SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ

Department of Physics and Process Control

22nd WORKSHOP ON

ENERGY AND ENVIRONMENT

BOOK OF ABSTRACTS

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December1-2, 2016

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 25, 2016

Further information, please, contact:

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Founding Chairman of the Workshop

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22nd WORKSHOP ON ENERGY AND ENVIRONMENT

December1-2, 2016, Gödöllő, Hungary

Program

December 1 (Thursday)

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

December 2 (Friday)

09.00-09.10 Opening the Workshop by:

Prof. I. Farkas	Director of Institute 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 *Chairman: Dr. I. Seres*

09.10-09.20	I. Farkas: Solar thermal energy use worldwide
09.20-09.30	A Szilágyi, I. Seres: Possibility of solar cooling
09.30-09.40	Z. Dodog: Estimating of near-surface earth temperature
09.40-09.50	M. Al-Neama, I. Farkas: Design characteristics of solar air collectors with different absorbers plates
09.50-10.00	B. Bagi, P. Víg: Effect of contamination on performance of PV panels
10.00-10.10	Á.I. Soltész, P. Víg: Thermal energy from compost-based bioenergy system
10.10-10.20	Á. Bijl, I. Seres: Artificial solar radiation
10.20-10.30	A. Lammamra: Experimental study between two solar collectors of planar and curvilinear geometry
10.30-10.40	I. Fekete, I. Farkas: Building enclosure elements integrated solar collectors
10.40-10.50	H. Zsiborács, P. Weihs, H. Trimmel, S. Oswald, B. Pályi: A thermal model for monocrystalline solar modules

10.50-11.10	COFEE BREAK
	Session 2 *Chairman: Dr. Cs. Mészáros*
11.10-11.20	Cs. Mészáros, Á. Bálint: Symmetry analysis of collective elementary excitations in Chain-type organic molecules relevant for solar elements
11.20-11.30	Gy. Ruda: Saving energy and environment in building practice
11.30-11.40	J. Tóth, I. Farkas: Design plan of a block oriented modelling environment for solar energy applications
11.40-11.50	I.R. Nikolényi: Symmetry based study of solar cell materials
11.50-12.00	W.M.A. Elmagid, T.A. Mekhail, W.A. Abdel-Fadeel: Design and testing of a small turbine blade at low speed wind
12.00-12.10	A.F. Elbarghthi, J. Buzás: Construction of double pass air flow solar collector for active space heating
12.10-12.20	J.P. Fejes: Computer simulation of storage tank filling with liquid propane
12.20-12.30	Z. Kapros: Forecasting methodology for small-scale photovoltaic power systems
12.30-12.40	S. Bartha, L.C. Duarte, F. Carvaheiro, B. Vajda, N. Antal: Energy willow a new feedstock in bioenergy production and biorefinery
12.40-12.50	D. Rusirawan, M. Haekal, F. Hidayat, M. Pramuda N.S., M. Alexin P., L. Hartawan, I. Farkas: Realization of 1000 Wp photovoltaic power plant
12.50-13.00	CLOSING

SOLART THERMAL ENERGY USE WORLDWIDE

I. Farkas

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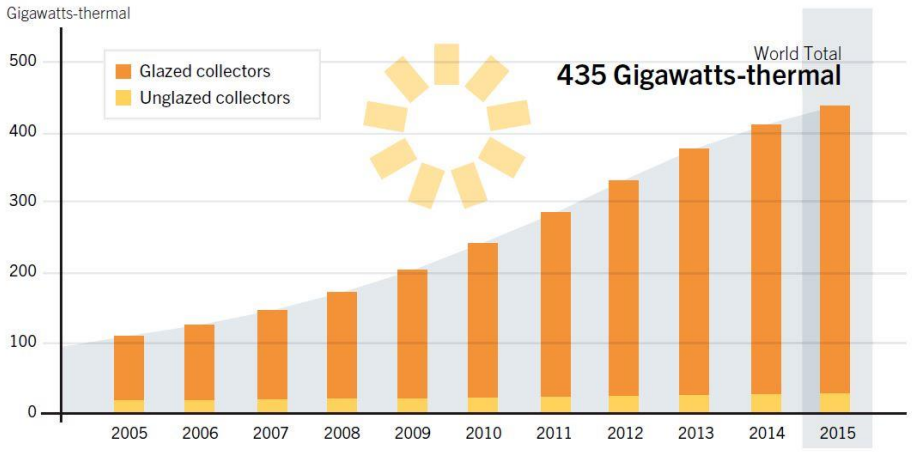
This paper deals with the overview of the worldwide position of solar thermal energy use. Beside the technological issues the environmental questions will also be touched upon.

The worldwide situation is analysed based on the recent development shown intensively at the Solar World Congress organized by the International Solar Energy Society at Daegu, Korea in 2015 and also at the EuroSun 2016 Solar Conference organized in Palma de Mallorca, Spain in 2016. Additionally, the most recently published books in this topic served also a basic source to the overview statements.

The main thematic questions, specifically related to the solar thermal, are as follows:

- solar buildings and architecture,
- solar thermal heat for industrial processes,
- solar thermal collectors,
- solar heating and cooling,
- thermal storage,
- solar assisted district heating and cooling and large scale applications.

The Figure bellow shows the global solar thermal capacity for the period of 2005-2015 (IEA Solar Heating and Cooling Programme, 2016).



The main characteristics of the use of solar thermal energy in Europe can be summarized along with the following statements:

- mainly solar domestic hot water systems are in use,
- growing share of combined systems,
- growing number of collective (large) systems,
- plastic absorber for swimming pool collectors,
- several solar district heating systems,
- pilot plants for process heat and for solar thermal assisted cooling systems.

POSSIBILITY OF SOLAR COOLING

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The air-conditioning and cooling systems' consumption is increasing year by year. The maximum energy consumption of these devices are in the middle of summer. The most air-conditioning and cooling systems are working with electrical energy (power). This energy come mainly from the power plants, especially from heat power plants. In summer this plants give more power and more emissions. So this emissions generate several environmentally effects, for example global warming, air pollution, etc.

Against of fry we can use solar energy for cooling. There are active and passive cooling systems. The active cooling systems are using electrical energy or heat. The passive cooling systems are working without energy sources, these are for example shadows, semi-transparent glass covers, solar driven ventilation effect, etc. The utilization of the solar energy is given a good possibility for us, that we can use this energy for cooling. There are two main forms of the solar energy utilization, which are the heat production with solar collectors and power production with solar photovoltaic cells. Solar collectors can work with absorption or adsorption cooler, solar cells can work sorption coolers or compression cooler or thermo-electric cooler. The thermally driven cooling system are open or closed cycle. For air-conditioning we can use these systems. By the solar cooling we do not need energy storage mainly, because the consumption and the heat wave is in the same time.

We have an experimental absorption cooling system at the Department of Physics and Process Control, Szent István University, Gödöllő, Hungary. We can measured this system with solar cells and solar collectors, especially with vacuum tube collector. According to our measuring the solar cells and collectors are able to ensure the energy needed directly in the necessary time for the cooler and for the other air conditioning devices, for example fan and water pump. With this application we can save costs, energy, because we do not use fossil fuels, and reduce our environmental pollutions and the global warming's human effects.

ESTIMATING OF NEAR-SURFACE EARTH TEMPERATURE

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Information on ground temperatures is essential in the field of geothermal heat utilisation in order to design suitable underground heat-exchangers. The ground temperature distribution is mostly affected by ground surface cover, structure and physical properties of the ground, climate interaction by air temperature, wind, solar radiation, air humidity and rainfall. From the surface reaching a depth of about 1m the ground temperature is very sensitive to short time changes of weather conditions. Below this depth short time changes has limited effect, while temperature depends mainly on the seasonal cycle weather conditions. Deeper than about 20 meter the temperature is practically constant and slowly rising with depth according to the geothermal gradient.

In many cases heat exchangers are installed in 1-20 meter depth range. This presentation is focusing on those mathematical formulas that are able to determine vertical heat distribution in ground. Charts can be found in engineering literature providing information about vertical temperature distribution in a specific regions, but they are too general with the possibility of serious error.

Kusuda (1965) found that the temperature of the ground is a function of the time of year and the depth below the surface. He created a correlation, for calculation the following input parameters are required: mean surface temperature, amplitude of surface temperature, thermal diffusivity of the soil, and day of the year of the minimum surface temperature. This formula had been tested many times in various places and experiments show good correlation.

An enhanced version of this correlation is exists, where geothermal gradient were taken into account.

These methods are suitable for prognosis about temperature field in ground near to surface. Some local parameters can cause notable discrepancy, therefore they must take into account for more precise prediction. Parameters like this for example the slant of the surface, ground layer structure, underground water flow, etc.

Reference

Kusuda, T., and Archenbach, P.R., Earth temperature and thermal diffusivity at selected stations in the United States, ASHRAE Transactions, 1965. Vol. 71, Part 1.

DESIGN CHARACTERISTICS OF SOLAR AIR COLLECTORS WITH DIFFERENT ABSORBERS PLATES

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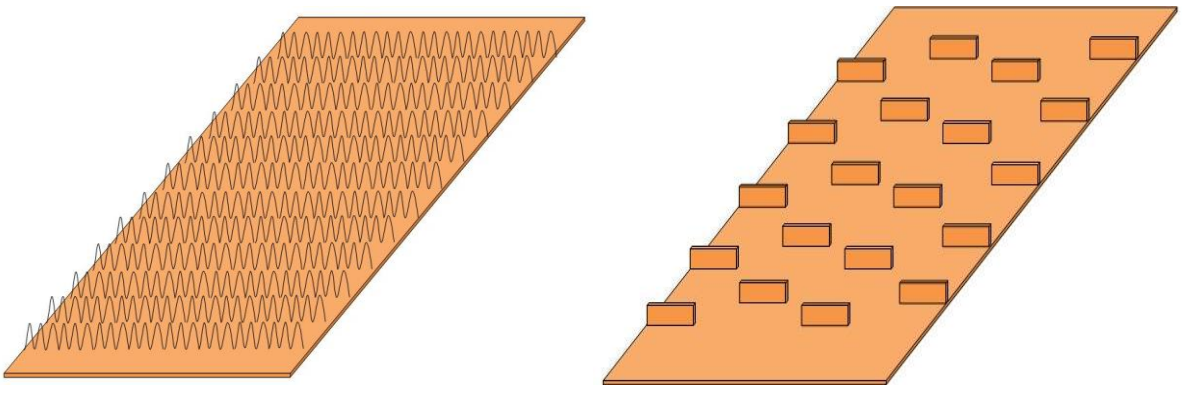
Solar air collectors are becoming more and more popular in space heating and industrial processes due to their cost effectiveness and easy maintenance. Solar air heater (collector) is one of the basic equipment through which solar energy is converted into thermal energy. However, how to increase thermal performance of solar air collectors becomes a major challenge. In this paper, the design of different solar air heaters with different absorber plates are discussed.

Many parameters are affecting significantly on thermal performance of the solar collector, such as area of absorber, shape of absorber, speed of air, number of flow passes, number of glasses, material of absorber,…, etc. The major parameters which discussed in this paper is the absorber shape, absorber area, double pass air flow and double cover glass.

The increasing of absorber area will increase the rate of heat transfer from the absorber to the air. The shape will affect on the thermal performance of the collector because will change the turbulence of air flow (change air flow stream lines). Double pass air flow will increase the efficiency of solar collector significantly in case the thickness of absorber will not be more than limits. The double cover glass has a strong effect on the performance of the collector. In case the transitivity of glass material high, the double glass cover will play as a positive parameter for collector efficiency increasing.



Different absorbers with different shapes and different areas

EFFECT OF CONTAMINATION ON PERFORMANCE OF PV PANELS

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As the Earth is slowly running out of fossil fuels, humans need a way to support their need for electricity. Because of this, energy policies of many countries contain some kind of renewable energy resource program. Out of the many renewable energy sources, the primary one is the solar energy. This energy reaches Earth in the form of electromagnetic waves, which humans used in throughout of history with different utilities. These contain the thoughtful positioning of the buildings, as well as collecting the heat from these waves using solar collectors, and even transforming them into electricity, using photovoltaic modules.

A decade ago the main active utilization of solar energy were by the solar collectors. Solar collectors are used for producing domestic hot water and help the heating of buildings. Nowadays, manufacturing the collectors is a mature technology. Although the creation of PV-modules are more difficult, and it requires great effort, nowadays these took the place of the solar collectors, and many scientists are working for developing this technology for rising the efficiency gain of the PV modules.

The efficiency of photovoltaic modules are determined by many parameters: geographical and meteorological data, orientation and tilt angle, type of solar cells and also depends on the cleanness of the solar array.

The focus of this work was this dependence on cleanness. We examined the efficiency of the PV module in case of different kinds of contamination on the surface of the panel. These were sand, clay, loam and dust.

The place of measurements was the Department of Physics and Process Control, Szent István University. We used several quantity from these pollutants and examined their effect in various horizontal and tilt angle positions. Artificial, infrared light in perpendicular lighting were used in the measurements. The currents and voltages of the PV module with different load resistance were determined, and the maximum power of the module was calculated based on such data. Beside the type of the contaminations and inclination angle it was also was examined the effects of airflow with used ventilator.

Finally, it can be concluded that the performance-reducing effect of contamination is significant.

Our other aim was to find innovative methods for cleaning PV panels and solar collectors. The first self-cleaning method is to use the Lotus-effect. It can be found on different kind of plants' leaves in nature. The other is use of photocatalytic thin layer. The next step in our research is to examine the applicability of those methods for active solar equipment.

The demonstration of the measurements and their results will be in the presentation.

THERMAL ENERGY FROM COMPOST-BASED BIOENERGY SYSTEM

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Nowadays, the main point in energetic policy is researching and developing technologies able to solve sustainable development. In this research the goal was to examine such a solution that is based on using organic and inorganic systems at the same time.

Traditional technological solutions are based on upholding chemical reactions on primal sources, using the released energy of it. Compost-based bioenergy system in another way operates with the waste energy produced by micro-organisms during their life functions. From the cycle we only can gather as much energy, which does not endanger the process. This process has many advantages. First of all, there are areas where there are easily reachable energy sources, like vegetables and zoological biomass. Secondly, the output of the whole process is fully environment-friendly waste, which is mould, and it is not dangerous, but has a secondary benefit.

It seems using this kind of technology can be realized mostly in countryside. Typically, it means gardens and farms with wood and bushes. Another favourable aspect is the output of carbon-dioxide in order to hold on the natural cycle. As materials are used locally, it has a minimal transportation, which is a further benefit for CO_2 output.

The aim of this research is to examine the process in different cases, like different materials, how the temperatures and performance changes. The work gathers information about the topic, introduces the working of the system, the structure of the compost-based bioenergy system model and makes conclusions about the gathered information.

The future plan is to build this system in our garden, and realize the measuring and data gathering system, as well. This is located in Pilisszántó, Hungary where there are forest and bushy areas. The idea is, to use the waste form wood cutting, and from bush cutting. In the structure there will be a coil as a heat exchanger, made of polyethylene, placed vertically. The pile will take place near to the house, and pipes will be isolated, for minimising the heat loss. The inner heat will be used for heating the house. The ambient temperature, building temperature, inside and outside temperature of the bioenergy system, inside and outside fluid temperature of the pile, and volumetric flow rate of the transporting fluid will be the measuring variables.

The presentation will touch upon the detailed of the planned work.

ARTIFICIAL SOLAR RADIATION

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Artificial light is great for a lot of everyday tasks, but their spectral distribution is so different from the sunshine's one, that they cannot be used for special tasks. The spectral difference cause high changes in the colour sense – it can be important for museums, their varying intensity – stroboscope effect – make them unusable for workshop with fast rotating machines, or just they irritates the vision of some sensible persons. Another important field is imitating the solar radiation for testing solar panels. The outdoor testing is not always an option due to inconsistent light conditions - changing intensity, changing inclination angle during longer tests.

There are some solutions in the market for reproducing the solar radiation with high power, but these solutions – artificial sun systems/solar simulators, working generally with xenon lamps – are generally very expensive. But if we do not want to measure a complete module, but just a solar cell, then the problem is reduced.

Different types of light sources exist which generate different SPD (spectral power distribution), but do not have the SPD of the sun. That's why we looked at different light sources and came to the conclusion that as for now the best solution is by combining LED's with different spectral output. By the right combination of LED's an SPD that is close to the SPD of the sun light. Achieving this goal also means that we have the ability to look beyond the application of solar testing to applications for fashion retail lighting, supermarket accent lighting or museum and gallery lighting.

As the first step of the work, the SPD of the solar radiation under different meteorological conditions were measured. Following this different light sources were measured, all the spectral measurements were elaborated by a USB200+ VIS-NIR_ES spectrometer made by the Ocean Optics company, Austria. Based on these measurements the next step is to select a proper series of LEDs, from which we can reproduce the spectral curve of the solar radiation.

EXPERIMENTAL STUDY BETWEEN TWO SOLAR COLLECTORS OF PLANAR AND CURVILINEAR GEOMETRY

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The thermal conversion of solar energy depends on the temperature at the output which can be supplied by systems such as solar collector air or water, designed separately, or integrated into the houses for space heating, sanitary water or drying agree-food products.

This work represents an experimental study between two solar collectors of flat plat and curvilinear geometry. The experiment will be carried out in a natural source of illumination, using collectors constructed by Mechanical Engineering Laboratory at the University of Biskra, Algeria. These collectors are composed of different materials whose measurements varied but were based on the optimum capacity for the present experiment. Materials like Plexiglas plate was used as transparent cover, black painted galvanized iron sheet was used as absorber plate, polystyrene board used as back insulation layer, hardboard sheet as bottom plate which forms a smooth underside of the flow channel, plywood panel used as back cover, a collector box that holds the different plywood panel was used as back cover, and a collector box that holds the different parts of the solar air heater together had been fabricated from single and double hardwood plank.

Through this study we will be able to determine the performances of these systems, evaluate the coefficient of loss and illustrate the efficiency of the absorber as well as measure the air flow (Qv); Solar radiation measurement; Inclination of the panel with respect to the horizontal; measure inlet and outlet temperature; ambient temperature along with the wind speed because the convective exchanges between the window and the ambient air increase with the wind speed. Constants data is also included in the experiment such as: specific heat of air and air density.

BUILDING ENCLOSURE ELEMENTS INTEGRATED SOLAR COLLECTORS

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The design of the present heat exploitation solar collectors has special structure in many cases as it uses particular material, therefore the specific expenses of such type of energy production can be considered high. In the course of designing shell-structured collector bodies a proper combination of the traditional and new materials was applied.

The literature review confirms that people with solar collectors appreciated not only by their usefulness, but also according to aesthetic considerations. In addition to traditional solar collectors is viable to study the solutions how the structural elements of the buildings can be used to capture solar energy, when the architectural design would not change, but the required surface operates as solar collector (Fig. 1).

Fig. 1. The traditional and advanced structure design of solar collector

The temperature distributions in the planned shell-structured collector was first analysed using a mathematical model including the solar radiation energy absorption and the thermal conductivity processes. The one-dimensional heat and mass transfer differential equations was developed along with the space discretization of the collector and the energy balance of inputs and outputs depending on the heat transfer liquid material used in the flow circle.

Measurements were carried out at different material surfaces in order to compare the actual capture of solar radiation. Based on the modelling and simulation results a pilot system was designed and installed. The temperature distribution on the collector surface was validated by an infrared camera recording.

The outcome of this work was to develop new type of shell-structured solar collectors for the heat exploitation of the solar energy and to determine its thermal efficiency. It could help to reduce the urban heat-island effect, when the heating of buildings worsens human comfort. The developed architectural elements can be used also in design of new and renovation of old buildings in order to meet the increasingly stringent building energy standards.

A THERMAL MODEL FOR MONOCRYSTALLINE SOLAR MODULES

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Silicium based crystalline solar modules are the most widespread worldwide. These types react most sensitively to temperature rise influencing negative electric energy production. Several factors can influence the efficiency of utilizing solar energy arriving onto the Earth. One of the important factors in the case of solar modules is temperature undulation caused by the changing of daily temperature and global horizontal irradiance. During hot days the temperature of solar modules may reach 60-70 °C in Hungarian climatic conditions. Due to its high temperature the energy production of solar modules decreases. In the case of silicium based crystalline models, efficiency decreases by 0.5% with 1 °C of temperature increase.

In the present experiment a monocrystalline solar module (SM636-50, 50W) was examined under real climatic conditions on July 19th (09:00 am – 17:40 pm), installed on ground fixed platforms in Hungary, Keszthely. Measurement of the solar module was continuous using PicoLog data loggers during the experiments. These instruments allowed second-based, continuous data recording by a PC. Regarding the monocrystalline solar module surface temperature was measured at one point (in the middle of the top third of the module) and voltage and current intensity were also measured. A True Maximum Point Seeking (TMPS) device, which maintained the maximum power point (MPP) was used for the measurement. For recording the temperature a few Pt 100 sensors were applied. Additionally, the following technical-environmental parameters were determined: relative moisture content of air, global irradiation (Eppley Black and White Modell 4-48 pyranometer) and wind speed (JL-FS2, 4-20mA).

The components of heat transfer are conduction, convection, and radiation. Only long-wave radiative (Q_{Rad} [Wh]) and convective (Q_{Conv} [Wh]) heat exchanges are considered for crystalline PV modules. Energy exchange in the form of electricity output by the PV module (Q_{PV} [Wh]) is also considered. The solar radiation (Q_{Solar} [Wh]) is collected by PV front surface. The difference between these four components (Q_{Solar}–Q_{Rad} –Q_{Conv} –Q_{PV}) gives the remaining heat energy (Q_{Rem} [Wh]) of PV module.

According to our measurements on July 19th from 09:00 am to 17:40 pm the percentage of daily energies were the following: Q_{Rem}: 56%, Q_{Rad}: 19%, Q_{Conv}: 9% and Q_{PV} : 16%. Clearly visible that the Q_{Rem} was the highest value which caused the high PV module temperature. For this problem various cooling technologies may offer solutions.

SYMMETRY ANALYSIS OF COLLECTIVE ELEMENTARY EXCITATIONS IN CHAIN-TYPE ORGANIC MOLECULES RELEVANT FOR SOLAR ELEMENTS

Cs. Mészáros and Á. Bálint

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It is well-known, that the detailed experimental and theoretical research of basic structural of different types of carbon nano-tubes plays a role of continuously increasing importance in the whole condensed matter physics.

The detailed symmetry analysis of all these aspects represents a crucial part of investigation of all the relevant problems being investigated (Barros et al, 2006; Damnjanović and Milošević, 2010). One of the most successful mathematical techniques from this point of view is related to detailed application of the exact symmetry theory of quasi-one-dimensional (Q1D) (Vainshtein, 1966) systems, also known under the name of line groups, which is the genuine mathematical basis for structural investigation of stereo-regular polymers by diffraction methods for decades.

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, despite of the fact, that in the most detailed quantum-statistical descriptions of collective elementary excitations relevant for light absorbing organic materials the selection rules based on the line group theory have not been applied in detail yet. Among them, the possible new fields of applications may be of importance in the case of modelling of the exciton-type collective modes, too (Agranovich, 2009).

In the present work we will demonstrate some further possible and very promising applications of the same modelling method relevant for chain-type molecular systems, which may contribute to understanding and increase of the energy transformation efficiency in solar energetics.

References:

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SAVING ENERGY AND ENVIRONMENT IN BUILDING PRACTICE

Gy. Ruda

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Acknowledged, the mechanisation is mainly responsible for the energetic and environmental (EE) issue as well as the mechanised building industry moving and transporting the largest masses of materials with an extensive loading on EE.

The EU already in Directive Nr. 2002/91/EC emphasises that the communal sphere, including building activity, can have 40% share in a total national energy demand with a similar rate of environmental load. Besides, existing built environment has special sources of values together with out of date buildings.

Their further use can be new function or in case of demolish local reuse of selected building materials mean an extra energetic and environmental (EE) benefit. The later is the more concrete task to take the whole life cycle of the structures into consideration from the beginning: exploitation of materials, transporting processing, constructing, maintenance, functional changes later on demolition, selection and finally a successful reuse of materials saving a great deal of EE.

We started investigations in the clearly arranged large-scale farms at the turn of the century, till now having surveyed and measured some 700 buildings mainly large sheds, stables built during the collectivisation (1950-75). These structures are standardised, similar all over the country by the ten thousand (!) becoming often empty so far – making easy our analyses of the potentially reusable materials.

In case of demolition, the processes (selection, crushing) can be practically mechanised with sufficiently low energy need available locally. The brick, stone and concrete represent usually the greatest quantities. Their reusing process needs some 1.5 to 2.0 kWh/ton energy whilst for newly producing these materials needs at least an order of magnitude greater (15 to 80 kWh/ ton) energy.

Statistical processing of the data revealed that in the first part of the investigations the reusability of materials was above 50%. It was followed by a decreasing tendency because the structures became lighter and less durable due to modernisation.

Extrapolated these findings to total domestic building property the savings in reuse may be put at some TWh energy with a financial benefit of billions.
The role of environment-conscious design is primarily determining so as to prefer the natural, durable materials. The modern less durable structures, in turn, should be easily demounted and selected.

DESIGN PLAN OF A BLOCK ORIENTED MODELLING ENVIRONMENT FOR SOLAR ENERGY APPLICATIONS

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

In the recent work the main goal is to create a development environment for solar systems, where one can make unique tool based on a set of predefined building blocks. There were attempts to create a similar system.

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.

Another advantage of the block-oriented approach is the possibility of the use of external libraries, which are user defined functions built by another compiler. This is a very important aspect, because MATLAB and Simulink are high-level languages, it follows that it is easy to implement very complex algorithms, but the execution-time of these algorithms usually higher than a program made by native compilers (e.g. C, C++). So it is a common practice to do the I/O parts with the convenient, high-level and the critical parts with a quicker program or library. The external libraries open another way: extends the capabilities of the MATLAB, so a real-time, hardware-specific measurement/simulation can be done this way.

In this paper it is shown a concept how to create a unified virtual simulating system, where users can create large-scale solar systems, can define each device and with this system can do experiments. Another purpose of this system is the capability of testing a variety of controlling algorithms, such as on-off, PID, neural-network based or model-based. This way the comparison of these controllers can be done by ease.

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SYMMETRY BASED STUDY OF SOLAR CELL MATERIALS

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Conjugated (stereo-regular) polymers (CP), carbon-nanotubes (CNT) and graphene for solar cell applications have been widely studied nowadays due to some of their extremal properties. The first two types of substance have quasi–one dimensional (Q1D) structure, while graphene is a two dimensional (2D) atom thick, honeycomb lattice layer. CNT-s are built up by rolling-up the graphene sheet. We wish to study these solar cell materials from the aspect of their special symmetry described mathematically by the so-called line groups.

Within their mathematical frame our attention focuses on the so-called projective representations of symmetry elements which have fundamental role in original crystallography and it seems to us from the literature that its usage in line group theory have not been fully exploited yet.

Projective representations also appear when materials are in uniform magnetic field. In this case the electron states are classified by projective representations of translation groups of crystal lattice. In the rational valued magnetic field case a mathematical group can be created by a so-called magnetic translation group (MTG). MTG structures for graphene in finite size are known from the literature.

There is an interesting outlook at the field of study of High-Temperature Superconductors (HTSC) in the presence of magnetic field: penetrating the superconductors the flux lines create a well ordered magnetic lattice observed by neutron scattering method. Connection with MTG has already raised on international school (SSPCM). On the other hand structure of HTSC can be studied by line group technique.

DESIGN AND TESTING OF A SMALL TURBINE BLADE AT LOW SPEED WIND

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Many studies have concentrated to improve the aerodynamic performance of small wind turbine blade experimentally and theoretically. In the present study, a small wind turbine blade is designed, fabricated and tested. The wind turbine is developed to match the local weather conditions (Aswan city), by using the Blade Element Theory (BET) and Matlab program. The performance of small horizontal axis wind turbines is calculated by using Computational Fluid Dynamic (CFD). The three-dimensional CFD models are presented using ANSYS-CFX v13 software.

The rotational effect is studied and the analysis of wake effect of the blade is carried out. The calculated results are compared with the experimental data that measured from the small wind turbine model according to a vehicle-based test system.

A small wind turbine blade is designed, fabricated and tested at low speed wind (2 - 7.5 m/s). The Matlab program is used to design the blade based on the BET. Tip loss, drag coefficient correction and wake factor are taken into account when designing small wind turbine. Using the standard k-ε turbulent model, ANSYS-CFX v13 shows a good agreement with the measured data at different wind speeds (from 2 m/s to 5 m/s). The GGI algorithm with an appropriate solver can be successfully used to simulate the flow at big rotating geometries. Behind the wind turbine, the root and shroud vortices shed along the axial direction. The wind turbine rotor effects on the position and magnitude of the tip and hub vortices and diminished far away from it. The wake structure is similar to the theoretical classical signature predicted in previous studies.

The output power produced near the tip of the blade is greater than that at the hub. The major output power is produced at the medium and tip sections. The wind turbine have the optimum performance at range from 0.5 m/s to 4.5 m/s wind speed because the shape of the designed blade matches the design condition at this range.

CONSTRUCTION OF DOUBLE PASS AIR FLOW SOLAR COLLECTOR FOR ACTIVE SPACE HEATING

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The importance of solar energy as an alternative source of energy cannot be overemphasized, especially now that the global attention is on climate change mitigation.

Solar energy therefore, plays a significant role as an infinite renewable energy resource. Despite the attenuation, the total amount of solar energy available on the Earth is still enormous, but because of its low-density and intermittency, it needs to be collected and stored efficiently.

A construction of double pass air flow solar collector utilized for active space heating wasmanufactured at the energetic laboratory of Szent István University to reach the desired indoor temperature condition. The comfort winter zonedata gotten from ASHRAE are generally sited as 22 °C to 26 °C, whereas the total heating load calculated for the peak space heating demand regarding an office as a target space was 1917.92 W.

The solar air collector was made as a prototype. The body is mainly from wood as it is light in weight and can work as an insulation with addition of the 20mm polystyrene layer thickness at the back side. The absorber is made from 99.9% copper having dimension of 1210mm x 462mm with 1.2mm thickness and painted with black matte colour.

The air inlet on the absorber front slat side (first case study) is directed to the second side via the plate holes to pass only through a 35 mm x 160 mm rectangular cross section path in seven parallel rows to the outlet. A constant shaped fins and a porous metallic material at the front side will be added (second and third case) under governing conditions to declare the possible allowed predicting collector performances.

The absorber plate temperature was measured on the 31st of October 2016 at 2:10 am at outdoor temperature of 19,7 °C and 850 W/m^2 radiation which gradually rose to 91 °C within a measurement time of almost 15 minutes.

The total cost of the collector including the manual and tools and the major cost regarding the copper plate used is 340 EUR. The time it takes for construction is approximately 8 hours.

COMPUTER SIMULATIONOFSTORAGETANKFILLINGWITHLIQUIDPROPANE

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Liquefied Petroleum Gas is used for a wide variety of applications: in road transport as an energy source, fuel and propellant in internal combustion engines; for non-energy purposes in refrigerators and air conditioning systems as coolant, with low greenhouse potential; or as a feedstock in the production of intermediate petrochemicals.

LPG is transported by rail, road or marine in pressurized tanks. Trans-filling of LPG is carried out during transport to storage tanks or between LPG carriers. This study introduces a possible approach of modelling the dynamics of a tank filling with liquefied LPG, especially with liquid propane.

A mathematical model of loading liquid propane into a storage tank is accomplished by splitting the system into four control volumes (CV, vapour and liquid phase of propane, the vapour and liquid side of the tank wall), and modelling the CVs with lumped parameters. The heat transfer between the vapour and liquid phase and the heat transfer to the tank wall is driven by Newton's law of cooling assuming natural heat convection between them. The change of the liquid volume and the geometry of the CVs are modelled, to calculate the surfaces of the heat transfer during the loading. The mass transfer between the phases by evaporation or condensation is modelled with the Hertz-Knudsen equation. The Peng-Robinson equation of state can be used in the model to calculate the thermodynamic properties of the phases, real gas and liquid equations to calculate density. The mass and energy of the control volumes are calculated by a pair of differential equations.

The presented model of propane loading is implemented in MATLAB/Simulink environment using the Thermolib library. Thermolib is used in the simulation to calculate the thermodynamic properties, temperature, pressure, density, enthalpy of the CVs. The Simulink model is divided into smaller subsystems which maintain the states of the four control volumes by the mass and internal energy differential equations. The phase change subsystem in the model is responsible for calculating the evaporation flux from the pressure of the vapour phase, the saturation pressure and the temperatures of the vapour and liquid phase. In the thermal balance subsystem the heat transfer between the phases and the tank walls is calculated using equations of natural convection.

A pressure and temperature measurement system for the propane loading is presented which is capable of measuring the pressures inside the pipes and the temperature of the pipe wall and the tank wall. A data recorder system is developed to collect the signals from the pressure and temperature beacons.

To validate the model the measured and simulated values are presented and the root-mean-square deviation is calculated during the simulation.

FORECASTING METHODOLOGY FOR SMALL-SCALE PHOTOVOLTAIC POWER SYSTEMS

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In this paper a data-driven forecasting methodology for small-scale photovoltaic power systems are introduced and analysed.

At present in Hungary, the weather-dependent variable renewable power plants (wind and solar power) share of gross electricity consumption is only around 1.8%, although this is increasing value. But a realistic goal for the next 20-30 years can be to reach the 20-25% VRE ratio in the electricity consumption. However, barriers also in Hungary, that there is a lack of models and methods, which can be provided by the grid integration of a large number of photovoltaic systems.

A dynamic data-driven forecasting methodology is worked out and tested by examining the Budapest District Heating Co. Ltd. top installed solar systems. Firstly the forecasts were tested only for a reference PV system; secondly it was made for a group of PV systems with establishing the monitoring data only from the reference system. The tested forecast method was only for 5 minutes ahead, but not only for the expected performance was evaluated, but also for the expected average performance in a 15-minute period.

By the reliability of the methodology the accuracy dependence on weather conditions also were evaluated. The main elements of the tested methodology and soma main result will be presented on the conference and the paper.

ENERGY WILLOW A NEW FEEDSTOCK IN BIENERGY PRODUCTION AND BIOREFINERY

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Today the from total primary energy requirement of the world 81% is obtained from fossil fuels and the biomass resources give, approximately 50 EJ in this energy mixt, in term of quantity the biomass is the fourth largest energy resources after oil, coal and natural gases. The biomass represents a large store of the solar and chemical energy; today this resource is obtained from forest and forest waste and from agriculture. The growing energy needs of the society can be resolved with helpful of the growing the renewable sources part in the energy mixt. On way to produce energy in sustainable way from biomass is to use the as feedstock the waste from different industrial and agro-forest activity and from short rotation plantation. On of this plant, which can be offer a solution for the sustainable bioenergy production and use for industrial activity is the energy willow. This plant can be cultivated in good condition and high yield in East and Central European and Scandinavian lands.

The present paper are focused to indicate a state of arte of the bioenergy production in the Eu-27 and presented the Romanian experience in energy willow production and that use as feedstock's for sustainable energy production. The willow plant needs for high yield a good fertilised soil, which has pH 5.5-7.5 and good climatologically location where the annual rainfall is higher than 650 mm /year/ ha. In this condition the production can be arrived 15-20 t DM (dry material). Generally is harvested in every 2 years, in period; December – middle March and the for energy production that row material are used in wood cheeps form in this form can be stored a long period. The lifetime of the plantation is around 22- 25 year, after the land can be reused in agricultural mass production. In the second parts of the paper we will presented the technical aspects of producing high added value product from the energy willow base on the biorefinery technology. The biorefinergy concept is analogues to petroleum refineries, which produced a multitude of compose and product from biomass. The biorefieneries can be categorised according to platforms, feedstock, and process. The classification ″base on platform″ includes: biogas, syngas, the bio-hydrogen, C6 and C5 sugars, lignin pyrolytic liquid, organic components and bioenergy-electricity and heat. Base on classification by feedstock we can mentioned the followings groups: whole -crop biorefinery, which use cereals, - green biorefinery which use naturally wet biomass; such green grass, lucerne or immature cereals and the last category is the lignocellulose feedstock's which uses naturally dry row materials –in this family is the energy willow. Finally the paper presents the experimental results obtained after the acid and auto-hydrolysis of the energy willow in different acid concertation and temperature and the conclusions.

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REALIZATION OF 1000 WP PHOTOVOLTAIC POWER PLANT

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Presently, research in the photovoltaic (PV) field becomes interesting topic for many institutions, universities and companies, as a response to the crisis of energy and environmental problem all over the world. A PV power plant is a prospective system for Indonesia climate conditions, due to geographic location of Indonesia. Nevertheless, controversy about the suitable's PV technology for Indonesia climate's still becomes hot topics in many PV discussion in Indonesia. As one of solution, the PV performances data, especially in yield of energy system of various PV technology in Indonesia should be available, based on field experiments in Indonesia.

Regarding to the above mentions, Institut Teknologi Nasional (Itenas) Bandung, as one of Academic Institution try to take responsibility to prepare and serve the data about yield of energy system for various of PV technology, in the Indonesian climate. Our effort were initialized by realizing 1000 Wp of the PV power plant, and for the first time using polycrystalline PV modules.

The type of system is grid connected, which consists of:

No.	Components	Specifications
1.	PV modules	4 units of PV modules @ 265 Wp
2.	Inverter	*String inverter* - UNO-2.0-I-OUTD-5
3.	Monitoring logger	VSN700-03-EQ/VSN-MGR-CMML-P1-EU

Presently the progress of work still focus on simulation of system using software package i.e. PVsyst 6.49 in order to find yield energy system. Optimisation data for surface orientation were 12^o and 0^o (pure to South) for tilt angle and surface azimuth angle, respectively. Based on simulation, it is found that for one year operation, the yield of system is 1345.5 kWh/kWp. It is planned that the installation of 1000 Wp PV power plant will be completed in the beginning of year 2017.

As a series of our research, in the future, Itenas will realization also 1000 Wp PV power plant with thin film PV modules. As an outcome of our research, comparative data of yield of energy PV power plant in various PV module technologies will be acquired, especially in the Indonesia weather.

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