, W.M.A.
PhD School of Mechanical Engineering
Science, Szent István University
Gödöllő, Hungary

Eryener, D.
Department of Mechanical Engineering
Trakya University
Edirne, Turkey

Farkas, I.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Géczi, G.
Institute for Environmental Eng. Systems,
Szent István University
Gödöllő, Hungary

Gubán, S.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Háber, I.
Department of Mechanical Engineering
University of Pécs
Pécs, Hungary

Habtay, G.
Mechanical Engineering Doctoral School
Szent István University
Gödöllő, Hungary

Haekal, M.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Hartawan, L.
Department of Mechanical Engineering,
Institut Teknologi Nasional (ITENAS)
Bandung - West Java, Indonesia

Hegedűsné Baranyai, N.
Department of Agricultural Mechanization
University of Pannonia
Keszthely, Hungary

Hermanucz, P.
Institute for Environmental Engineering
Systems, Szent István University
Gödöllő, Hungary

Kajtár, L.
Budapest University of Technology
Faculty of Mechanical Engineering
Budapest, Hungary

Kapros, Z.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Kátai, L.
Faculty of Mechanical Engineering
Szent István University
Gödöllő, Hungary

Keppler, I.
Institute of Mechanics and Machinery
Szent István Univerity
Gödöllő, Hungary

Kocsány, I.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Mészáros, Cs.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Molnár, I.
Institute of Mechatronics and Vehicle
Engineering, Óbuda University
Budapest, Hungary

Moniz, P.
National Laboratory of Energy and Geology
LNEG, Departamento de Biotechnologia,
Lisbon, Portugal

Nikolényi, I. R.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Patonai, Z.
Institute for Environmental Engineering
System, Szent István University
Gödöllő, Hungary

Pintér, G.
Department of Agricultural Mechanization
University of Pannonia
Keszthely, Hungary

Ruda, Gy.
Department of Environmental Techniques
Szent István University
Gödöllő, Hungary

Rusirawan, D.
Department of Mechanical Engineering
Institut Teknologi Nasional (ITENAS)
Bandung - West Java, Indonesia

Seres, I.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Shantika, T.
Department of Mechanical Engineering
Institut Teknologi Nasional (ITENAS)
Bandung - West Java, Indonesia

Szilágyi, A.
Department of Vehicle and Agricultural Engineering, University of Nyíregyháza
Nyíregyháza, Hungary

Szulyovszky, L.
CROSS Institute of Construction Biology Budapest
Hungary

Tóth, J.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Tóth, L.
Institute of Process Engineering
Szent István University
Gödöllő, Hungary

Víg, P.
Department of Physics and Process Control
Szent István University
Gödöllő, Hungary

Zsiborács, H.
Department of Agricultural Mechanization
University of Pannonia
Keszthely, Hungary