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SZENT ISTVÁN UNIVERSITY GÖDÖLLŐ  
Department of Physics and Process Control

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17<sup>th</sup> WORKSHOP ON  
ENERGY AND ENVIRONMENT  
BOOK OF ABSTRACTS

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December 1-2, 2011  
Gödöllő, Hungary

## PREFACE

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

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

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

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

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

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17<sup>th</sup> WORKSHOP ON ENERGY AND ENVIRONMENT  
December 1-2, 2011, Gödöllő, Hungary

**Program**

**December 1 (Thursday)**

14.30-17.00 Registration

Visiting the Department of Physics and Process Control

Visiting the exhibition of the solar installations of the Department

**December 2 (Friday)**

09.00-09.15 Opening the Workshop by:

Prof. I. Farkas Director of Institute

Institute for Environmental Engineering  
Szent István University, Gödöllő, Hungary

Prof. I. Szabó Dean of Faculty

Faculty of Mechanical Engineering  
Szent István University, Gödöllő, Hungary

*Session 1*

*Chairman: Dr.Cs. Mészáros*

09.15-09.30 I. Farkas: Energy and environment issues in the program of Engineering  
Doctoral School at Szent István University, Gödöllő

09.30-09.45 I. Seres: Spectral dependence on the energy production of a medium size PV  
system

09.45-10.00 Z. Kapros: Green-X method for photovoltaic systems' New feed in tariff  
support mechanism in Hungary

10.00-10.15 D. Rusirawan and I. Farkas: Characteristics of the photovoltaic modules  
availability at a predetermined temperature

10.15-10.30 L. Máthé: Field measurements for determination of vehicle speed in case of  
run-off accidents

10.30-10.45 D. K. Kertész and P. Víg: Investigation of the Glauber's salt for heat storage

10.45-11.15 COFFEE BREAK

*Session 2*

*Chairman: Dr. I. Seres*

- 11.15-11.30 Cs. Mészáros, I. Farkas and Á. Bálint: Solitary wave type solutions of the convection-diffusion of a process through porous media
- 11.30-11.45 Z. Hudoba, L. Kocsis and L. Fenyvesi: The energetic comparative examination of different tillage technologies
- 11.45-12.00 I. E. Haber and I. Farkas: Performance optimization of a large scale solar array
- 12.00-12.15 I. Kocsány: Possible use of exergy analysis for PV/T collector
- 12.15-12.30 Z. Dodog: Evolution of wall constructions in Hungary
- 12.30-12.45 V. Demeter: Air pollutants in closed spaces
- 12.45-14.00 LUNCH BREAK

*Session 3*

*Chairman: Prof. I. Farkas*

- 14.00-14.15 G. Bernvalner, V. Kalcsó, A. Szaniszló, B. Gyarmati and Á. Bálint: Effect of acid rain and heavy metal for garden cress
- 14.15-14.30 M. Czikkely, Á. Bálint and Cs. Dobolyi: Properties of thermophilic fungi in sewage sludge on biogas production
- 14.30-14.45 S. Bartha, D. I. Teodoreanu and M.T. Lates: Preliminary design and modelling of the solar street lighting PV system with LED energy efficiency lamp
- 14.45-15.00 M. T. Lates and S. Bartha: Design and implementation of the wind turbine - PV hybrid renewable energy systems
- 15.00-15.15 CLOSING

ENERGY AND ENVIRONMENT ISSUES IN THE PROGRAM OF ENGINEERING DOCTORAL  
SCHOOL AT SZENT ISTVÁN UNIVERSITY, GÖDÖLLŐ

I. Farkas

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This paper deals with the current activities in the Engineering Doctoral School at Szent István University, Gödöllő, Hungary. The legal regulations include the national wise Hungarian law and Doctoral Council rules along with the university level adjustments.

The Doctoral School of Agricultural Engineering (namely Technical Sciences) at the Szent Istvan University was established in 1993 with two specific parts of which one is the "Agricultural Energetics and Environmental Technique" and the other one is the "Basics of Agricultural Engineering".

The operating conditions and the main data of the Doctoral School is shown in detail involving the entry, teaching, research, quality assurance and the degree issues. The recruitment procedure of PhD students is rather important in the entire process. A special emphasis is given also to the evolution of the PhD structure and especially to the content of the 3<sup>rd</sup> cycle education in the field of biosystems engineering.

In every year the supervisors submit their new topic proposal until 30 January, after that the Council of the Doctoral School discuss them. To get to the doctoral education there are several national requirement for the applicants: MSc or equivalent diploma with at least good grade level, at least medium level foreign language (preferably English) exam.

The duration of the education is 6 semesters, while the students have to collect 180 ECTS credits. The credits can be got in four educational units as: courses, research, teaching and publication.

The main checking points for the doctoral education are as follows: literature overview, written research report which has to be defended in public and final research report. After fulfilment the educational and the research requirements the student can get an "Absolutorium" certificate giving a prove for finishing a stage of their PhD activities.

After getting the Absolutorium, the student can apply for starting the degree process. As a prerequisite they should show an appropriate publishing. During this period the students have to get through on a comprehensive exam, and prepare their Thesis work. In order to submit the Thesis work for final evaluation a good level of internationally recognized publication is needed.

At the moment the Doctoral School has 74 PhD students in total. During the last 5 years 27 persons have got absolutorium and a PhD degree were awarded to 30 persons.

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## SPECTRAL DEPENDENCE ON THE ENERGY PRODUCTION OF A MEDIUM SIZE PV SYSTEM

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In the framework of the PV Enlargement Project of the European Union, a 10 kW<sub>p</sub> photovoltaic system was installed at the campus of the Szent István University, Gödöllő, Hungary in 2005. The entire system has the nominal power of 9,6 kW<sub>p</sub> in three different subsystems, two identical parts of 3,1 kW<sub>p</sub> from Hungarian made amorphous silicon DS40 modules, and a 3,4 kW<sub>p</sub> part of ASE100 modules from multi-crystalline silicon. Every subsystem has an own inverter, through what the produced energy is fed to the electrical grid. For the scientific analysis of the system operation a data logging system was set up together with the energetic components. All the important power data (AV and DC voltage, current, power, phase angle) are recorded, together with the environmental properties (environmental temperature, module temperature, radiation in horizontal and module plane).

As the system was connected to the electrical grid in October, 2005, the about six years of operational data gives the possibility to see if there is any degradation in the energy production of the system. Of course the yearly energy production is depending on the meteorology of the given year, as well, so during the analysis the measured energy income of the given time period is taken into the account, as well.

The working data (produced energy for each subsystem) are compared to the original modelling results achieved during the planning of the system to see how the plans were realized. The data analysis was done separately for the subsystems using different PV technologies, too.

During the presentation an experiment done for the temperature dependence of efficiency of the photovoltaic modules is introduced as well. During this test the temperature of a polycrystalline PV module of a hybrid collector was controlled with the collector solar fluid temperature, and the electrical energy production was measured from what the efficiency was determined. With the experience the degradation of the efficiency with the temperature increase was shown.

From the different working of the alternate technologies an investigation was elaborated to see how the energy production of the modules is depending on the spectral properties of the solar radiation. For this purpose spectral measurements were done at the site of the PV system in cooperation with the Meteorological Institute of BOKU, Vienna. The results of this investigation are presented as closing.

As a conclusion we can declare that the working of the system meets the requirements in every field and the operation of it follows the plans.

*Acknowledgement:* This work was supported by the project OTKA K 84150.

## GREEN-X METHOD FOR PHOTOVOLTAIC SYSTEMS' NEW FEED IN TARIFF SUPPORT MECHANISM IN HUNGARY

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The presently Hungarian feed-in tariff system is not acceptable by experts or politicians. The author by co-ordination of the Hungarian Energy Office and Pylon Ltd. made a new proposal with adaptation of the GREEN-X method. This proposal aims to aid the new system, which could have more guaranteed feed-in tariff for the different renewable technologies.

In this research program we could make some evaluation about different photovoltaic systems. We have counted not only acceptable and satisfactory feed-in tariff, but we have appraised the needful premium support for the autonomous photovoltaic or pv-wind systems, moreover we could estimate the needful feed in tariff for a photovoltaic power station with combinations a regenerative fuel cell.

In presently with some altering of technical an economical data the author and the Pylon Ltd, according to the needful supports of Green-X method, the Hungarian Action Plan 2010-2020 is modeling by proxy GKI Energy Research and Consulting LTD.

The presentation shows some summarizes the new scientific achievements point of view of photovoltaic systems.

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CHARACTERISTICS OF THE PHOTOVOLTAIC MODULES AVAILABILITY  
AT A PREDETERMINED TEMPERATURE

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Photovoltaics (PV) comprises the technology to convert sunlight directly into electricity. One single PV cell produces up to 2 watts of power, so to increase a power output, many PV cells are connected together to form modules, which are further assembled into larger units called panel or array. A complete PV system consists not only of PV modules, but also the "balance of system" or BOS, included the support structure, wiring, storage, conversion devices, etc. i.e. everything else in a PV system except the PV modules.

Two major types of PV systems are available today. i.e. flat plate and concentrator. The major types of materials of PV are crystalline and thin film, which vary from each other in terms of light absorption efficiency, energy conversion efficiency, manufacturing technology and cost production.

In thermodynamic point of view, photovoltaic (PV) system (cell/module/panel/array) performance can be evaluated in terms both energy and exergy (availability). Energy analysis (energetic) is based on the first law of thermodynamics meanwhile exergy analysis (exergetic) is based on both the First and the Second Laws of Thermodynamics. Exergy analysis method is employed to detect and to evaluate quantitatively the causes of the thermodynamic imperfection of the process under consideration. Therefore, it can indicate the possibilities of thermodynamic improvement of the process under consideration.

This paper concerns on characterize of availability (exergy) two different of Photovoltaic (PV) modules technologies (flat plate type), i.e. polycrystalline technology (ASE-100) and amorphous silicon technology (DS-40), under Gödöllő, Hungary climatic conditions, at predetermined parameter, i.e. the constant temperature.

The total one day of an actual operational data (empirical data), such as solar irradiation ( $G$ ), current ( $I$ ), voltage ( $V$ ) and electrical power ( $P$ ) are used in order to characterize both of above module technologies. The PV modules placed on position  $5^\circ$  to East face to South ( $\gamma$ ) with a tilt angle  $30^\circ$  ( $\beta$ ).

Some of terminologies such as solar exergy, efficiency of exergy, exergy losses (as the result of the irreversibilities in the process), as resulted from availability analysis, will be found in this characteristics. Further outcome from this works, the real possibility improvement of both PV modules (i.e. electrical efficiency) can be studied, observed and achieved.

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## FIELD MEASUREMENTS FOR DETERMINATION OF VEHICLE SPEED IN CASE OF RUN-OFF ACCIDENTS

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The research is supported by the Hungarian National Innovation Office. Vehicle accidents on terrain cause many problems for forensic investigators. On an international meeting for experts was stated that computer simulation analysis of accidents occurring on terrain can only give approximate results. It is necessary to measure the soil mechanics parameters to make a good assessment of terrain accidents. Accident analysis must incorporate the soil-tire interaction and the effect on the vehicle's mobility of soil mechanics parameters.

A series of field measurements were carried out with the primary aim of recording data for a soil database to be used in the simulation of motion of vehicles involved in run-off accidents. The measurements were used to determine travel resistances, a required parameter for the determination of the speed of a vehicle entering terrain at the moment it runs off the road.

A vehicle leaving a surfaced road enters the adjacent terrain with a certain kinetic energy. Its motion is affected by larger terrain obstacles and by vibrational acceleration induced by micro-obstacles. The deceleration and halting of the vehicle is influenced by travel resistances arising from the vehicle-soil interaction.

Previous vehicle-terrain interaction theory research by the Department of Automotive Engineering has proved very useful during the investigation, because the motion of a vehicle running on to terrain after an accident is governed by the vehicle-soil and tire-soil interactions.

If, following a run-off accident, the speed at which a vehicle left the road is not known, and all that can be measured are tracks left on the terrain, the accident should be examined from the viewpoint of travel resistances – the forces that slowed down and halted the vehicle. If these can be defined with sufficient accuracy, the vehicle speed at the moment it left the road can be determined from the change in kinetic energy.

With knowledge of the vehicle mass, the distance traveled on the terrain, and the effects of the soil parameters, then if the other forces acting on the vehicle are known, the speed of the vehicle as it left the road may be calculated (providing that it came to a halt on the terrain).

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## INVESTIGATION OF THE GLAUBER'S SALT FOR HEAT STORAGE

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One of the most important question of the solar energy utilization is the storage of solar energy. Nowadays, water is the most widely used heat storage medium in the solar-thermal systems. Water has high specific heat capacity, it is cheap and easily available. In this study the properties of a phase change material (PCM), the Glauber's salt ( $\text{Na}_2\text{SO}_4 \times 10\text{H}_2\text{O}$ , sodium sulfate decahydrate) are examined as a heat storage medium.

In the selection of the material the most important points were the medium should have favorable thermodynamic properties and the phase change should happen at such temperature that makes the material ideal for use in building heating. Consideration was also given to that the substance must not be toxic or flammable, it should have relatively high thermal conductivity and it should be cheap. The thermodynamic properties of the Glauber's salt in the literature are documented rather incompletely. The melting temperature, the latent heat, the solid and liquid specific heat capacity data were determined from measurements by using polystyrene box as a calorimeter in the absence of a professional one. The measurements were carried out in the Laboratory of the Department of Physics and Process Control, Szent István University, with the help of NCT-10K B=3950 sensors and a National Instrument data logger system which was connected to a computer. The measured data was gathered and stored in the computer with the use of a software coded in LabView and then it was processed in Excel.

The behaviour of the Glauber's salt was compared to water's in a self-made tile-stove model too. Based on these measurements, it can be said that the specific heat capacity of Glauber's salt depends on the temperature, and the thermodynamic characteristics of Glauber's salt are more favorable than the characteristics of water.

Supercooling was observed in each case during the cooling of Glauber's salt. By mechanical influences (moving), the solidification started accompanied by the expected heat release. According to our experiments the beginning of the release of the heat, which the Glauber's salt stored in the phase change, can be controlled in the temperature interval which is suitable for building heating. This makes the use of Glauber's salt very advantageous as a heat storage medium.

This paper details the measurements for determining the thermodynamic properties of Glauber's salt and the obtained results. Presents the tile-stove model, and summarizes the conclusions, results and experiences.

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

## SOLITARY WAVE TYPE SOLUTIONS OF THE CONVECTION-DIFFUSION OF A PROCESS THROUGH POROUS MEDIA

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The mathematical modelling of non-classical transport processes plays a role of increasing importance in both fundamental research and engineering applications, since appearance of the advanced computer algebra systems gave us boundless possibilities for such research activities. Nowadays, it is also possible to work with the otherwise very complex systems of nonlinear partial differential equations characterizing the simultaneous and usually coupled transport processes.

In the present work the partial differential equation describing simultaneous convection and diffusion through porous media is discussed in detail, particularly from the point of view of its general nonlinear character. The relevant description within frame of the non-equilibrium thermodynamics formalism is also given and some open problems related to the future applications of the Lagrangian representation in this field are also indicated. Particularly, some possible future results of the very promising flow-line diffusion technique are presented in connection with some recent results of authors. It is shown, that the Riccati-type ordinary differential equation, playing a crucial role in some contemporary modelling procedures of the simultaneous convection-diffusion problems must be treated in a refined manner, by taking into account the genuine dispersive character of the porous bulk, through which the actual transport phenomenon of this character takes place. As a novel element, the projective representation of the symmetry group leaving invariant this differential equation is effectively used and it is shown, that this approach may lead to a remarkable simplification of the rather complicated mathematical apparatus initially developed for effective solving of the most general convection-diffusion problem.

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

## THE ENERGETIC COMPARATIVE EXAMINATION OF DIFFERENT TILLAGE TECHNOLOGIES

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We carried out different soil tillage experiments during the cultivation of different seeds. The aim of the experiments was to compare the conventional soil preparation (with plowing) and soil-conserving tillage technologies and seeding systems.

The examination was carried out in three parcels: primary tillage with plough; primary tillage with loosening one; grubbing tillage and sowing aggregately. Our task was to measure the required fuel consumption of different machines. Provide information for the energetic and expense analysis of cultivation systems.

We carried out the measurements three times: the primary cultivation; the seed-bed preparation and sowing. The examinations were carried out on identical soil (sandy clay), under similar circumstances, on parcels beside each other.

As the result of the examinations it was verifiable, that the tillage technology of three kinds is able to create a physical soil state after similar sowing.

## PERFORMANCE OPTIMIZATION OF A LARGE SCALE SOLAR ARRAY

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In our previous works (Haber and Farkas, 2010) the heat transfer coefficients were investigated through CFD at the typical placements of solar panels, but mainly at artificial circumstances. The identified functions for the relation of wind speed and the heat transfer coefficients were used at the heat resistance model, to get the junction temperatures of a solar panel. Through the known temperature of one cell in the module, we can define the proper (and actual) efficiency of a solar module or a whole array.

With the simulations, it was also looked for, what is the most ideal construction placement for an individual module, like what is the ideal gap between (Gan, 2008).

Keeping in our mind the information got before that can be used to optimize a whole array, placed on any rooftop. In our example a brand new plus energy factory building (RATI Kft.) will be analysed, which is located in Komló, Hungary. While it is a plus energy building, it was very important to make predictions for the solar energy production, even in the design phase.

A 1:100 scale model of the building and the close terrain were analyzed in wind tunnel, in order to get the pressure values in 96 points, and to get information about the flow properties, and about the natural ventilation of the building. This measurement can be a type of validation for the investigation of the average heat transfer coefficients with CFD.

The comparison between the wind tunnel test and the CFD results has been made, through these 96 points. The values show just 2-6% deviation, so in our opinion, the CFD can be used for further investigations in this case.

### *Literature:*

Háber I., Farkas I.: Numerical determination of the heat transfer at free standing solar modules, ECT 2010 Valencia, Civil-Comp Press, Proceedings of Seventh International Conference on Engineering Computational Technology, 14-17 September 2010, Valencia, Spain, Paper No.132, pp. 1-13.

G. Gan, Numerical determination of adequate air gaps for building-integrated photovoltaics, Solar Energy, Vol. 83, 1253–1273, 2008.

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## POSSIBLE USE OF EXERGY ANALYSIS FOR PV/T COLLECTORS

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Among the solar energy application possibilities the solar thermal systems can reduce the consumption of traditional energy resources. By using less energy obviously leads us to less pollution. Flat plate collectors and PV modules are the most commonly used equipment of solar energy. The solar market has shown an effective 33% growth per year since 1997 until today. As a result of developing the photovoltaic solar energy system the hybrid photovoltaic/thermal system was developed. The term PV/T refers to solar thermal collectors that use PV cells as an integral part of the absorber plate.

At the Department of Physics and Process Control, Szent István University, Gödöllő various solar applications were installed for educational, demonstrational and research purposes, such as PV and solar thermal units, transparent wall insulation and solar dryer unit.

Thermal and photovoltaic technology combined into one system is known. The PV/T system can be segregated into two parts, the thermal solar technology what converted the solar energy into heat, and the photovoltaic technology which derived from solar cell technology and convert the solar radiation into electricity. The hybrid collector can reduce the main problem of photovoltaic systems, the high temperature of the solar cell effects reduction in the efficiency. In order to reduce that problem and get more efficiently system it is necessary to cool the PV cell and decrease its temperature. To solve the problem -which is not an easy task especially in hot and humid climate areas- flat plate hybrid collector has developed, it is produces both thermal energy (by cooling back the module) and electricity at the same time. Thus, the PV/T solar collector gives opportunity to growing the overall solar efficiency and provides a better way utilizing solar energy. The PV/T, combining PVs into the solar thermal module, indicates a new direction for renewable energy utilizing.

The PV/T module can collect solar energy at different brands of the spectrum and lead to energy and exergy efficiency. Sum of the collector's thermal efficiency and the PVs' electrical efficiency gives the overall efficiency. Hybrid collector efficiency is defined as the ratios of useful system heat gain and electricity gain to the incident solar irradiation on the collector's absorbing surface.

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

## EVOLUTION OF WALL CONSTRUCTIONS IN HUNGARY

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The energy consumption of heating and cooling systems determines the maintenance cost of buildings to a great extent. Nowadays in Hungary 40% of all energy is used in buildings, two thirds of this for heating and cooling. 70% of the four million housing stock does not meet the actual heat technical requirements, therefore there is a huge energy saving potential in this area. Saving energy good for operators and and it is also important in national economy aspect. Solutions have to be found by mankind as soon as possible for global environmental problems, to prove sustainable development on our planet. Steps have been taken into this direction, among others, Hungarian energy strategy in harmony with EU governing principle proposes a 30% reduction of housing stock heating energy consumption.

Countries of the European Community carry out the energetic controlling according to the 91/2002/EK building energetics directive, adapted to local circumstances. In Hungary this is executed by the 7/2006 TNM order, which applies controlling in different layers. One of them is the limitation values for heat transfer coefficients allowed for boundary surfaces. The directives refer to new buildings and a considerable extent of renewing, too. The effect of new, more strict regulations on architecture following the former ones can be perceived through continuous changing of applied boundary constructions.

Loss of energy in buildings has two main parts, the transmission heat loss and the filtration heat one. Transmission loss is associated with the heat flow through the wall structure, while filtration loss is caused by ventilation and defective air filtration. The rate of these losses can vary a great deal because of the different use, construction and designation of buildings. Generally, the dominated transmission heat waste can be described by the analysis of building physics of boundary constructions.

These boundary constructions, typically walls, have the task to isolate, defend space. Building walls have pristine traditions from prehistoric times, when our ancestors realised that not only could they accommodate to, but also form their environment. Consequently, this evolution resulted in various wall constructions depending on local climate conditions and geographical location. The aim of this study is to summarize the evolution of the above mentioned technologies from the beginning till nowadays, and sketch future trends.

Sustainability, climate protection and supply safety require the use of renewable energy resources. Energy efficiency has a significant role in the development of building energetics, too. The old wall constructions used so far and the knowledge of their building technologies are important from a traditional point of view, and they can provide new ideas for future development of energy saving.

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## AIR POLLUTANTS IN CLOSED SPACES

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In residential buildings, office buildings and other facilities, many of the materials appear in the air, which are undesirable, harmful, or unpleasant. These substances can be removed - assuming that the outside air quality is acceptable, this job can be solved by ventilation. The ventilation is not only removal of unwanted materials, but - especially in winter, large amounts of energy also enters the environment. The exchange of air and ventilation are important roles in reducing energy consumption. The ventilation in general is still in many cases, means opening of the windows, but nowadays more and more mechanical ventilation come in the focus. The ventilation equipment can be adapt to the prevailing degree of contamination, so this energy can be saved.

To design and operate a ventilation system is necessary to know the factors which determined the amount of ventilation air. The amount of airborne pollutant is determined from these factors. This paper is about the enclosed spaces intended for human residence for different pollutants and how they are intended to reduce.

In enclosed spaces the presence of human is an impact on the environment in itself. Such substances are among the metabolic products (vapor, CO<sub>2</sub>, heat), the level of output is generally known. Less, or, sometimes, we do not have knowledge at all on the physiological processes which are not closely related to the degree of odor.

In the context of human activity the closed spaces are charged with odor, depending on the nature, and effecting of a very different matter. As an example, it can be felt out in the kitchen during the cooking process and when its resulting odor substances, but equally significant amounts of natural substances can appear during cleaning, and many other cases.

There is a list of pollutant in enclosed spaces which are not directly linked to human activity, but during the preparation of an object, tool, furniture, the materials derived from them constantly on the environment, such as carpets, plastics and adhesives containing furniture, paint, etc.

In this study it has been explored the properties and the activity-related effects the amount of such materials.

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## EFFECT OF ACID RAIN AND HEAVY METAL FOR GARDEN CRESS

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Our environment is threatened by several sorts of pollution. Among these loads, heavy metals and acid rain need to be emphasized. Anthropogenic activity accountable for several source of heavy metal pollution, however heavy metals occur naturally in the ecosystem, too. Most commonly they appear in soil. Contaminated soil may affects indirectly human health through consumption of plants, which are capable to accumulate heavy metals under suitable circumstances. Acid rain is caused by atmospheric emissions of acid gasses primarily originated from human activities.

Zinc and cadmium were used for this research since zinc is an essential trace element that is vital for growth and development of living organs. Nevertheless its importance in industrial applications, such as anti-corrosion agent or basic component of alloys, is significant.

Cadmium is a highly toxic element, which is often applied as a key component by many common industrial uses, like battery production or electroplating.

The garden cress (*Lepidium sativum*) as test organism was applied to observe the effect of heavy metals and acid rain. This plant was chosen because of its short vegetative period and high vitamin C content. After several experimental setups, the separated effect of heavy metals and acid rain was examined as well as their combined effect on the physical parameters and vitamin C content. Measurements were done by HPLC.

Statistical analysis was performed by SPSS 14.0 programs. About the physical parameters it can be stated that the treatments decreased the length of root and stem compared to the control samples, but the nitric acid rain caused an increase on the surface of leaf. Control samples had an average 29.53 mm<sup>2</sup> of leaf surface but the nitric acid treated samples had an average 33.67 mm<sup>2</sup>. Generally it can be stated that the phosphorous acid and phosphorous acid – heavy metal treatments show significant difference compared to the other data.

Regarding vitamin-C: the cadmium and phosphorous acid polluted samples contained the least amount: 6.17 mg/100 g fresh plant. The most vitamin C was only in the nitric acid treated samples: 23.83 mg/100 g fresh garden cress. However there are significant differences between each treatment.

As a result it can be concluded that the zinc and nitric acid treatments stimulated the plants but the phosphorous acid and mostly the cadmium treatments had negative effect both on the physical parameters and the vitamin C content of the samples.

## PROPERTIES OF THERMOPHILIC FUNGI IN SEWAGE SLUDGE ON BIOGAS PRODUCTION

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Biogasification, i.e. anaerobic digestion, is a well known sustainable option for the management of sewage. The produced biogas is a valuable biofuel for the replacement of fossil fuels in various technical applications (Kymalainen et. al, 2011). Anaerobic digestion can be considered the most promising way to reclaim energy from materials of high organic matter concentration. Co-digestion can be an interesting option for improving yields of sewage sludge anaerobic digestion (Bernat et. al, 2010). Sewage sludge is characterized by high content of organic compounds, which engenders putrescibility and this is the cause of its putrescibility, therefore sludge should undergo chemical and hygienic stabilization before landfill disposal or agricultural application. One possible method of stabilization and hygienization involves methane fermentation (Sosnowski et. al, 2003).

In this study the statement and specific definition of thermophilic fungi content of sewage sludge were the main objectives. The sewage sludge was applied on biogas production in Kiskunfélegyháza. High thermophilic fungi content was expected in sewage sludge. Our methods included breeding in laboratory by standard mycological methods (on potato dextrose agar, malt extract agar, Martin's agar, microcrystalline cellulose agar), in order to define the minimum, maximum and optimal growth temperature and ecophysiological properties, beside the definition of demolition spectrum of cellulose, xylan, mannan, lignin, fatty acid ester, keratin and phosphate.

On potato dextrose agar  $1.3 \times 10^5$ , on malt extract agar  $1.6 \times 10^5$ , on Martin's agar  $8.8 \times 10^4$  and on microcrystalline cellulose agar  $6.1 \times 10^4$  microbial colonies were grown. 8 thermophilic fungi species were isolated (*Malbranchea cinnamomea*, *Thermomyces lanuginosus*, *Scytalidium thermophilum*, *Myceliophthora thermophila*, *Paecilomyces sp.*, *Thermoascus aurantiacus*, *Myriococcum thermophilum* and *Rhizomucor pusillus*).

In the case of definition of minimum, maximum and optimal growth temperatures our results pointed out, that the minimum temperature were between 26-32 °C, the maximum temperature changed between 55 and 60 °C and the optimal temperature varied between 46 and 51 °C. The ecophysiological properties (more precisely demolition of cellulose, xylan, mannan, lignin, fatty acid ester, keratin and phosphate) were the following: 3 species were able to demolish the cellulose, 7 species were able to demolition of xylan, 7 species were able to demolition of mannan, 2 species were able to demolition of lignin, 7 species were able to demolition of fatty acid ester, neither species could not demolition of keratin and 4 species were able to demolition of phosphate. According to our experience is one of the best types of biogas production occurs on sewage sludge. The high thermophilic fungi content of sewage sludge were expected. 8 thermophilic fungi species were isolated and the growth temperature was defined. Consequently, on the grounds of its wide range of growth temperature and demolition spectrum, thermophilic fungi may regard as the most important base of biogas production.

PRELIMINARY DESIGN AND MODELLING OF THE SOLAR STREET LIGHTING PV SYSTEM WITH LED  
ENERGY EFFICIENCY LAMP

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Energy efficiency low"199/2000" indicated the national policy direction of efficient use of energy, according to the Energy Charter and Protocol on energy efficiency the low proposed environmental obligations for the energy producers and instituting incentives for the consumers. In energy low 13/2007 has two capitols for promoting the use of renewable energy sources, electricity production with these alternative sources and uses high efficiency cogeneration methods.

This paper describes a case study for solar street lighting system indicated to be installed in Romanian Central Region 7. One way to respect this indication of the energy low is to renew the street lighting equipment that can be realized with helpful of solar street lighting units with LED energy efficient and DML lamps. That is very durable, can easy install and operate and reduce pronounced the energy consumption. The solar led lamp consumes up to 72 % less energy than other light sources, has a lifetime up to 100000 hours that means 10 years continuous use. With brightness up to 80 Lumens/Watt, LED light outperforms incandescent, halogen and neon light sources. The principal component of the solar street lighting system is a stand alone, off grid photovoltaic energy supply system, which produced energy for DC consumers.

The paper presented the principles and design method for planning the of – grid photovoltaic supply system. The design method starts with analyzing the solar radiation potential in application site. That can be realized with helpful of different solar radiations maps. In Romania on a horizontal surface of 1 m<sup>2</sup> it is possible to capture in one year period, energy between 900-1450 kWh, depending on the season. For the Central region this value is 1200-1300 kWh/ m<sup>2</sup>, year. The paper presented the technical structure of the off grid system, the evaluation parameters is calculated from energy balance and is used to estimate to the amount of photovoltaically generated electrical energy and actually value used by the consumer. In following the evaluation parameters, solar fraction, performance ratio and final yield are explained. Those parameters make possible to compare results from different system components, operation management modes or systems at different locations. The system parameters have been evaluated with use of computer –aided design and simulation software.

In finally of the paper is presented same economically aspects for advantages of use of solar street lighting systems, in this mode the consumer eliminate the dependency on growing cost of the electricity price.

## DESIGN AND IMPLEMENTATION ISSUES OF THE WIND TURBINE – PV HYBRID RENEWABLE ENERGY SYSTEMS

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Many times, according to the local conditions, one stand alone renewable energy system cannot supply the energy requirements (due to the small wind velocities, the small amount of the sunny days, the nonexistence of the water flows etc). In this case, a common solution for the energy independent households is represented by the hybrid renewable energy systems (photovoltaic panels and a wind turbine, small hydro plant and photovoltaic panels, small hydro and a wind turbine etc, all of these systems, combined or not with an electric generator – a diesel one f. e.).

The wind turbine – PV hybrid renewable system is implemented in Brasov, Romania, on the top of the University's hill (approx. 750 m altitude above the sea level). The system is composed by a unit of 1 kWp PV panels and a 1kW wind turbine and is a demonstrative one which is used in didactic processes.

The main issues related to the hybrid system's implementation were related, first, to the weather conditions. According to that, one year long, the weather data for the wind speed, wind direction and the solar radiation were collected by the meteo station installed at 50 m from the hybrid system's location. In order to compare the amount of the produced energies (by the PV panels and by the wind turbine), a solution of 1 kWp PV and 1 kW for the wind turbine was chosen.

The PV panels are installed on the roof of the university's building, on by own designed and by own manufactured supporting frames. The design of the supporting frames was made by using Catia software by considering an orientation to the South of the panels. By using the finite elements method the stresses and displacements fields were established in the case of extreme conditions for the Brasov area: 30 m/s wind and a snow layer of 20 cm.

The wind turbine was installed on the top of a tower which was designed and manufactured by own, also. The tower has a truss beam shape, in order to accomplish the mechanical resistance conditions at a high level. The tower was modelled by using Catia software and two types of finite elements analysis were done: one for the mechanical resistance (there were considered the shear forces from the turbine's rotor, the weight of the turbine and bending and torsion moments – also from the rotor) and a second one – an eigen values analysis for the free frequencies, in order to avoid the resonance of the tower, due to the rotor's rotational speed and due to the earthquakes).

The data were measured during the period October 2009 and October 2010 and show that the amount of the energy produced by the wind turbine is at a level not higher than 7% from the entire energy produced by the hybrid system.