SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ

Department of Physics and Process Control

23rd WORKSHOP ON

ENERGY AND ENVIRONMENT

BOOK OF ABSTRACTS

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November 30 – December 1, 2017

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, 2017

Further information, please, contact:

Prof. I. Farkas
Founding Chairman of the Workshop

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23rd WORKSHOP ON ENERGY AND ENVIRONMENT

November 30- December 1, 2017, Gödöllő, Hungary

Program

November 30 (Thursday)

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

December 1 (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. K. Gottschalk*
Dr. I. Seres

09.10-09.25	I. Farkas: New initiatives in the use of solar thermal energy
09.25-09.40	K. Gottschalk and R. Pecenka: A thermodynamic model for open-air drying of wood chips
09.40-09.50	I. Seres, I. Kocsány and I. Farkas: The first experiences with the operation of a transparent photovoltaic system
09.50-10.00	I. Haber and G. Bencsik: City climate measurement and simulation for smart city applications
10.00-10.10	H. Zsiborács, P. Weihs, H. Trimmel, S. Oswald, C. Gützer, I. Farkas, G. Pintér, B. Pályi: A thermal model for amorphous silicon photovoltaic technology
10.10-10.20	Sz. Bődi, P. Víg and I. Farkas: Application of thermal resistance network models for solar energy systems
10.20-10.30	B. Bagi and P. Víg: Examination of self-cleaning coatings at solar modules
10.30-10.40	Á.I. Soltész: Compost-based bioenergetic system - construction and operation experiences
10.40-11.10	COFFE BREAK

	Session 2	*Chairmen: Prof. P. Weihs* *Dr. Cs. Mészáros*
11.10-11.25	M. Revesz, P. Weihs, H. Trimmel, S. Oswald, A. Schneider, S. Zamini: Investigation of higher albedo on BIPV performance and human thermal comfort	
11.25-11.35	Cs. Mészáros and Á. Bálint: Projective symmetry analysis of collective elementary excitations of chain-type organic molecules relevant for solar cells	
11.35-11.45	M.A. Al-Neama and I. Farkas: Daily efficiency estimation of forced convection solar air heater	
11.45-11.55	J. Tóth and I.Farkas: Simulink-based study of a solar thermal system	
11.55-12.05	W.M.A. Elmagid and I. Keppler: Mathematical model of the solar updraft chimney	
12.05-12.15	I.R. Nikolényi: Influence of external magnetic field on solar cell relevant quasi-one dimensional materials	
12.15-12.25	D. Atsu, I. Seres and I. Farkas: Performance evaluation of solar photovoltaic modules under real conditions	
12.25-12.35	A. Barczi and G. Géczi: Forwarding the wastewater treatment - treatment and the society	
12.35-14.00	LUNCH BREAK	
	Session 3	*Chairmen: Prof. I. Farkas* *Dr. A. Kovács*
14.00-14.15	A. Kovács: Some application of infrared thermo-camera from agricultural basic research to testing grain dryers	
14.15-14.25	Gy. Ruda: Energetic reserves of the built environment	
14.25-14.35	Z. Kapros: Different methods for the prime energy factor of the Hungarian electricity system	
14.35-14.45	A. Dhaundiyal, M.M. Hanon, S.B. Singh: Approximations for parabolic ramping of temperature	
14.45-14.55	Kh.E. Zehouani and A. Boukhari: Study of Rayleigh Benard convection by Lattice Boltzmann method	
14.55-15.05	P. Hermanucz, G. Géczi, I. Barótfi: Analysis of multi resources heat pump	
15.05-15.15	S. Bartha, L.C. Duarte, F. Carvaheiro, B. Vajda: Integrated farm-based biorefinery model, developed for rural villages	
15.15-15.25	D. Rusirawan, D. Suhaya, I. Farkas: Study of a solar chimney power plant	
15.25-15.35	CLOSING	

NEW INITIATIVES IN THE USE OF SOLAR THERMAL ENERGY

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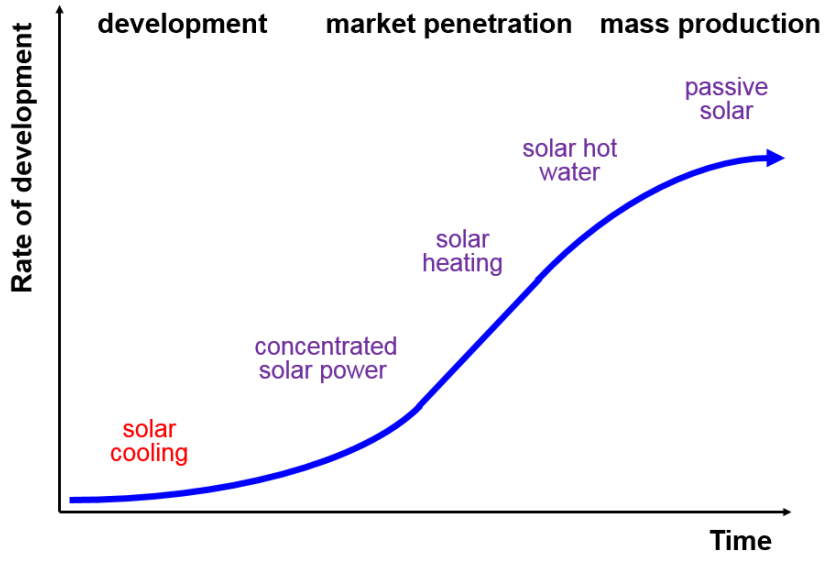
Nowadays, within the use of solar energy the solar thermal field identified at a lower innovation potential, however their application shows large varieties.

There are several attempts in order to improve the solar thermal technologies. Accordingly, a great number of books, publications and conference proceeding are presented to share all the available information in the field.

The worldwide situation can be overviewed based on the recent development shown in a great extent at the Solar World Congress events. The recent one just was organized by the International Solar Energy Society in Abu Dhabi, UAE during October 29 - November 2, 2017. The motto of the Congress was "Innovation for the 100% renewable energy transformation".

The rate of development of the solar thermal applications in a long time horizon is shown in the Figure bellow.



Focusing the solar heat energy worldwide several comments can be drawn. The most important ones are as follows:

In the share of the total installed capacity in operation (including the glazed and unglazed water and air collectors) China is taking leading position with 71%, following by Europe with about 11% and USA/Canada with about 4%.

In the period of 2000-2016 the global solar thermal capacity of glazed and unglazed water collectors grew from 62 GWth (89 million m^2) to 456 GWth (652 million m^2) in 2016. The corresponding annual solar thermal energy yields amounted from 51 TWh to 375 TWh.

A THERMODYNAMIC MODEL FOR OPEN-AIR DRYING OF WOOD CHIPS

K. Gottschalk and R. Pecenka

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Wood production for combustion is an option for the delivery of sustainable bioenergy. Moisture content of open-air stored wood chips in piles influences its storability for up to 6 to 9 months. The drying process of the wood chips in the pile largely depends on particle size and particle size distribution. Other factors to be reduced are mass loss due to microbial metabolic and chemical conversion processes which reduces energy gain for combustion purposes. The development of pathogenic molds which cause hygienic problems can be reduced by controlling the thermophilic phase. Experimental investigations for 300m³ piles show that the maximum moisture content of 40% required by combustion plants is achieved for fine chips after 6.5 months and for coarse chips after 3.5 months. Thus, the moisture may decrease to approximately 25 to 35% due to increase of temperature in the pile.

The extraction of organic solid fuels gained increasing importance, to make alternative energy production methods and farming options (e.g. on fallow land) for farmers. Wood chips allow a fully automatic loading and control of combustion systems. A pre-drying increases the calorific value of the organic solid fuel material and improves its shelf life. For producing higher amount of wood for combustion the chopped wood chips technology is applied since wood in bulk can be handled easier. Since wood as fuel material compete with fossil fuels, the procedure for obtaining energy should be improved to get good sales revenue.

Examinations of the storage and drying behavior of chips, chunks and whole trees have shown that the particle size of wood chip material has an essential influence on temperature development and moisture content and therefore storage losses over a longer period of typically six to twelve months (Lenz et al., 2015) and (Pecenka et al., 2014) determined for storage of fine chips losses of 15 to 27% dry matter and moisture loss of 30 to 34%.

A thermodynamic model of drying processes based on the Finite Volume Method (FVM) simulates the development of pile temperature, moisture content and dry matter loss of wood chips for variants of different wood chip sizes, wood chip size distributions, ambient (open-air) climatic conditions and pile construction dimensions. Different combinations of the variants achieve reduction of dry matter loss and mold development (Fig. 1). Boundary and initial conditions can be set, as ventilation conditions, adiabatic conditions etc.

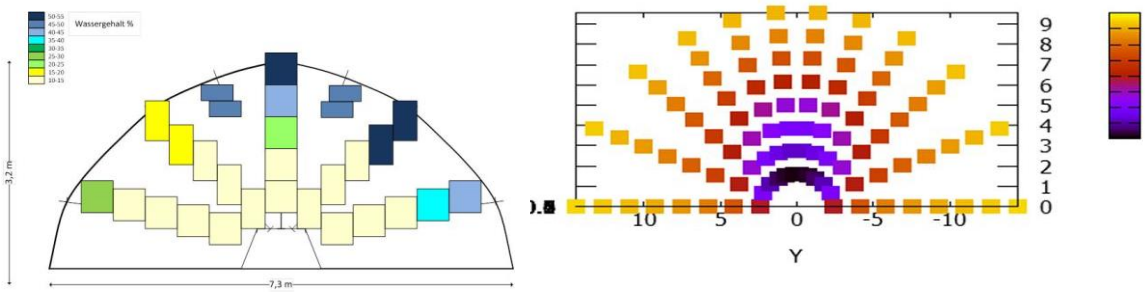

Fig. 1: Cross-section of a wood chip pile; left: experimental moisture profile; right: modelling result of moisture profile; conditions: inlet air: 15°C, outdoor air: 5°C.

THE FIRST EXPERIENCES WITH THE OPERATION OF A TRANSPARENT PHOTOVOLTAIC SYSTEM

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The Department of Physics and Process Control has a long time experience with photovoltaic technology, and carried out investigation based on the comparison of them. Until now mainly thin film technology modules (amorphous silicon modules) and polycrystalline modules were used, and analyzed from different point of view, e.g. seasonal dependence of the energy production, spectral dependence of the operation, and so on.

Recently, a new possibility opened on this field, as a within a running project it has been established a new photovoltaic system consisting of monocrystalline, but semi-transparent modules. The system was installed in front of the Aula building of the Szent István University, in Gödöllő.

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

As the (semi)transparent PV technology is new in our experience, some analysis about its advantages and disadvantages is provided together with the introduction of the main technical data of the system. In long time experiments we would like to see, if these modules can transmit sufficient quantity of light for the plants to live below (interested e.g. for greenhouses).

The online monitoring of the system will be presented together with the main energy production data in different time distribution (daily, weekly, monthly).

So far, a few month of operational data were collected, therefore a certain analysis of the operation can only be provided. One aim of the study is to present some conclusions, which can be drawn from these data, for example the orientation and the inclination of the system is not ideal, as it was adjusted to the existing staircase. It was a serious question, that beside the non-optimistic orientation, wether the operation of the system can fulfill the originally planned energy production.

Another topic is the unequal operation of the different modules. However, the modules are identical (the same type of the same brand), the energy production are slightly different for them. As the energy data are measured for every module separately, spatial and time distribution in the actual power data can be recognized. Such differences are to be presented together with the possible causes of them.

CITY CLIMATE MEASUREMENT AND SIMULATION FOR SMART CITY APPLICATIONS

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City climate is very important from many approaches. It can influence the inhabitants conform, it is needed to keep in sight at urban planning. Cities could have driven wind channels, whose can help to filtrate exhaust gas emmissions, or to manage hot spots. Since it's very important to reach high level in building efficiency, if designers could have a renewable energy potential map, they can optimize the newly build facilities, houses for the renewable energy sources. These sources can cover sun energy by PV and thermal applications, or wind for micro generators and natural ventilating.

The aim of the research is to create a city energy map. In our previous work it has been highlighted that the efficiency of photovoltaic and solar applications is largely dependent on the cooling effect of the wind (Haber, 2016). In addition, it is well-known that in cities there may be built-in so called wind tunnels along on steets which energy output is more favourable, so exploration of these is beneficial for wide range of renewable energy investments (Zsiborács et al., 2016). If such an energy map would be created, it could be planned with it and this would give the private sector guidance as a chapter on public order planning. As an ancillary benefit, wind energy investments could be planned based on this, which applies to passive building ventilation by wind, as our reference work shows (Haber et al., 2017).

The tangible lack of experience, opportunities and the energy map motivates me to carry out research that, due to its complexity, can provide me with many years of research.

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A THERMAL MODEL FOR AMORPHOUS SILICON PHOTOVOLTAIC TECHNOLOGY

H. Zsiborács[2], P. Weihs[1], H. Trimmel[1], S. Oswald[1], C. Gützer[1], I. Farkas[3], G. Pintér, B. Pályi[2]

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Due to their reliability the silicium based photovoltaic solar modules are the most widespread worldwide. These types react sensitively to temperature rise influencing negative electric energy production. The temperature coefficient of amorphous silicon (a-Si) solar modules is better than that of crystalline ones. Under Hungarian climatic conditions the temperature of silicium based solar photovoltaic modules can reach 60–70 °C on warm summer days, due to its high temperature the energy production of solar modules decreases. In the case of crystalline silicon photovoltaic modules the efficiency characteristically decreases by 0.5% while in the case of amorphous silicon solar modules by 0.3% as a result of a 1 °C temperature rise.

In this study an amorphous silicon solar module (Kaneka, G-EA050) was examined in real climatic conditions on July 19th (09:00 am – 17:40 pm), with 50 W nominal performance, installed on dual axis solar tracking system in Hungary, Keszthely. For this measurements two PicoLog data acquisition systems were used, the data's were recorded every second with a PC. The voltage and the current were measured by the help of a True Maximum Point Seeking (TMPS) device. For recording the temperature a Pt 100 sensor was applied. Additionally, the following technical-environmental parameters were determined: radiation intensity (Eppley Black and White Modell 4-48 pyranometer) and wind speed (JL-FS2, 4-20mA).

In this case the components of heat transfer are the long-wave radiative (Q_{Rad} [Wh]) and the convective (Q_{Conv} [Wh]) heat exchanges. Electricity output by the PV module (Q_{PV} [Wh]) is also considered. The incoming solar radiation (Q_{Solar} [Wh]) is collected by solar module front surface. The difference between these components ($Q_{Solar} - Q_{Rad} - Q_{Conv} - Q_{PV}$) gives the remaining heat energy (Q_{Rem} [Wh]) of a-Si module.

According to our thermal analysis on 19th July from 09:00 am to 17:40 pm the percentage of daily energies were the following: Q_{Rem}: 42%, Q_{Rad} : 21%, Q_{Conv} : 31% and Q_{PV} : 6%. We can say that the remaining heat energy (Q_{Rem}) was the highest value which caused the high amorphous silicon solar module temperature. For this problem various cooling technologies may offer solutions.

Acknowledgements

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APPLICATION OF THERMAL RESISTANCE NETWORK MODELS FOR SOLAR ENERGY SYSTEMS

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At present our world has to face energy problems. Environment is burdened by pollutants emitted by burning traditional energy carriers. In our world heat energy is obtained mostly by burning fossil energy sources (gas, oil, coal). Because of the increasing amount of gases causing greenhouse effect and because of other environment pollution, it is more and more necessary to use renewable energy resources.

Photovoltaic (PV) systems absorb solar radiation and convert it directly into electricity. Solar thermal collectors absorb the solar radiation, and they convert it into heat energy with the help of converter medium (water or air).

The photovoltaic-thermal collectors (PV/T) are systems that generate electric energy and heat energy simultaneously, as photovoltaic modules are combined with traditional solar collectors. Concentrating PV/T collectors (CPV/T) are also developed, which use lens or mirrors, and circulating liquid, in order to avoid the high operation temperature of the PV.

There are different energetic models in the investigation of solar recovery systems. For such purposes, the thermal resistance network (TRN) modeling is a common description of heat and mass transfer equations that takes into account initial and boundary conditions. The great advantage of the model is that it can be achieve the required accuracy and apply the same simulation model for different structures. Thus, along the entire length of the structure, it can be able to make calculations with the same structure.

The considered model can be used to describe the optimal operation of the entire solar system and to define the parameters needed for also for control purposes. During the TRN modeling, the average temperature of each piece (nodes) of the tested structure is determined instead of the continuous spatial distribution of the temperature. The nodes of the network assign the thermal capacities of each part, connect the nodes with heat transfer resistors, and represent the heat streams that occur in the individual pieces with current generators connected to nodes.

In the present work it will be demonstrated the importance and some very promising applications of thermal resistance network modeling in order to increase the efficiency in solar energetic devices.

Acknowledgements
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EXAMINATION OF SELF-CLEANING COATINGS AT SOLAR MODULES

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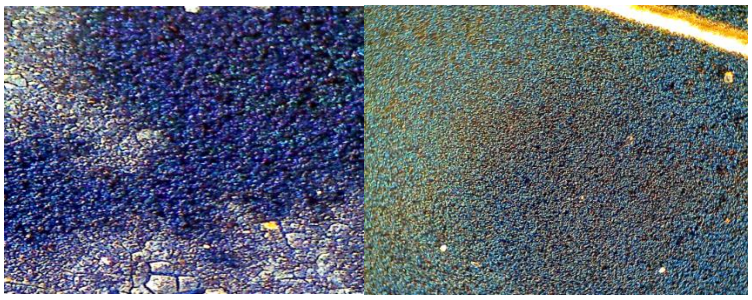
The power of photovoltaic modules are determined by many parameters: geographical and meteorological data, orientation and tilt angle, type of module and also depends on their cleanness. The performance-reducing effect of contamination is significant, so it is worth cleaning and to keep clean the modules.

Near the manual and mechanized cleaning methods of solar modules is a novel option for using self-cleaning coatings. In the present work two types of nanotechnology coating were in our focus: working based on the Lotus-effect and photocatalytic thin layer. The aim was examination effect of some such coating for solar modules cleaning.

The place of measurements was the laboratory of the Department of Physics and Process Control, Szent István University. During the measuring it was used artificial, normal light in perpendicular direction in each case the same lighting. In every case there were determined the currents and voltages of the PV module with used different load resistance, and was calculated from these data the maximum power of the module.

A 4 W power a polycrystalline solar module with 156x156 mm area without cover, as untreated and same modules, 2 with photocatalytic thin layer and 4 with lotus-effect coated were compared. One photocatalytic and one Lotus-effect coated sample can be seen in the photo taken using a microscope.



Three series of measurements were carried out. Firstly, it was examined the effect in performance of the coatings compared with uncoated solar module. The second case was the examination of the performance-change with the dust contamination. In every case there were used sediment dust with evenly. In the third series of measurements the solar modules were washed with rainwater in equal method and the performances were determined again and compared.

As a conclusion, it can be stated that the coatings themselves increase the performance compared to the performance of the same non-coating solar module, and the coats have a positive effect on the removal of contamination. The presentation will detail the measurements and the results.

COMPOST-BASED BIOENERGETIC SYSTEM - CONSTRUCTION AND OPERATION EXPERIENCES

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The goal of making compost is to product a living, nutrient-rich material. To achieve this necessary the suitable biological material mixture and to keep for it in optimal temperature, humidity and air conditions. The compost is rich in biological livings, so it is essential for regenerating the soil in the natural cycles, and it can be used as a vaccine for regenerating wasted soil.

Nowadays, living on the countryside is highly varied. In the rural life the nature is nearby, and it is used by humans are differently. In the economy there are areas where can be find extra resources. For example, in upholding roads they provide and mill a huge quantity of biomass. The output of this activity is a good raw material for composting. Another possible source is manure, which is the output of stock farms. Only from these two sources can be able to make the right mixture connecting to an existing section of economy.

During decomposition a significant quantity of heat energy is released. Using this kind of energy there are existing solutions in the industry. This is a larger scale, in this study the conception is to examine solutions for local communities in a smaller scale.

During this work it was built a system and examine the built compost-base energetic system operation.

The built system (Fig. 1) can found in our garden in Pilisszántó, Hungary, which is connected to existing heating system in the house.

Fig.1. The built compost-base bioenergy system

This work describes the design and the building process from getting the raw material to the possibilities of further using. Additionally, it is keeping in sight the local opportunities, shows the steps of the construction of the compost-base system and monitoring system (temperature and flow rate measurement), details the design of data logger and controlling system, introduces the received data from evaluation of measurement data. Finally the gained information and experiments are represented.

INVESTIGATION OF HIGHER ALBEDO ON BIPV PERFORMANCE AND HUMAN THERMAL COMFORT

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Within the project "PVOPTI-Ray" the effect of increasing the albedo of streets and building facades on the yield of building integrated photovoltaic (BIPV) systems and the comfort of pedestrians (thermal and visual) was investigated. Therefore, different typical urban was to find an optimised solution (with regard to the structure of an urban canyon and properties of surface materials on streets and buildings), where the yield of directly and indirectly integrated PV is increased and the comfort of pedestrians is maintained within limits.

While research in PV and urban climate modelling is already quite advanced, the interaction of BIPV in cities and urban climate has not yet received the required attention. In addition, city planners search for solutions to increase renewable energy production inside cities. Besides roofs, also building facades can be used for the installation of PV systems. Using reflected irradiation can improve the yield of BIPV systems. The results of the present research will support urban planners to structures, e.g. intersections and squares, with varying dimensions were analysed. The aim achieve their goals. Further, the results can also serve as a guideline for a following and larger research project. The used models can still be improved and more specific scenarios should be analysed. The results are expected to have an impact on future urban planning.

Firstly, for the analysis, different available models for urban climate and PV yield have been assessed. The most suitable models were combined. In a further step relevant scenarios were defined, concerning mainly the urban structure, different surface materials (distinguished by reflectivity and emissivity) and different PV technologies. In a last step, the models were tested, using real measurement sites. Then, different scenarios were simulated and assessed for an optimised PV output.

Simulations show, that increasing the ground albedo from 0.15 to 0.40 lead to increased irradiance on building walls (as expected) and result in a gain of power output for vertical, south facing BIPV by almost 10 % for hours around noon. Therefore, higher yield can be achieved by using highly reflecting concrete for streets instead of dark bitumen. The simulations were compared to measurements. Increasing the ground albedo from 0.13 to 0.75 for an area of ~20 m2 in front of PV modules caused an increased PV yield by ~13 %.

To conclude: An urban climate model and a PV model were successfully coupled. However, the simulation of ground reflection requires further improvement, since the procedure is usually very simplified, based on a few assumptions [1]. Further, it was demonstrated, that an increased ground albedo leads to significantly improved PV yield inside an urban canyon.

PROJECTIVE SYMMETRY ANALYSIS OF COLLECTIVE ELEMENTARY EXCITATIONS OF CHAIN-TYPE ORGANIC MOLECULES RELEVANT FOR SOLAR CELLS

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It is well - known nowadays, that the detailed experimental and theoretical investigation of basic structural and physical properties of different types of carbon nano - tubes plays a role of continuously increasing importance in the condensed matter physics (Barros et al., 2006). Among the newest methods of investigations of such types of condensed matter systems, research activities connected to possible applications in solar cells became also very significant, e.g. (Lee et al., 2008).

In the present study we will demonstrate in detail some further possible and very promising applications of the group representation theory relevant for chain-type molecular systems, which may contribute to understanding and increase of the energy transformation efficiency in solar energetics, too. According to the definition, the complete set of symmetry transformations leaving invariant a Q1D system belongs to one of the (discrete) infinitely many line groups gathered into 13 families. The exact symmetry and representation theories of such types of discrete infinite chain systems has been elaborated in detail for decades, including the basic selection rule formulae, too.

In the present study, all these relations will be applied in detail and incorporated into correlation functions necessary for comparison of experimental-, and theoretically derived light scattering intensity curves. Although some applications of the projective representations of crystallographic point groups in solid state physics are also known for decades, they are completely absent even from the most complete works about applications of line groups in various types of structural investigations of condensed matter systems. In order to overcome this problem, we apply here our own earlier results about generalized - type description of structure factors (realized by a simple, but completely novel-type use of projective representations in the case of incommensurately modulated crystals) to extend the existing Fourier-analysis formalism relevant for interpretation of the diffuse X-ray scattering intensity curves, too.

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DAILY EFFICIENCY ESTIMATION OF FORCED CONVECTION SOLAR AIR HEATER

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Solar air collectors are becoming more and more popular in space heating, industrial processes and drying process due to their cost effectiveness and easy maintenance. Solar air heater (collector) is one of the basic equipment through which solar energy is converted into thermal energy. A solar air heater made with single air passes, as shown in Fig. 1. The external dimensions of the built solar heater are 120×50×15 cm length, width and thickness respectively. The external case of unit is made from wood sheets and bars with different thicknesses with dimensions. The most important part is the absorber. Two absorbers are made from copper sheets with 1.5 mm thickness and thermal conductivity 385 W/mK. Absorber's dimensions are 46.2×121.8 cm. To increase the absorbed energy and decrease reflected solar radiation, a black matt paint used to coat copper absorber.

According to the experimental results and investigations, many conclusions are deduced. The experiments showed that the maximum temperature differences of solar heater and useful heat energy were between 12:00 and 13:00 up to the highest values of solar radiation and ambient temperature during test day. The instantaneous efficiencies of solar heater had a low variation during high variation of climate aspects. Also, daily efficacies of solar heaters is determined at around 44%.

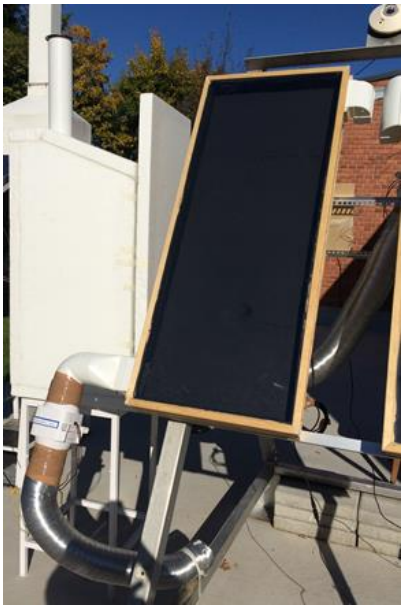

Fig. 1. Solar air heater at the laboratory of the Institute for Environmental Engineering System

Acknowledgements

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SIMULINK-BASED STUDY OF A SOLAR THERMAL SYSTEM

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The development of the solar system is highly speeded up in the recent years. For that reason, quite a lot of experiments were carried out along with creating several prototype systems. With the aid of the computer assisted modelling methods the planning and installation costs can be reduced, but such algorithms were developed for a specific task, and they not provide sufficiently enough flexibility, so far.

In the recent work the main goal is to show the possibilities of a system study in a block-oriented way. There were attempts to create a similar system (Bíró, Farkas, 1997; Tóth, Farkas, 2017). The MATLAB + Simulink software package, made by MathWorks, is an ideal choice for the base for modelling and operational environment. Ordinary differential equations, which are the most obvious descriptors of these devices, can be solved with these programs by long-time tested, proven-to-work numerical methods. The Simulink is a block oriented modelling tool for simulations and it supports all the necessary basic element for a more complex system, such as a solar energy device.

The main building blocks of a solar thermal system are the collector unit, the storage tank and the controller unit. Each device has governed by its own mathematical model, which can be found in the literature. The collector unit was implemented using the Hottel-Vhillier model and for the storage tank a water storage model was used (Duffie, Beckman, 2013). In this study, two controllers were implemented with different functioning algorithms, which are the On-Off and the PID controllers.

As an example, a solar thermal system was simulated using measured data for the environmental temperature and the global radiation. The system contained a collector, a storage and a controller. Two types of controller were presented comparing their controlling capabilities. Based on the theoretical and experimental results, it can be stated that the block-oriented modelling approach for a solar thermal system is fairly advisable.

The further development will be the extension of the device library with new modules, e.g. pipes, and the creation of the more sophisticated version of the already existing ones.

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MATHEMATICAL MODEL OF THE SOLAR UPDRAFT CHIMNEY

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Utilization of renewable resources is dramatically essential for reducing fossil fuel effect on the human environment. Thus, many innovative concepts have been proposed to capture more energy from the renewable energy sources such as solar, wind, and hydroelectric energy. The most promising paths towards the sustainable development are solar energy, especially in energy production.

One of the options that will help in global electricity production by using solar energy resource is the solar chimney power plant (SCPP). The Solar Chimney Power Plant System (SCPPs) is a natural driving power generating system. It can convert solar energy first into thermal energy then into kinetic energy and finally into electrical power. The operation of a solar chimney power plant (SCPP) is based on a simple principle: when air is heated by the greenhouse effect under the transparent roof of a collector, buoyancy forces arise as a consequence of density variation, this less dense hot air rises up a chimney, which installed at the centre of the collector. At the base of the chimney, the air flows through a turbine to produce mechanical energy for driving a generator. It combines the concept of solar air collector and central updraft chimney to generate a solar induced convective flow which drives wind turbines to generate electricity. The SCPPS has been proposed as a device to economically generate electricity from solar energy in commercial-scale in the future.

According to the operation principle mentioned above, a solar chimney power plant has many physics principles. The air inside the collector is heated by solar radiation (greenhouse effect).The heating collector is work as air heater by solar energy, where all terms of heat transfer are applied to predict his performance. Consequently, the hot air inside the system is less dense than the atmospheric air outside. To analysis of chimney, the heat transfer is neglected but buoyancy force (fluid mechanics) is taken into account. The air density difference between the inside and outside of the chimney causes a pressure difference between the system and the ambient air (chimney effect). The combination of energies of solar radiation and chimney effect is therefore captured by the air, which will drive the wind turbine installed at the chimney base to generate electricity (wind turbine effect).The turbo machine theories should be applied to design and analyse the turbine. The capability of mathematical model are demonstrated, as a powerful research tool and engineering analysis method for analysis of complex thermal systems and aerodynamic, such as the solar chimney power plants.

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INFLUENCE OF EXTERNAL MAGNETIC FIELD ON SOLAR CELL RELEVANT QUASI-ONE DIMENSIONAL MATERIALS

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Nowadays, the quasi-one dimensional (Q1D) materials – for example conjugated polymers (CP), nanowires and nanorods (for example ZnO or GaAs ones), carbon nanotubes – are under very intensive studies both theoretically and experimentally. A few examples verifying their importance, namely the so-called vertically aligned nanowire based technology, the detectability of the so-called carrier multiplication process in carbon nanotubes and other type of nanowires have been already presented in the near past conference paper.

The recent work focuses on the case when solar cells are placed in external magnetic field. Beside the experimental and theoretical results about the influence of the external magnetic field on the solar cell parameters there are many other important theoretical approaches studying Q1D materials in the presence of magnetic field could be relevant to the solar cell applications in the near future. The one of the most important one is the Tronc and Smirnov's symmetry –based method (2007) for generating selection rules. Another remarkable result is the Dzyaloshinski and Kats's one (2012) for the pointing out the magnetic field induced tendency of the superconducivity in Q1D materials in the presence of the so-called umklapp process.

In the experimental investigations the magnetic field studies - for example the magnetic field effect of photocurrent - are powerful technique to study the photovoltaic CPs processes. CPs are interesting materials because of the phenomenon of the so-called singlet fission process too which one can raise the value of the external quantum efficiency above 100%. The magnetic field dependence of the photocurrent is a fundamental effect in this field of research.

For the theoretical studies of CPs we wish to follow the very useful tool the so-called Method of Positive Semidefinite Operators according to Trencsenyi and co-workers's article (2011). Tthe recent research work focuses on defining the bare band structure and the properties of the ground states of backbones of the PPV-derivates (the most frequently applied CPs for solar cells) within the frame of the Hubbard modell. The magnetic field influence will be taken in account via the so-called Peierls factors.

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Acknowledgements

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PERFORMANCE EVALUATION OF SOLAR PHOTOVOLTAIC MODULES UNDER REAL CONDITIONS

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The energy demand of the world is increasing with increasing population and economic development. At present, the energy generation led by conventional energy sources has a severe impact on environmental conditions, as well as energy security due to the fast depletion of fossil fuels. Therefore, the worldwide emphasis on the use of renewable energy sources for sustainable and green energy production to cater for energy demand.

Deployment of solar energy, a ubiquitous renewable energy source, is gaining popularity due to the easiness of installation, availability and competitive cost. For effective utilization and higher penetration of solar energy, knowledge about technology and performance of solar energy system is very much required.

The accurate and consistent evaluations of photovoltaic (PV) system performance are crucial for the continual development of the industry. PV module/system operation under environmental conditions far differ from the standard test conditions. Variations in solar radiation and ambient conditions influence the performance of solar modules and energy production.

The objective of this study is to investigate the performance of different make solar modules on the basis of standard parameters like performance ratio, yield energy, reference energy and capacity utilization factor as well as energy efficiency.

The GUNT setup which was used for the measurement is also presented with its possibilities of use for different measurements. It can be focused on the performance evaluation of grid-connected photovoltaic modules.

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FORWARDING THE WASTEWATER TREATMENT - TREATMENT AND THE SOCIETY

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At the early nineties, new state of mind came up by using environmental benefits; almost nothing is limitless. More than 6 billion habitants harvests the gift of the planet called Earth, which has no white spots left, everything has been already discovered. Sadly before, the view of the decision-makers think a bit slower, during the age of "ism"-s, they continued their old-school knowledge, so in the end of the bipolar world the bells rang loudly.

Wastewater treatment is a field with different eras and periods during the history of humanity. We can divide the canalization period, and the real treatment period, however the first steps to the method was the canalization.

The new age, lot of new knowledge can help maximise the efficiency of a treatment plant, but he world cannot be divided by black and white, there are many huge differences between the needs, different types of pollution, there are differences in cultural mentality, there are still many disagreement in the wastewater treatment necessity. Not to mention the different financial abilities.

It can be observed that these issues are not he problems only for the expert engineers, or the designers, these are huge issues to the decision makers, because there are many more maters that must be counted in their project while building a new treatment plant, or just renovate them.

There are lot of opportunities to satisfy these problems, no matter what the source of the issue is; chemistry, biology, or geographical, cultural, or even financial. So the future is a bit brighter, and can shine towards, if there are no unnecessary fear of non-existent, or already solves side effects of wastewater treatment.

Different "smart" systems can use less energy with the same efficiency. Mechanized swamps have side-benefits which can bridge the cultural fears. New research and developments can help us to produce smaller biological footprint. With various intensification methods, and the deep knowledge of microbial living space, the acceptation of wastewater management, wastewater treatment should be no longer an issue for humanity.

The civil counter feelings are odd, and as every technology has developed, he treatment process are not that epochal, vociferous, malodorous anymore, those facilities can be installed in the centre of a business-square, without any notice of the side-effects.

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SOME APPLICATION OF INFRARED THERMO-CAMERA FROM AGRICULTURAL BASIC RESEARCH TO TESTING GRAIN DRYERS

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Infrared thermography is non-destructive methods that detect infrared energy (heat) emitted from an object. Everything with a temperature above 0 K emits heat: the higher the object's temperature, the greater the IR radiation emitted. Heat sensing can be carried out by infra-red spot probes or cameras that produce a thermal image or video, on which precise temperature calculations can be performed. However, reliable results can only be reached by thorough experimental conditions. For example correct temperature values can only be gained if the object plane is parallel to the lens surface. There are several applications of thermal images from basic researches until practical monitoring. This presentation summarizes the measurements carried out with the infrared techniques of Departments of Agricultural and Food Engineering. Devices include an Ahlborn type Almemo FI A628-xL type infrared measuring heads and a FLIR PM675 thermo-camera.

Examples of testing objects by using thermography are the following:

- surface temperature changes during drying of different commodities;
- plant disease and insect detection;
- electrical systems;
- buildings, home isolation problems;
- grain drying performance.

Thermography techniques are capable tool for both basic research measurements and practical testing. Drawing conclusions from thermos-images however need accurate professional evaluation and interpretation.

ENERGETIC RESERVES OF THE BUILT ENVIRONMENT

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The building activity uses and moves the largest masses of materials with gigantic energy and environmental (EE) loads. Meanwhile building up is encroaching upon the green surroundings; it has to be controlled. The building sphere is less discovered in EE matters, contrasted with the exact results of mechanical engineering. The vast building heritage, from different time and site, is rather heterogeneous in its materials and individual architectural styles.

Special methods had to be found to select building systems suitable for objective investigation. In Central-Eastern Europe there was a certain period between 1950-1975 years when large scale industrialization was introduced also to the agriculture, overwhelmed with standardized simple structures, easy to survey.

Collecting of experiences began already in the former decade in the Department of Environmental Techniques Szent István University. The statistics of the Hungarian Ministry of Agriculture provided the basis, the concrete numbers.

This year, expanding our survey in the country, at least 25.000 industrial scale farm buildings could be found, built in the 1950-75 years period. Controlling and measuring hundreds of these, their standard structure and condition is generally homogeneous. Their size and structure are, in the majority of cases, the same or at least similar, length around 60,0 - 84,0m, width 12,0m. The structures are also uniform: Concrete foundation and floor, reinforced concrete frame, (later in this period steel) hard traditional brick walls. All of these long-life materials provide further functional use in the next decades too, as these spacious sheds had originally been designed for possible changes. Some of these structures in cases deteriorated, became abandoned, then demolition can be suggested regarding the reuse of durable traditional materials.

The amounts of structural materials were calculated and summarized. Regarding the prime energy demand, included mining transport and processing, estimating by continual approaches, the total saving of energy can be several TWh for the 25.000 referred model sheds.

Living houses were built in manifold numbers, also in this period of concentrated development, representing even greater EE problems. Traditional architectural appearance of this countryside also changed. Hundred thousands of family houses were built according to ill-considered planning. By now this houses have become out of date and more or less abandoned. Regarding the extremely great numbers, the functional or material reuse of these structures, following our above outlined method, even 100 TWh energy saving can be realized, with measureless environmental benefits.

DIFFERENT METHODS FOR THE PRIMERY ENERGY FACTOR OF THE HUNGARIAN ELECTRICITY SYSTEM

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There are the options for measuring and evaluating the quantity of the primary energy use or the final energy consumption. However this is not easy task to accurately estimate the effect of the final energy consumption change to the primer energy level.

The primary energy (conversion) factor (PEF) for an energy use can be determined in the general by knowledge of the total aggregate final energy consumption, the quantities of each directly utilized energy sources (main energy sources and auxiliary energies) and their own different primary energy factors.

These types of power plants which operate with secondary energy sources represent a significant part in the whole electricity production. In these cases it could determine the PEF values by all of these special energy sources to be able to get the complex PEF of the electricity production. One of these secondary energy sources the nuclear energy produced steam, which has usually the 33.33% as a statistically acceptable primary energy factor. However this constant number does not characterize the efficiency of a given power plant. Furthermore other examples are the power plants utilizing petroleum products, wastes or some industrial process gases. However the biomass or biogas utilization also comes with the use of auxiliary energy, which does not necessarily appear in the power plant self-consumption.

The assessment of the primary energy conversion factor by electricity nowadays determines the ranking of energy efficiency and renewable energy technologies and leads the design-engineer. For example, it can be mentioned the heat pump or other electricity heating solutions, but good example the special new electricity fuel product for the electric car in the regulations.

These evaluations (such as passive houses) are often depends on the amount of the carbon-dioxide, so the PEF is often zero by the renewable energy sources. The final energy consumption and primary energy demand of a country, however, are the results of special statistical evaluation, where special methodologies and definitions work.

In the presentation two possible evaluation versions will be compared, illustrating the differences between the results of the statistical and the building-energy approaches. I also look at the decentralized assessment possibilities and the expected values of PEF by the visually special electricity fuel in the green mobility which could depend on the renewable and nuclear energy justified ratio behind it.

APPROXIMATIONS FOR PARABOLIC RAMPING OF TEMPERATURE

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A careful analysis of higher order regime is carried out using an asymptotic expansion, which will unveil the influence of different regime on the estimation of kinetic parameters.

The Distributed Activation Energy Model (DAEM), adopted for the pyrolysis of a wide domain of materials, namely coal, biomass, residual oils and kerogen, postulates that the thermal decomposition of numerous components is delineated by a distribution of activation energies. In order to evaluate activation energies, a continuous distribution function f(E) is assumed to exhibit pyrolysis behaviour as function of activation energy *E*.

Existing theories are based on methods of evaluating solution quickly and efficiently by using computer based numerical technique and asymptotic expansion, which can be under purview of one of two distinct and physically relevant regime. However, there are numerous relevant regimes subjected to be examined critically. A careful analysis of higher order regime is carried out using an asymptotic expansion, which will unveil the influence of different regime on the estimation of kinetic parameters.

The distributed activation energy model (DAEM) has proven very successful in describing the pyrolysis of various coals under differing temperature histories. While our focus here is primarily on parameter values relevant to loose biomass, the DAEM also applies to the pyrolysis of other materials, including biomass, residual oils, resin chars and kerogen. Calculations of solutions to this model may require many evaluations of double integrals, involving rapidly varying functions and this creates significant numerical difficulties.

The aim of this paper is to use asymptotic methods to make accurate approximations to the integrals and thereby allow rapid calculation of DAEM solutions. Existing approximations in the literature are reviewed, and are noted to have had varying degrees of success. Next one of the main sources of numerical difficulty, namely the double exponential term arising in the DAEM, is investigated for various temperature histories. This double exponential term acts over a narrow range of activation energies, which changes as time progresses. The key to our approach is to recognise the importance of the parabolic regime as compared to temperature undergoing constant and linear ramping.

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STUDY OF RAYLEIGH BENARD CONVECTION BY LATTICE BOLTZMANN METHOD

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The lattice Boltzmann method (LBM and its scheme D2Q9 and D2Q5) is applied for the numerical study of hydrodynamic and thermal instability during confinement of air or water in rectangular cavities with aspect ratios A = L / H varying in the range (0.5, 1, 2, 3, 5). The lattice Boltzmann method (LBM) was used to discretize the steady-state and transient flow equations.

The cavity is differentially heated on the horizontal walls. The study is carried out for a Prandtl number of Pr = 0.71 (air), and for Pr = 7.01 (water). The Rayleigh number values change between (6×10^3)-(130×10^3). We have discussed and analyzed the influence of Rayleigh number on the dynamic and thermal fields as well as on the average Nusselt number of the flow. In addition, critical frequencies dominating the oscillatory flow have been determined.

The results show the frequency dependence with the aspect ratio and the critical Rayleigh number. Although our study is two-dimensional, it is expected that the results of a three-dimensional numerical simulation, focusing on the possible obstacles or structure in the flow, as well as the possible presence of the instabilities due to the double diffusion, confirm the qualitative results obtained in this work (Fig. 1).

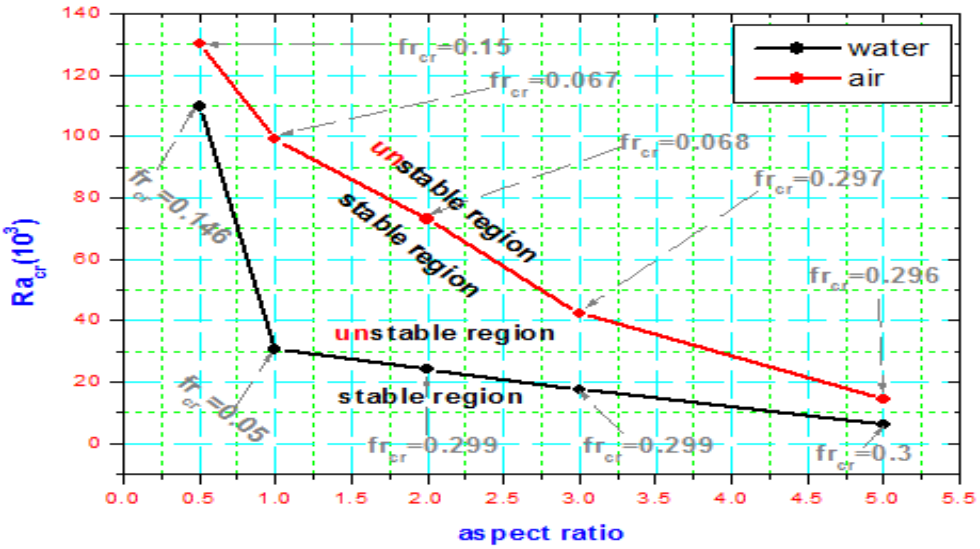

Fig. 1. Stability diagram Ra_{cr} vs aspect ratio of the cavity

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ANALYSIS OF MULTI RESOURCES HEAT PUMP

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Reducing the energy consumption of buildings is an important energy and environmental objective. The modernization of buildings lower the design heat load and low-temperature heating systems, which are increasingly fed by heat pumps, come to the fore. Meanwhile, the amount and temperature of the energy used for DHW production remained virtually the same, so the proportion of energy used for heating and DHW was significantly altered, compared to the previous approach. The change also affects the operating parameters of heating systems.

The heat pump operates at different ambient temperatures during the year, and heat load as well as the temperature of the heating medium also changes. So the evaporation temperature on the heat source side vary between -20...+30 ºC, the condensation temperature on the heat demand side between 35...60 ºC. Thus, there's a need to apply multiple heat sources, because it's difficult to maintain an outstanding seasonal coefficient of power (SCOP) at significantly different operating conditions.

In the case of heat pumps, environmental considerations imply the introduction of new refrigerants such as R600 or R290 that are flammable and require special technology. At the same time, new opportunities arise, e.g. a heat pump using R600 as refrigerant allows the production of high temperature heating medium.

Widening the operating temperature range for air-to-water heat pumps required the use of the EVI (Enhanced Vapour Injection) cycle and the introduction of corresponding compressor constructions. To achieve a high SCOP, it's necessary to maintain the superheating in the evaporator at a stable, low value. This is achieved by a precise electronically controlled electronic expansion valve (EXV).

Combining commercially available components enables adaptation of the heat pump operation to multiple heat sources. Using a simple mathematical algorithm, the optimal ratio of parallel heat sources can be determined for the heat demand to achieve the best COP and lower the energy consumption as well as CO2 emission. Using multiple heat sources throughout the year, it is possible to optimize (lower) the evaporator size of each heat source.

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). With the help of some measuring systems, the COP is measured using different evaporators (heat sources) at given condensing temperatures (heat demand). Using measurement data, a mathematical algorithm can be operated to select the appropriate heat source for the heat demand at a given time, taking into account the seasonal effects, and the maximal COP. The refrigerant I'm using allows the system to operate at high evaporating (5…50 ºC) temperatures but much lower pressures, compared to the HFC-type refrigerants such as R410a used today. At a same time, we can realise an outstanding SCOP by using a refrigerant with GWP 3…6 instead of 2050…2100.

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INTEGRATED FARM-BASED BIOREFINERY MODEL, DEVELOPED FOR RURAL VILLAGES

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Today the biomass use in most European village are focused to the producing the heat energy with burning the wood base biomass or the agricultural lignocellulose base residues in low efficient equipment; stoves, boilers etc. In lot of case are used the CHP system where the principal product is the electrical energy –in this case the heat is one industrial waste.

The paper are structured in the following chapter –in the first part is present the flowchart of the proposed "Integrated farm-based biorefinery ("IFBBR") structure "developed for one small scale village with 2000-3500 inhabitants. In this part is established the used technologies and the type of feedstock which can be integrated in this technological schemes – in this flowchart is integrate tree modules –one for the converting the organic residues resulted in village into bio- methane-that process has for conversion steeps: hydrolysis acidogenesis, acetogenesis and methanogenesis) of the used feedstock, with large portion of the fat, protein, hemicellulose and cellulose content.

The studied model concept is built with the combination of the anaerobic digestion the open pod algae cultivation (that can be a good way to reduce the CO_2 emission for the thermal units) and the biofuel production –based of the mixing the existing locally feedstock –in this way creating the synergies between process stream and producing multiple fuels and chemical products. In this schemes is built one small scale CHP (combined heat and power) system where the resulted residues are coffered with solid biomass resulted from energy plant plantation.

The second part of the publication present the experimental results and modelling dates, focusing to the producing the bioethanol from wastes from agricultural activity –like corn stove, corn cobs, wheat straw and solid biomass chips produced in energy plant plantation with biorefinery technologies.

The publication also present a model for implementation of the bioenergy production schemes with this type of feedstock used for heating and cooling the local authorities' buildings.

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STUDY OF A SOLAR CHIMNEY POWER PLANT

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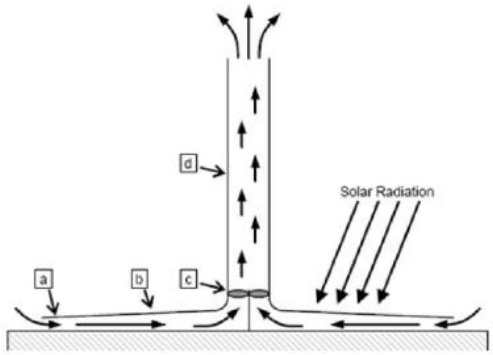
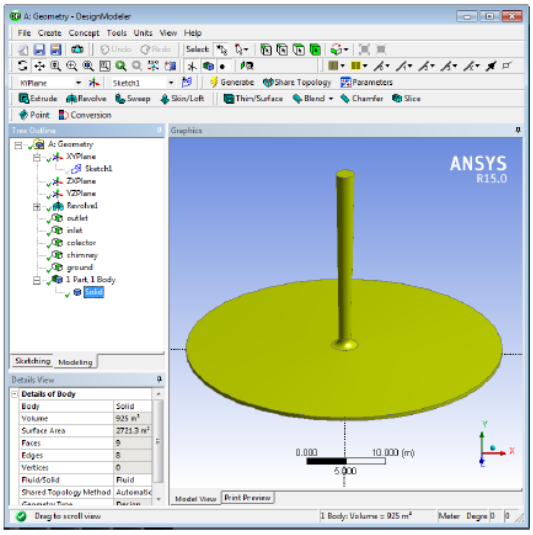
Solar chimney power plant (SCPP) is one of an alternative power plant in order to protect the environment and also as a step towards energy diversification program. The main component of SCPP consists of collector, turbine, generator, and tower (chimney). In this works, study, and design of small scale solar chimney power plant have been performed, which is emphasized on determine the main parameters of the system. In our study, the SCPP will be placed in the Sumbawa district, Nusa Tenggara Barat – Indonesia. For the design and optimization purpose, ANSYS – fluid flow CFX software is used. The schematic diagram and evaluation concept of SCPP using ANSYS can be seen in the figure below, and main parameters as a mentioned are: inlet collector height, collector diameter, inlet tower diameter, and tower height.





In the course of modelling four main parameters were used as a basic for the optimization.

Parameters	Model 1	Model 2	Model 3	Model 4
Inlet collector height	0.5 m	0.5 m	0.5 m	0.75 m
Collector diameter	40 m	60 m	40 m	40 m
Inlet tower diameter	1.5 m	1.5 m	1.5 m	1.5 m
Tower height	25 m	25 m	35 m	25 m

Based on evaluation, it can be observed that the highest velocity and temperature at inlet tower diameter can be achieved by model 2. Meanwhile, the highest performance can be achieved by model 3. Based on this research, it's hoped that illustration of utilizing of SCPP in Indonesia can be acquired, particularly in the point of view the main parameters (dimensions).

23rdWORKSHOP ON ENERGY AND ENVIRONMENT

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