12th International Workshop for Young Scientists

BioPhys Spring 2013

B P S

BOOK OF ABSTRACTS

Institute of Agrophysics Polish Academy of Sciences
Lublin, Poland

Czech University of Life Sciences
Prague, Czech Republic

Szent Istvan Univesity
Gödöllő, Hungary

Slovak University of Agriculture in Nitra
Slovak Republic

Polish Academy of Science, Branch in Lublin
Poland

21-23.05.2013, Lublin, Poland

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Edited by:
Józef Horabik, Agata Pacek-Bieniek, Beata Kondracka

Graphic design:
Agata Pacek-Bieniek

ISBN: 978-83-89969-04-0

Edition: 100 copies
Printed by:
***ALF-GRAF* Lublin**

May 2013

CONTENS

INTRODUCTION

Dear friends and colleagues,

It is my great pleasure to invite you to the 12th International Workshop for Young Scientists "BioPhys Spring 2013" which is held in Lublin on 21-23 May 2013. Each year we alternate the place of workshop between Prague, Lublin, Nitra and Gödöllő to facilitate participation of young researchers from broader region of neighbouring countries. The workshop is oriented on deeper insight into the physical processes occurring in biological, agricultural and food systems. The workshop combines two basic tasks of international meeting: exchange of professional experience and integration of young people from different countries.

A new element of the this workshop will be practical sessions in the new laboratories of the Institute, during which you will be able not only to see the modern apparatus but also make sample measurements. We welcome all participants of the workshop to actively participate in this form of mutual exchange of experiences and the development of their professional skills.

We cordially invite young scientists to participate in the BPS 2013 Workshop, to present results of research in application of physics to life sciences and to discuss your own experience and visions of strengthening of international scientific cooperation of young researchers. Papers presented at BPS Workshop can be submitted for publication in International Agrophysics, Research in Agricultural Engineering, and/or Scientia Agriculturae Bohemica.

It is my pleasure to invite you to spend a few days of May 2013 in friendly atmosphere between young people in Lublin.

Józef Horabik
Chairman of the Scientific Board

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LECTURES

EFFECT OF LOADING RATE ON THE EGGSHELL STRENGTH

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The paper deals with the study of the behaviour of eggs of different domestic fowles (hens,goose and Japanese quails) under compressive loading between two plates. The influence of the loading orientation as well as the effect of compressive velocity are studied. Main physical and geometrical properties such as mass, eggshell thickness, length, width, geometric mean diameter, surface area, sphericity, volume, and eggshell radii of curvature were determined for all tested eggs. Eggs have been loaded between their poles and in the equator plane. Five different compressive velocities (0.0167, 0.167, 0.334, 1.67 and 5 mm/s).

The increase in rupture force with loading rate was observed for loading in all direction (along main axes). Dependence of the rupture force on loading rate was quantifies and described. The highest rupture force was obtained when the eggs were loaded along their axes of symmetry (X-axis). Compression in the equator plane (along the Z-axis) required the least compressive force to break the eggshells. Each of these directions of the loading exhibits different main curvature of the eggshell surface which is in the contact with the loading plate. The scatter in the main curvature showed no correlation with the scatter in experimental data. The rate sensitivity of the egshells strength is highest for the hen`s eggs.

The possible explanation of the influence of the loading rate on the strength behavior of the tested eggs is briefly outlined.

OPTIMIZATION OF MOISTURE CONTENT DISTRIBUTION IN GRAIN DRYERS

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The drying is one of the most important technologies for long term storage of grains. The mixed-flow grain dryers are the most widely used equipment for such purposes. It is still a key question to optimize the moisture distribution during the drying process in order to avoid the moisture fluctuations in the course of grain-flow in the bed.

The initial job is to establish an appropriate grain drying model to be able to calculate the simultaneous heat and moisture transfer in the course of the process. Validation of such models definitely requires carrying on with a sufficient number of accurate measurements.

Beside the heat and mass transfer it is important to take into account the actual movement of grain particles in the dyer as it has a strong influence on the even moisture distribution. This job is an essential part of the design of a drying system providing even moisture distribution. That is absolutely required to reach a high quality end product.

Intensive mass flow experiments were carried out by the pilot mixed-flow dryer at Leibniz-Institute for Agricultural Engineering Potsdam-Bornim e.V. (ATB) in Potsdam studying the grain movement through the dryer (Mellmann et al., 2011). Their experiments show how big differences could develop because of the different residence time by the mass-flow.

It can be concluded that the unevenly (over- or under-) dried grain will lead significant quality degradation and causing also a non-effective energy consumption.

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

LOADS IN GRAIN SILO: COMPARISON OF EXPERIMENTAL STUDIES AND DEM SIMULATIONS

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Storage, handling and processing of grain in silos are matter of care of many fields of industry and technology and still needs scientific support from several braches of science such as physics, chemistry, mechanics, agriculture and engineering. Agriculture and the food industry are, next to chemical and pharmaceutical industries largest producers and users of granular materials. Two basic conditions have to be fulfilled by equipment for storage and processing of granular materials: predictable and safe operations and obtaining high quality of final products.

The contribution presents review of experimental studies of loads in model silos of different scales and DEM modeling selected from several research projects performed by the authors. Special attention was given to effects typical for cereal grain, like: deposition of cutin on frictional contact, impact of anisotropy, elasticity and swelling of grain on silo loads. Experiments on model silos have been conducted in the Department of Biosystems and Agricultural Engng, Univ. of Kentucky, USA on silos of 0.6, and 2.4 m in diameter and in the Institute of Agrophysics PAS on silo of 0.4 m in diameter. The wall and floor of the silo were each supported independently on three load cells to isolate the wall and floor loads. Such an experimental configuration allowed for determination of vertical wall and floor loads, and of the resultant moment exerted by grain on the wall and floor of the silo. The silo loads were investigated for different filling and discharging methods. Some of these tests were modeled with DEM. Experimental and simulated data were compared and analyzed.

Experimental findings indicated strong influence of material properties on load distribution. Total vertical wall load was found to be decreasing during initial period of operations due to smoothening of contact surface and covering its with cutin. Swelling of grain resulting in pressure increase is another example of the phenomena typical for biological materials. It was found that filling procedure influences the internal structure of assembly of particles and in that way affects the pressure distribution in a silo. Off-center discharge produces strong asymmetry of wall loads. The asymmetry is the highest when the orifice is located at half the radius of the silo floor. The load asymmetry can be reduced by off-center filling located on the side opposite to the discharge orifice location. The asymmetry of loads generated by off-center filling is a result of anisotropy of the bedding of granular material produced by grains rolling along the surface of the cone of natural repose. The DEM simulations proved very good qualitative and quantitative agreement of experimental and simulated results. Similar findings obtained from DEM simulations for considerably smaller objects (scales 1:4 to 1:24) proved the DEM to be promising method for analyzing mechanical processes in granular materials.

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APPLICATION OF X-RAY COMPUTATIONAL MICROTOMOGRAPHY AND MODELLING FOR ESTIMATION OF THE SATURATED WATER CONDUCTIVITY OF THE POROUS MEDIA

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There are some important macroscopic properties of the soil porous media such as: saturated permeability and water retention characteristics. These soil characteristics influence soil transport processes and are commonly used as parameters of general models of soil transport processes used extensively for scientific developments and engineering practise. These characteristics are usually measured or estimated using some statistical or phenomenological modelling i.e. by use of pedotransfer functions.

On the physical basis, saturated soil permeability arises from physical transport processes occurring at the pore level. Current progress in modelling techniques,

computational methods and X-ray micro-tomographic technology gives opportunity to use direct methods of physical modelling for pore level transport processes. Physically valid description of transport processes at micro-scale based on Navier-Stokes type modelling approach gives chance to recover macroscopic porous medium characteristics – water conductivity from micro-flow modelling.

Water microflow transport processes occurring at the pore level are dependent on the microstructure of porous body and interactions between the fluid and the medium. In case of soils, that is the medium where exist relatively big pores in which water can move easily, but also finer pores in which water transport processes are dominated by strong interactions between the medium and the fluid are present – full physical description of these phenomena is a challenge.

X-ray computational microtomography is a technique which can be used for scanning of the three dimensional structure of the soil samples. For sands and sandy soils these CT scans gives reasonably good representation of the soil samples which allows for direct determination of the pore space and some basic geometrical characteristics – porosity and specific surface.

Samples of sands with a diameter of 5 mm, were scanned using X-ray computational microtomograph. Resulting 3D images were used for reconstruction of the pore space for further modelling. Computational mesh was constructed for the pore space and numerical modelling of water flow through the sample was performed. Steady-state Navier-Stokes equations for incompressible laminar flows were used for that purpose.

Values of the soil saturated permeability determined by pore level transport modelling agreed with results from measurements made using constant head permeameter.

PHOTOVOLTAIC SOLAR SYSTEMS

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The small photovoltaic (PV) solar systems were constructed and installed at the Czech University of Life Sciences Prague. The PV systems were compared from the point of view of the produced energy amount. One system was installed with tracking stand TRAXLE™, one system was installed with tracking stand TRAXLE™ and with the soft ridge concentrator, the reference system was installed with fixed stand. Comparison of the amount of the produced energy shows the energy surplus up to 60% in the case of the tracking system with the soft ridge concentrator in the local conditions 50° north latitude (Prague) and the energy surplus was up to 40% in the case of the tracking system without concentrator (Poulek, Libra, 2000 and Libra, Poulek, 2002).

The small off-grid photovoltaic system for illumination was constructed and tested at the Czech University of Life Sciences Prague. Energy saving light source with LED was used. Description of the PV system and results were presented in few papers. Test period was started in summer of 2011 and the results show that the PV system was self-sufficient during the summer period. Data monitoring during the winter period showed how must be modified the illumination time and the illumination intensity during the winter (Libra et al., 2011).

A silicone gel lamination technology of PV panels has been developed and gel

lamination apparatus with an annual production capacity of 1 MW_p has been designed and manufactured. Silicone gel laminated c-Si PV panels were prepared and tested at 3.5 times concentrated solar radiation in the UV chamber. Negligible corrosion of silicone gel laminated PV panels was observed in comparison with EVA laminated panels. In contrast to EVA-laminated panels the transparency reduction induced by UV radiation in silicone gel lamination is very small. Production of silicone gel laminated PV panels with 50 years lifetime could be achievable because of the strongly reduced corrosiveness which is main source of failures in commercial PV panels (Ketola B et al., 2008 and Poulek et al., 2012).

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THE PHYSICAL LAWS OF THE SOLAR RADIATION AND ITS BIOPHYSICAL AND ENERGETICAL CONSEQUENCES

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The solar energy is our primer energy source and almost all of our usual energy sources are originated from it. To understand how the solar radiation is determining some important biophysical processes and the background of energetic usage of the solar energy the basic principles of the solar radiation has to be analyzed.

From the power distribution of the black hole radiation (Planck law), the main characteristics of the radiation can be seen. The Wien law derived from the Planck law helps to understand why the 380-780 nm wavelength range of the electromagnetic spectra was the best during the evolution in order to develope the sense of vision, but from this law the 7-15 μm infra range is used for thermal imaging.

The other consequence of the Planck law, the Stefan – Boltzmann law, is important to understand the radiational energy processes, and the power radiated out of a given

object. Some short calculations indivates the high potencial of the solar radoiation in the Earth, and stress, where the radiation has to ba taken into the account during analyzing the energetical processes. Its knowledge is important to understand how the climate of the Earth is determined by the distance from the Sun.

In the presentation some simple demontsration of the solar radiation will be presented, together with some specialities nowadays technically not really used, but in a long time scale can be perspectival (e.g. light/radiation pressure).

Finally, the energy producing process of the Sun – the fusion energy – is analized from the point of view of the long time stability of the solar energy, together with the possibility of the fusional energy power plants.

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

PLANT MICROSTRUCTURE AND BIOMECHANICS

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The biological functions and utilization of plants are extensively determined by the biomechanical properties. In general, the biomechanics of plants is governed by water and structure at tissue, cellular and macromolecular level. Due to heterogeneous and hierarchical composition, and limitations of measuring techniques, biomechanics and structure of plants must be still considered independently at these scales.

The goal of this contribution is to discuss current scientific achievements and technical developments in evaluation of plant microstructure and mechanical properties with particular attention on the scale issue. A state-of-art will be presented on structure characterisation of plant tissue at the length scales form nano- to macro and on experimental and modelling studies on biomechanics. Discussion will focus on fruits as a model plant tissue. Three techniques will be presented: atomic force microscope AFM, confocal scanning laser microscope CSLM and macroscope with adequate examples of image analysis for structure quantification. For the each length scale of structure characterisation, three mechanical test will be presented: AFM force spectroscopy, micro-tension technique and briefly macro-mechanical evaluation.

ORAL CONTRIBUTIONS OF YOUNG SCIENTISTS

BIOSPECKLE APPLICATION FOR MONITORING OF PRE-HARVEST APPLE DEVELOPMENT

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Biospeckle technique is a nondestructive, optical method based on the analysis of laser light variations scattered from sample. According to Braga et al. (Braga et al. 2009) processes such as cytoplasmic streaming, organelle movement, cell growth and division during fruit maturation and biochemical reactions are responsible for certain biospeckle activity. Previously, biospeckle method was implemented to postharvest evaluation of tomato (Romero et al. 2009) and apple (Adamiak et al. 2012, Zdunek et al. 2007). In this study, biospeckle method was used for pre-harvest monitoring of apple fruits development. This was aimed on evaluation of this method as a potential tool for nondestructive prediction of the maturity state of apples. Therefore the experiment was carried out to compare biospeckle activity with destructive analyses (soluble solids content, titratable acidity, starch content and firmness) usually used for apple maturity evaluation.

Apples of the cultivars 'Ligol' and 'Szampion' were tested at four stages of development and maturity. Biospeckle activity and firmness were measured on individual apples. Moreover standard quality attributes, including acidity, starch and soluble solids content were also determined for the each development stage.

The device for biospeckle measurement consisted of diode laser (8 mW, λ= 635 nm) illuminated the sample and a CCD camera as a detector of scattered light. Biospeckle movies lasting 4s were recorded in form uncompressed AVI films and analysed to obtain correlation coefficients $C^{k\tau}$, where k is a frame number and τ is a lag time (1/15 s). In this study, C^4 was analyzed only as the correlation coefficient between the first frame and the frame at $k\tau$ = 4s. Then, a $BA=1-C^4$ value was determined as the biospeckle activity parameter for a certain sample. Higher biospeckle activity corresponds to higher $1-C^4$ value.

The results revealed that biospeckle activity reflects the biochemical changes during apple development and maturation. An increase of biospeckle activity in pre-harvest stages was observed whereas increase in soluble solids and slightly decrease in starch and acid content occurred. Strong correlation was obtained between biospeckle activity and soluble solids content, starch content and firmness showing that this method has a potential to be used for non-destructive evaluation of these properties in the pre-harvest period.

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Acknowledgement: The study was supported under the project NR 12 0137 10 founded by The National Centre for Research and Development (NCBiR) (usage and methodology of biospeckle activity measurement) and the project nr 2011/01/D/NZ9/02494 founded by The National Centre of Science (NCN) (in terms of destructive chemical analysis).

INFLUENCE SOME PHYSICAL PROPERTIES OF SOIL ON WATER INFILTRATION WHICH COMES FROM ATMOSPHERIC DEPOSITS

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Researchers team of University of Environmental and Life Sciences in Wrocław*, Institute of Agrophysics in Lublin** and University of Wroclaw*** developed a precisely method of determining the absorptiveness of the soil in the result of forming dew, hoarfrost, deposition of fog, condensation of water vapour from the soil air, and adsorption of water from the atmosphere. This method uses TDR sensors and water impermeable aluminium barriers under the soil surface. May be distinguished two groups of factors influencing the intensity of the effective non-rainfall. The first is the meteorological factors, including among others, temperature and relative humidity air, solar radiation and wind speed. The second is the physical properties of the soil, which include: initial moisture, mineralogical composition, organic matter content, compaction and soil temperature.

Aim of this thesis is to determine effect of soil factors on the absorptiveness of the soil as a result of the processes described above. Each researcher will be performed according to scheme presented in the figure (one of the soil parameters is variable, the other meteorological and soil factors are constant):

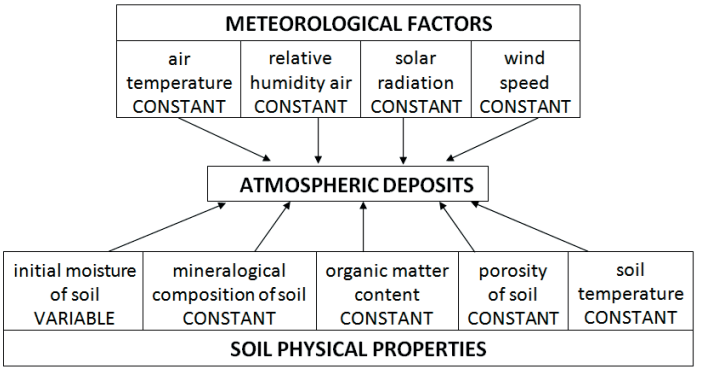

Fig. Factors influencing on effective non-rainfall.

Team members:
* Grzegorz Janik;
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*** Marek Błaś, Mieczysław Sobik.

PROPERTIES AND USE OF ZEOLITES

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Zeolites are natural volcanic minerals having a lot of unique properties. They form when volcanic ash settled in ancient alkaline lakes. The reaction of volcanic ash with various substances dissolved in lakes converts ash into different zeolite minerals.
Zeolites, similarly to the most common minerals – feldspars, are characterized by a skeletal specific structure which is under growing interest by contemporary science and technology.

In 1756 Swedish mineralogist Axel Fredrick Cronstedt discovered, that stilbite, natural mineral, releases water when heated. He called stilbite-similar group of minerals zeolites from Greek spoken word "boiling stones". Zeolites that time were group of minerals without the greater significance. Cronstedt was remembered mainly as the discoverer of nickel.

Zeolites are crystalline aluminosilicates most often saturated by hydrated alkaline metals ions. Synthetic crystalline aluminosilicates and natural zeolites are built from silica [SiO_4] and alumina [AlO_4] units connected by shared oxygen ions in polyedric structures which are fundamental units of spatial construction of zeolites. In natural zeolites the minimum ratio of silicon to aluminum has the value 1:6.

The Si/Al ratio effects zeolite properties. At low silicon content zeolites are characterized by increased acid resistance, stability at high temperatures and hydrophilicity. Zeolites of high silicon have high ion exchange capacity and hydrophobicity.

The best known zeolites are: a) chabazite, b) clinoptilolite, c) mordenite, d) analcime. Zeolites are applied in the industry (carriers of catalysts, in cracking processes, alkylation, reforming, hydrating, isomerization), farming (carrier of pesticides, herbicides, nutrients; additions to fodders and feeds; improving soil by improving structure, water and nutrients storage). Zeolites found application in biogas production (increasing the quality of obtained methane, and post-fermentation wastes treatment).

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CONTACT ANGLE GONIOMETRY AND MICROSCOPY OF STARCH-PROTEIN FILMS

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Starch, protein isolate and their combinations have been proposed as a promising biopolymer for edible films. They could have many applications in food industry (Jiménez et al., 2013). The objective is to better understand the effect of film composition and structure on the surface properties and behaviour in contact with liquids. Then, 6 films composed of starch and/or whey protein (100-0%, 80-20%, 60-40%, 40-60%, 20-80% and 0-100%) were analysed in terms of microstructure and contact angle goniometry. All packaging materials were stored minimum 7 days at 25°C and 53% of relative humidity prior analysing. Micrographs from scanning electron microscopy (SEM) display a better insight in the homogeneity and the film microscopic structure. The structure of the film depends on chemical interactions between components and on drying method of film forming solutions (Fabra et al., 2009). Micrographs give information about how the hydrocolloids are located and how they lie down in a film matrix, particularly at interfaces. Surface properties were investigated by goniometry. The value of the contact angle gives information on the surface hydrophobicity, spreading coefficients, surface free energy as well as liquid absorption rate by films (Karbowiak et al., 2009; Murillo-Martínez et al., 2011).

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APPLICATION OF FLUORESCENCE SPECTROSCOPY IN STUDY OF INTERACTIONS BETWEEN HUMIC ACIDS AND METALS

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Fluorescence spectroscopy belongs to a powerful tool for studying of soil organic matter including humic substances. Method is nondestructive for samples and includes very sensitive measurements. Investigations are not too costly and time-consuming. In respect of humic acids analyses, fluorescence technique is especially suitable for determination of different origin of organic molecules but also determination of changes in the fluorescence of structure under interactions with others substances in soil environment. Metal ions have high affinity to react with humic acids particles however kind of reaction and in the consequence strength and sort of creating bond can be varied. Among others, interactions metals with humic acids can be realised by connecting to different functional groups in organic particle like carboxylic, phenolic, alcoholic and many others. Reaction can involve chalating, ionic, covalent mechanisms and in general explanation of these processes is still not clear and need to be continued. Studying of interactions between humic acids and metals by applying of fluorescence spectroscopy has a great advantage because humic acids structure is rich components named as fluorophores. In the consequence, mechanism of metal bonding could be observed as change: quenching or excitation the fluorescence signal depending on cation and kind of interaction.

Examples of fluorescence spectroscopy application in this paper refer to spectra of excitation, emission, synchronous, and three-dimensional excitation–emission matrix (EEM). Studies show that applying of fluorescence spectroscopy in investigations of reactions between humic acids isolated from different organic soils and cations of selected metals at various pH circumstances enable to calculate complexation capacities and stability constants of created compounds. Using of single-mode spectra it is also possible to determine humification index, describe a structure in term of aromaticy, length of aliphatic chains or condensation of aromatic cores. Above mentioned methods show also point of saturation of humic acids structure by metal cations. Moreover, pH influence on the interactions could be visible and interpreted.

Acknowledgement: This work was partly carried out within the framework of a research project. The project was financed by the National Science Centre in Poland, on the base of decision number DEC 2011/03/N/NZ9/04239.

THE EFFECT OF MAGNETIC FIELD PRE-TREATMENT OF *SINAPIS ALBA* SEEDS ON LEAD ACCUMULATION

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Seeds pre-treatment by physical factors such as magnetic or electric fields, laser, microwave or ionizing radiation are used in order to obtain a greater yield or better growth factors of treated plants (Kornarzyński, Pietruszewski 2005). Data of many experiments have shown that magnetic or electric seeds pre-treatment results in better germination force, accelerating the achievement of maturity and stimulates higher and better quality of crop (Namba et al. 1995; Sasao et al. 1998; Carbonell et al. 2000; Pietruszewski 2002). Some researchers report that treated plants have higher activities of seeds α-amylases (Prashanth et al. 2008; Venkateswar et al. 2012) or that magnetic field has an influence on antioxidant activities (Sahebjamei et al. 2007).The use of physical factors to improve plant growth and development is an attractive alternative to chemical methods.

The aim of this study was to examine the impact of magnetic field pre-treatment on lead accumulation by *Sinapis alba* (L.) v. "Bamberka". Alternating magnetic field (50 Hz) was applied in two dosages 30 mT and 45 mT for the exposition time of 30 s. After surface sterilization the seeds were grown in dark at 25ºC for 3 days. After that period, the germination force was determined and the plantlets were put in the soil and grown under the following conditions: 14h light/10h dark, 22ºC/16ºC, relative humidity 60%, photosynthetically active radiation 280 μM m^{-2} s^{-2}. The content of lead in soil was 800 mg kg^{-1}.

The results show that especially 45 mT magnetic field stimulated growth rate. This was the most significant during the first day. On the third day the number of germinated seeds was similar in all samples. The effect of magnetic field on plants biomass production was noticeable in all variants in comparison to the control. Lead concentration in shoots was the greatest in plants treated with 45 mT. In the case of 30 mT stimulation lead concentration was lower than in the control. Nevertheless, these are very preliminary results which should be tested on a larger population to achieve statistical significance.

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EMISSION AND COMBUSTION CHARACTERISTICS OF A COAL STOVE FIRED WITH BRIQUETTES OF BIOMASS

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The potential of organic waste in the EU is significant but in its processing and its use, especially as fuel, struggles with many technical and economic difficulties. The article assesses thermal emission properties of selected samples of fuels from biomass in comparison with lignit sample. Biofuels samples are made from wood waste, straw and bark in the form of briquettes. Samples were burned on furnance grate in coal stoves. Methodology of work is based on the determination of fuel samples with elemental composition. There are carried out theoretical calculations of combustion characteristics based on elementary analysis. Hereby determined values are used for subsequent measurement by thermal emission gas analyzer GA-60. Thermal emission concentrations are assessed depending on the excess air coefficient and depend on time. Results of measurements are statistically evaluated by regression analysis.

The resulting values of the elemental and stoichiometric analysis show the different parameters of the individual examined biofuels samples. Large concentration of carbon dioxide emission was measured for wood waste sample, NOx concentrations with the highest values were measured for the wood waste, bark and lignite samples. Concentration of sulfur dioxide emission was large at sample of bark and lignite. When comparing the values of the efficiency of combustion devices depending on the time, you can generally say that biofuels burn less time and with higher efficiency of combustion than lignite. Similar combustion characteristics as lignite has bark sample.

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RAMAN MICROSCOPE AS A POWERFUL TOOL TO OBTAIN IMAGES OF SPATIAL DISTRIBUTION OF PLANT CELL WALL COMPONENTS

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The plant cell wall is a composite of many different natural polymers, mainly cellulose, xyloglucan, pectins and also lignin for secondary cell wall which is formed after cell growth. Proteins, lipids, enzymes, aromatic compounds and water are other components of this part of plant cell (Taiz & Zeiger, 2002). The plant cell is kind of a cellular skeleton that controls cell shape and determines the relationship between turgor pressure and cell volume.

Cellulose molecule is a linear polymer containing D-glucose residues linked by β-1,4 glycosidic bonds. Each cellulose molecule forms microfibrils – stiff, ordered structure, which is responsible for strength and resistance to degradation of this polymer.

Hemicelluloses are a group of polysaccharides with branched chains. The composition of hemicelluloses depends on the source: type of plant and plant tissue. Xyloglucan is the most abundant hemicellulose. Unlike cellulose it has short side chains that are made of monosaccharides. Hemicelluloses seem to form hydrogen bonds with cellulose microfibrils. In this way hemicelluloses create matrix which link microfibrils of cellulose.

Pectins are also a heterogeneous group of polysaccharides, whose backbone contains acidic sugars (ex. galacturonic acid) and sugars (ex. galactose, arabinose). Pectins are responsible for forming gels.

It is thought that the percentage of components of plant cell wall has an important influence on mechanical properties of fruits and vegetables. Therefore research on the content and spatial distribution of each component of this part of a cell is extremely important in the studies of the quality of fruits and vegetables (Agoda-Tandjawa et al., 2012).

So far many analytical and microscopic methods of investigation of plant cell wall have been developed. Nevertheless, none of these methods gives data relating to accurate distribution and amount of individual substances in micro-scale. Raman microspectroscopy can resolve this problem without the necessity of staining section of plant tissues.

In brief, Raman microscope is a connection of microscope and Raman spectroscope. It allows to collect spectra at each point of a sample. In this way a map of spatial distribution of sample's components can be obtained. This instrument allows to obtain “chemical” image of tissue and compare it with microscopic image. This instrument allows to obtain “chemical” image of tissue and compare it with microscopic image.

In this work I would like to discuss the methodology of measurement using Raman microscopy and present Raman images obtained for tomato tissue. Examples of distribution of main cell wall compounds will be depicted.

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ASSESSMENT OF RELEVANCE OF FUEL CONSUMPTION MEASUREMENT USING TELEMATICS

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The objective of the work was to verify whether the accuracy of fuel consumption data provided by CAN-Bus is sufficient enough for a common evaluation of operation at a farm. In fact, CAN-Bus fuel consumption data accuracy depends on tractor engine load. Based on the comparison of data about fuel consumption provided by telematic system JDLink and by the records on tanked amount of fuel, the accuracy proved to be sufficient enough in the case of a tractor used primarily for soil tillage operations.

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METHODS FOR LIPOPROTEIN ANALYSIS IN BLOOD SAMPLES OF EXPERIMENTAL ANIMALS

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Unhealthy lifestyle and overconsumption are the main causes of growing obesity and its complications such as diabetes type II, hyperlipidemia, hypertension, cardiovascular dieseases or nonalcoholic fatty liver disease. Lipoproteins contain protein and lipid complex, which enables hydrophobic lipids to be carried in the aqueous blood stream (Yang et al., 2012). There are several types of lipoproteins present in blood, including very low-density lipoproteins (VLDL), low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Lipid profile is a common use marker in different metabolic diseases. Low density lipoprotein (LDL) represents an emerging cardiovascular risk factor. Obese subjects are characterized by elevated LDL levels, triglycerides (TG) levels, very low density lipoprotein (VLDL) levels and apolipoprotein-B, as well as decreased high density lipoprotein cholesterol (HDL) levels (Nikolic et al., 2013). There are several competing methods for measurement of lipoprotein particle.

One of the method is a spectrophotometric assay for lipoprotein profile using a commercially available reagent. The principle of this method is based on the enzymatic hydrolysis. The color intensity is proportional to cholesterol fractions concentration. This method requires use a large amount of plasma samples (about 1 ml).

Another method using for measurement of lipoproteins is Fast Phase Liquid

Chromatography (FPLC). This is rapidly developed technique that has been validated for the isolation of lipoprotein from relative small samples volumes (about 10 l), the size-exclusion chromatography (SEC) separation and physiological mimetic elution condition assure the structure and component integrity of separated lipoprotein classes (Garber et al., 2000). It is an efficient, simple and sensitive method (Yang et al., 2012). FPLC allow to determine the lipoprotein and its lipid components. Additionally, this method permit to study the correlations between serum lipoprotein subclasses, lipid components and other factors, such as apolipoproteins and lipids metabolism associated enzymes, metabolism disorder related diseases (Weisner et al., 2009).

In conclusion, spectrophotometric method is simple, fast but require a large amount of plasma samples. In contrast, FPLC is time consuming, but provide a simple, sensitive, reliable and reproducible procedure for determination of serum lipoprotein and lipid profile from individual serum in micro-liter scale (Yang et al., 2012).

ISOTHERMAL CRYSTALLIZATION OF THE FAT PHASE OF A MODEL CHOCOLATE/HAZELNUT SPREAD

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Fat crystallization plays a very important role in the texture development of spreadable foodstuffs such as vegetable spreads, margarine and butter. During this process the liquid fat content of these products decreases while their viscosity increases at the same time. Fast and homogenous fat crystallization seems to be of utmost importance in case of particle–containing spreads because of the risk of particle “sedimentation” and oil separation. A very interesting example in this approach is the chocolate/hazelnut spread. In case of this type of spread there are present three kinds of solid particles (sugar, hazelnut and cocoa particles) and a relatively low amount of fat, which crystallizes partially over the time.

The aim of this preliminary work was to investigate the crystallization phenomenon of the fat phase of a model chocolate/hazelnut spread consisting of palm and hazelnut oil.

Pure palm oil and a fat blend containing 66% of palm oil and 33% of hazelnut oil were first melted at 70˚C to eliminate any thermal history. The samples were then cooled to the isothermal temperature (20˚C). The solid fat content was measured as a function of time using pulsed nuclear magnetic resonance (pNMR). Heat released during crystallization was registered with differential scanning calorimetry (DSC). The formation of fat crystals was observed using polarized light microscopy (PLM). Additionally the non-isothermal crystallization was examined and the melting profile was determined by DSC.

The fat phase of a model chocolate/hazelnut spread crystallized generally at a lower crystallization rate than the pure palm oil. Palm oil started to crystallize very rapidly and reached a solid fat content of ca. 10% after the first 16 minutes at the isothermal temperature. At the same time the respective value for the model fat blend was still close to zero. In both cases the continuous fat crystallization at a very slow rate was noticed after reaching the apparent plateau even after 7 hours of the isothermal time.

The presence of 33% hazelnut oil in this system significantly reduced the solid fat content. For example after 65 minutes of isothermal crystallization the solid fat content of the model fat blend was reduced by ca. half in comparison to the pure palm oil. In case of the palm oil it was observed that the nucleation and the crystal growth were generally two separate steps. On contrary in the case of model fat blend the fat crystals were growing while some new nuclei were still forming. As a result of this phenomenon the shape and size of these crystals were less homogeneous than in case of the pure palm oil. This behavior can be explained by a larger distances between nucleation sites in the model fat blend and a higher supersaturation levels at the beginning of the isothermal crystallization of the pure palm oil. In both cases the presence of high melting and low melting fractions was observed.

Crystallization of the chocolate/hazelnut spread fat phase at ambient temperature seems to be a crucial process during (at least) the first 65 minutes after pouring the spread into jars. It can be hypothesized that controlling the initial stages of the fat crystallization can make it possible e.g. to supplement some part of saturated fats in chocolate/hazelnut spread recipe with unsaturated ones without a significant deterioration of the final product. In future work the influence of particles present in this system on fat crystallization kinetics will be investigated.

VERSUS GRAVIMETRIC METHOD AND TDR METHOD IN CONDITIONS OF DIFFERENT TYPES OF WATER MANAGEMENT IN ALLUVIAL MEDIUM SOILS LOCATED IN THE ODRA VALLEY

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The paper presents an analysis and comparison of the results of moisture measurements in the alluvial medium soils located in the Odra valley. The purpose of the paper was the assessment of the accuracy of the values obtained TDR method in conditions of different types of soil water management. Monthly measurements were carried out using two methods: versus gravimetric method and the method of using the TDR probes. The analyzed results were obtained from field investigation from April to October in the years 2010-2012. Field investigation were conducted for two soil pits numbered 2 (located in Głoska - valley below the dam) and 5 (located in Warzyna - the area of the valley above the stage of fall in Brzeg Dolny). There are alluvial soils which consist of hard permeable formations in upper layer (to 1,0 m - medium sandy loam, clay loam) and in the deeper layers there are easy permeable formations (sand, loamy sand). They are located in the Odra valley which was divided into two zones with different effects of water levels in the river on water conditions in the adjacent area. Up the dam the valley area is additionally supplied by waters filtering from reservoir. In this area, there is confined groundwater surface, which is an average of 1.0 meters below the surface of the terrain. A different situation occurs below the dam in Brzeg Dolny where the valley is drained by river, the groundwater table is usually on depths 3,0-4,5 m below the surface

of the terrain. The correlation dependences between volume soil moisture measured TDR probe and versus gravimetric method are presented in the paper for two analyzed soil pits. The bigger correlation coefficients was reached for soil profile number 2, where soil is supplied only by precipitation. The correlation dependences in particular grain size group between TDR probe and versus gravimetric method soil moisture were also calculated.

FLUCTUATIONS IN FORMATION OF ACTIVATED SLUDGE PROTOZOA COMMUNITY CAUSED BY DIFFERENT LEVEL OF OXYGEN CONCENTRATION

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Sequencing Batch Reactors (SBR) used to wastewater purification by activated sludge method operated in laboratory scale, allow conducting experiments for the standard conditions but also doing tests which presents extreme situations. Thus, experiments make it possible for us to answer questions how to respond to difficult factors commonly affecting the process of wastewater treatment in a short time. Moreover, these conditions result in an interesting, from a scientific point of view, influence on active sludge or biofilm organisms (Głębicki et al., 2011; Jaromin & Łagód, 2011). There was a series of experiments conducted in the laboratory SBR bioreactor simulating various situations: 1. Aeration chamber. During the experiment, the first SBR chamber was constantly aerated (maintained a very high concentration of oxygen about 90% of saturation). 2. Mixing chamber. The second SBR chamber was devoid of aeration with compressed air and only mechanical mixing was conducted. It resulted in the persistence of the dissolved oxygen concentration of about 0.5 - 1 mg/dm^3. 3. Control chamber. The third SBR chamber was devoid of both the aeration and mechanical mixing. Activated sludge remained in conditions similar to anaerobic, and was mixed in a volume at the time of sampling for homogenization.

The concentrations of nitrogen as well as nitrites, nitrates, TOC and TC were systematically measured. The population of active sludge microorganisms was also studied. The number of protista representatives (ciliates, flagellates, testate and naked amoebas) and total number of specimens in morphological-functional groups were counted. Each of three series of conducted research for various process conditions was repeated tree times, and started from variable qualitative and quantitative characteristics of the activated sludge. The samples of activated sludge for microscopic analysis were taken at external recirculation channel in “Hajdow” WWTP. Counting of protozoa organisms were followed immediately after collecting sludge samples from the SBR chambers. Counts were conducted at least in triplicate and the sub-samples were analyzed for volume of 50 microliters (total 150 microliter). Five or seven repetitions were performed in cases when there was a significant decrease in the number of organisms in

a sample. After counting the number of protozoa species representatives were calculated per one ml. During the experiment, the system was not supplied with raw wastewater. Notwithstanding, the responses of individual morphological-functional groups and species included in the study groups on these factors are different, which is reflected in the positive or negative relationship (Łagód et al., 2012).

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MECHANICAL BEHAVIOUR OF SOME OILSEED CROPS UNDER COMPRESSION LOADING

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Recently, oilseed crops have gained special attention due to their non-food purposes such as biodiesel production (Gupta and Das 2000; Izli et al., 2009; Pereyra-Irujo et al., 2009). The mechanical pressing involving the use of a screw press is the most common method of oil extraction in the world (Mrema and McNulty, 1985). However, mechanical presses seldom exceed 80 % compared to solvent extraction method which is capable of achieving over 98 % (Bargale et al., 2000). To improve the performance of mechanical presses, knowledge of the mechanical properties and deformation characteristics of oilseeds crops is relevant. In this respect, the mechanical behaviour of oilseed crops such as jatropha, sunflower and rapeseed were tested using the pressing vessel diameters 40, 60, 80 and 100 mm and a compressive device ZDM 50-2313/56/18. A maximum force of 100 kN with a velocity of 1 mm s^{-1} was used to compress the seeds of jatropha, sunflower and rape measured at pressing height 20, 30, 40, 50, 60, 70 and 80 mm in each of the pressing diameters. The deformation characteristics as well as the deformation energy (J), deformation (mm) and hardness ($N.mm^{-1}$) of the selected oilseed crops were compared respectively. In terms of deformation characteristic curve, jatropha seeds exhibited a smooth characteristic curve in all pressing diameters with respect to their pressing seed heights. A “wave-like” effect was seen in diameters 40 and 60 mm for rapeseed. For sunflower seeds, only the diameter 40 mm showed this characteristic behaviour. The characteristic curve of diameters 80 and 100 mm of both sunflower and rapeseed was similar to that of jatropha seeds. The relationship between the deformation and pressing vessel diameter in relation to the seed pressing heights of jatropha, sunflower and rapeseed showed a negative correlation whiles that of deformation energy and pressing vessel diameter indicated a positive correlation. The seed hardness for all

pressing vessel diameters decreased with respect to seed pressing heights. The study showed that the seed size and size of pressing diameter have effect on the force-deformation characteristic curve.

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EVALUATION OF IMAGE ANALYSIS TOOLS FOR CHARACTERIZATION OF CRUMB COLOUR IN BREAD OBTAINED FROM NEW TRITICALE STRAINS

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Bread colour quality is affected by several factors but essentially depending on wheat genotype. The aim of the present research was examination of bread-making quality of varieties and new strains of winter triticale. Grain of 2 strains of triticale were assessed, together with wheat and triticale standards and were milled in the experimental mill. The wheat single phase method was used for bread baking. Bread were sliced transversely to obtain 15-mm thick slices. Slices of loaf were scanned using a flatbed LED light source scanner Perfection V500 Photo Scanner. Image was analysed using the software ImageJ ver. 1.46.

Bread colour heavily depends on its cellular structure. For the breads studies here, a very significant pore size distribution exists and pore size cover the large range of surface. The commercial colorimeters measure non-representative areas of a few square centimetres and cannot provide comprehensive information close to perception of colour. The H (hue), S (saturation) and B (brightness) colour values were determined on slices of loaf using a HunterLab spectrocolorimeter on 18mm diameter surface. The digital image analysis allows the obtaining colour values for each pixel of slice.

Image segmentation classifies monochrome digital images of bread-crumb slices into cells and background, generally based on either similarity of grey level values (thresholding) or discontinuity. Thresholding is common applications in analysis of bread-crumb slices and assumes that the object and background pixels can be distinguished by selection of an optimal grey level value – that uses the contrast between the two phases – pores and solid part. Therefore selection grey level value will be critical to computation of bread-crumb colour. Other method – Find Maxima within Tolerance – a plugin of ImageJ determines the local maxima in an image and creates a binary

(mask-like) all points within the noise tolerance (particles) for each maximum. Analyse Particles – a plugin measures objects in binary image and defines the regions of interest (ROI) representing areas of the particles. All images were acquired in the RGB space so conversion was carried out to obtain HSB values for each pixel.

Finally, colour analysis is only performed on the ROI selections in HSB image-channels obtained for all baked samples. This procedure can be advantageous in case since the whole surface of bread slices could be analysed and being not biased by the presence of large pores in the bread crumb. Crumb colour in breads of the examined strains of triticale showed significant differences - higher S and B values means higher yellow pigment content. The obtained results have shown that triticale can be a precious raw material for baking and has the potential to introduce valuable economic and environmental benefits to grain production systems.

THE HSA INFLUENCE ON GLYCATION OF THE FIBRINOGEN

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Glycation (Maillard reaction) is a non-enzymatic reaction which occurs between reducing sugars and free amino groups at the N-terminus or on lysyl/arginine side chains. This reaction has three stages. In the first step Amadori product is formed (Hodge & Rist, 1953). The second stage is the generation of different reactive intermediate products. Finally, a series of rearrangements lead to the formation of a heterogeneous group of substances, called advanced glycation end products (AGEs) (Cho et al., 2007).

In our research we examined the first step of this reaction for fibrinogen. Fibrinogen is a high molecular weight (341000 Da), dimeric glycoprotein found in the blood of vertebrates, where it plays a critical role in the coagulation system (Doolitte, 2007).

Although in vivo glycation proceeds in complex mixture of proteins, previous studies did not take in consideration the influence of protein- protein interaction on Maillard reaction. The aim of our study was to test the influence of human serum albumin (HSA) on glycation of fibrinogen. The isotopic labeling (using [$^{12}C_6$]- and [$^{13}C_6$]-D-glucose) and liquid chromatography coupled with mass spectrometry (LC-MS) were used as tool for identification possible glycation sites (Stefanowicz et al., 2010; Kielmas et al., 2012) in fibrinogen and for evaluation the effect of HSA on the glycation level of selected amino acids in fibrinogen.

The obtained data indicate that the addition of HSA protects the fibrinogen from glycation. The level of glycation in presence of HSA is reduced by 30-60 % and depends on the location of glycated residue in sequence of protein.

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ANALYSIS OF HEAT TRANSFER PROCESS IN THERMAL COLLECTORS

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The role of convection and conduction heat transfer in the performance of solar systems is obvious. Radiation heat transfer plays an important role in bringing solar energy to earth, but it is not so manifest that radiation heat transfer plays a significant role in the operation of solar collectors. The calculation of the heat loss can be very complicated, because of the variant components. Usually in practice radiation heat transfer is often negligible (Duffie and Beckman, 1991). In a thermal collector flux of the solar energy is large-scale smaller than in conventional heat transfer equipment. In addition to required preciseness, one must be taken to account available accuracy.

Emissivity of the absorber plate is specially characterized by the selective coatings where emissivity may have fluctuating between 10-50% (Spuckler & Siegel, 1992). This value is depending on the type and manufacture of the coating. It is difficult to anticipate the convective heat transfer with better than 20% accuracy. In solar collectors the heat is extracted by the heat transfer fluid, which flowing through the tubes (Shah and Furbo, 2007). In this paper the heat flow from the absorber to fluid through the tube wall is analyzed. Usually the conductance of the absorber and tube wall material has good thermal conductivity, but it has to be taken to the account in a correct model. The heat flow from wall to fluid occurs by convection and is described by the convective coefficient. Even though the achievable overall accuracy of a heat loss calculation may be quite low, there are situations where one would like to model certain details with much greater preciseness.

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Acknowledgement: The research was carried out with the support of the OTKA K84150 project.

SURFACTANTS AND BIOSURFACTANTS IN AGRICULTURE – COMPARISON

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Surfactants are amphiphilic molecules containing both a hydrophilic and hydrophobic domain; therefore, they are soluble in both water and oil. The polar component of surfactants can be ionic (anionic, cationic or zwitterionic) or non-ionic (with no charge groups). The non-polar part frequently consists of one or more hydrocarbon chains, which can be branched, linear or aromatic. Surfactants are able to increase aqueous solubility of non-aqueous phase liquids (NAPLS) by decreasing surface and interfacial tension at the interfaces between liquids, solids, and gases and they can increase mobility, bioavailability, and subsequent biodegradation of hydrophobic or insoluble organic compounds. Moreover, they exhibit excellent detergency, dispersant wetting, and emulsifying and foaming chemical activity. The extreme value of these physicochemical properties is reached at a surfactant concentration called Critical Micelle Concentration (CMC), above which the molecules are associated, thereby forming aggregates (micelles). The shape and size of a micelle depends of the molecular geometry of surfactant molecules and conditions of solution (surfactant concentration, pH, or ionic strength) as well as temperature and pressure (Holmberg et al., 2003).

Synthetic surfactants can be environmentally hazardous due to their toxicity and non-biodegradability. Surfactants may be bio-accumulated. Their production processes and by-products can lead to an increase in environmental pollution.

Biosurfactants are a type of surfactants. They are a group of surface-active substances synthesized by some living cells. They have similar properties to classical surfactants, but they are biodegradable, effective at extreme temperatures or pH, and exhibit low toxicity to the environment. They are possible alternatives to classical surfactants (Zajic & Seffens, 1984).

The potential agricultural applications of biosurfactants and surfactants are mainly based on the process of enhanced bioremediation (e.g. removal of hydrocarbon and heavy metals). In consequence, the use of these substances leads to improvement of soil quality (Paria, 2008). They can replace more toxic surfactants used as adjuvants in pesticide industries. Some surfactants can improve foliar activity of herbicide droplets (by decreasing surface tension and the contact angle and increasing the leaf surface) as well as reduce the amount of herbicide required to obtain weed control. Moreover, several biosurfactants have antimicrobial activity against plant pathogens (Sachdev & Cameotra, 2013).

The aim of the work is general comparison of classical surfactants and biosurfactants in the aspect of their use in agriculture.

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ABIOTIC STRESSES: DROUGHT AND HIGH TEMPERATURE

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During their lifetime plants are affected by numerous negative factors both biotic and abiotic. Intense stresses may lead to extinction of varieties, species and even entire populations of plants. The term of stress refers to factors that inhibit plants growth thus reduce the yield of crop. The two most important environmental factors which influence many physiological processes are drought and heat stress. Water stress (drought) and high temperature of soil as well as air significantly affect plant growth and water management**.** It should be noted that both kinds of stress often occur together. The combination of drought and heat - the major stress combination affect plant photosynthesis more drastically than drought or heat stress alone.

Drought in agriculture occurs when the amount of water available to the plant is less than what is required to sustain maximum growth and productivity. According to the UN report one third of humanity lives in areas with poor water resources. Droughts can greatly affect the growth and development of plants. Water stress induces various plant reactions depending on the species its stage of development and the intensity and duration of stress. Predisposition of plants to maintain a high water potential in the tissues is a measure of drought avoidance. On the other hand tolerance of water deficit by plants consists in keeping the physiological, morphological, and biochemical functions at low water potential. Morphological changes that occur during plants water stress may be associated with the change of phytohormones concentration.

The important factor in the expected climate changes are more frequent periods of time with elevated temperatures which can indirectly or directly affect agriculture. The effects of the increased temperatures can have both a positive and a negative impact on the cultivation of plants. The positive effects include lengthening of the growing season. The negative impact of high temperature appear in chlorophyll content decrease, increase in amylolytic activity and disintegration of thylakoid gran. In moderate climates exposing plants to a temperature higher than 35°C leads to alteration of metabolic processes as well as irreversible damage, such as wilting.

Acknowledgement: The results were obtained within an international research project named: “FACCE MACSUR Modelling European Agriculture with Climate Change for Food Security”. We gratefully acknowledge financial support from the National Centre for Research and Development in Poland.

MICROBIAL METABOLIC ACTIVITY IN POSTHARVEST SOIL AMENDED WITH DAIRY SEWAGE SLUDGE

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Microorganisms provide useful information about soil environment. Microbes very quickly react to environmental and anthropogenic changes. Agricultural managements, like organic fertilization can affect the structure and metabolic activity of microbial communities. Agricultural sewage sludge utilization is an ecologically friendly and reasonable approach providing economic benefits. This way of sludge management is crucial due to current poor soil quality and increasing amount of industrial organic waste.

The aim of the presented study was to evaluate the influence of dairy sewage sludge on microbial metabolic activity in postharvest soil.

The experiment was carried out under field conditions. The dairy sewage sludge was introduced to the soil plots before sowing spring wheat at two rates of 9.0 Mg dry mass ha^{-1} and 4.5 dry mass ha^{-1}. Soil samples of control plots and treatments amended with dairy sewage sludge were collected after harvesting from two soil layers 0-20 cm and 20-40 cm.

In this study CLPP *Community Level Physiological Profiling* method was used. It is based on the ability of microorganisms to utilize a specific set of carbon compounds as a source of energy. Biolog EcoPlates containing 31 carbon sources for soil community analysis were used. During 96-well plates incubation at a constant temperature soil microorganisms utilize substrates in the plate wells and simultaneously reduce tetrazolium dye. This reaction is connected with color development measured spectrophotometrically.

The biological activity measured as AWCD - Average Well Color Development showed significant differences between microbial communities of two soil layers. There was observed a trend in AWCD development with increasing amount of applied sludge. The Shannon-Weaver index of microbial functional diversity and the richness of substrate utilization obtained at 120 h readings were similar for almost all treatments. The analysis of 5 groups substrates utilization (polymers, carbohydrates, carboxylic & acetic acids, amino acids and amides/amines) revealed a slight impact of dairy sewage sludge on the metabolic activity of microorganisms in top soil. Substantial differences were observed for lower layer where dairy sewage sludge stimulated polymers and carbohydrates utilization.

Microbial communities from lower layer showed a significantly higher functional diversity and metabolic activity due to organic fertilization compared to control soil. Addition of sewage sludge can have a minor impact on top layer microorganisms because of other important organic matter sources in postharvest soils (roots, plant residues), whereas lower layer is deprived to a large extent of organic matter influx with vegetation.

CHANGES IN THE MORPHOLOGY OF *CANDIDA ALBICANS* CELLS AFTER THE ACTION OF *PELARGONIUM ZONALE* EXTRACT

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Candida albicans is a commensal fungus, which occurs naturally in 30% of human population. Under appropriate conditions, like immunosuppression or antibiotic treatment, it can cause serious infections. In recent years, the frequency of infections caused by *C. albicans* has been increasing. The rapid development of medicine made *Candida* yeasts become a major clinical problem. Intensity of drug resistance phenomenon forced researchers to design new antifungal therapies.

Studies of *Pelargonium* indicated its antibacterial, antifungal and antitumor properties. It is noteworthy that *Pelargonium* shows antifungal properties against *Candida albicans*. There are some data on the antifungal action of the root and leaves extracts but there is no information about the action of extracts from the plant stalks.

The aim of this study was to analyze anti-Candida activity of *Pelargonium* extract derived from the flower stalks.

In this study a wild strain of *Candida albicans* was used. The reference strain *Candida albicans* ATCC 1023 was obtained from the Medical University in Lublin. *Pelargonium zonale* was used as a plant material.

The *Pelargonium zonale* extract was prepared in Sörensen buffer (pH 6.4), after the mechanical disintegration of flower stalks. Transmission electron microscopy was used to analyze changes in the morphology and ultrastructure of *Candida albicans* cells treated with the extract of *Pelargonium* flower stalks.

After the action of *Pelargonium zonale* stalks extract, *Candida albicans* cells were swollen and deformed. Disturbances of fungal cell division were observed. During the budding process cells formed several buds simultaneously. The cells were sticking together and formed agglomerates. Formation of chains consisting of several non-separated cells was observed.

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EFFECT OF CALCIUM CHLORIDE CONCENTRATION ON CROSSLINKING OF SODIUM ALGINATE

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Alginates are powdered cell walls of seaweeds. Most large brown seaweeds are potential sources of alginates. Sodium alginates can be used for production of microcapsules. Microcapsules are tiny vessels designed to release their content in suitable conditions. They possess a simple structure in which a liquid or solid material called "core material" is encapsulated with a membranous material. Although their size is not clearly specified, microcapsules ranging from 5 to 300 μm are generally used.

The aim of this study was to characterize the effect of the calcium chloride concentration on crosslinking of sodium alginate and its influence on the diffusion phenomena.

Two types of sodium alginate (G39 and G63), calcium chloride, and methyl red were used for the investigations. The study included measurements of deformation of alginate capsules and measurements of dye diffusion from the capsules.

Dye diffusion decreases with the increasing concentration of calcium chloride (in the range of 1-3%) for both types of alginates. This is due to the presence of a bigger number of clusters filled by calcium ions, which leads to reduction of pores through which the dye can diffuse.

The level of deformation of alginate capsules made of alginate G63 is lower than in the case of alginate G39, because alginate G63 has a larger number of cluster structure domains that are organized by a greater amount of Ca^{2+} ions, which are responsible for gelation.

The investigations have shown that dye diffusion decreases with the increasing concentration of calcium chloride. The studies have shown that alginate capsules made of alginate G63 form more resistant structures, which is caused by a higher content of cluster structures.

COMPUTER-AIDED IMAGE ANALYSIS OF AFM HEIGHT IMAGES OF PECTIC FRACTIONS

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The outermost structure of a plant cells is primary cell wall, which maintains strength, flexibility and determines the shape of a cell. Pectins, beside cellulose, hemicellulose and structural proteins, are general compounds forming the primary cell wall. Pectins are also present, as the main component, in the middle lamella which cement adjacent cells. Pectic polysaccharides form hydrated gel in which cellulose-hemicellulose network is embedded. This feature of pectins make of them a matrix polysaccharides. They play a role of the hydrophilic filler, which prevents aggregation and collapse of the internal structure of the cell wall. Pectins constitute a heterogeneous group of polysaccharides.

Some pectic polysaccharides have a relatively simple structure, such as a homogalacturonan. The homogalacturonan backbone is composed of α-1,4'-linked-D-galacturonic acid residues in which some of the carbonyl groups are methyl esterified. It may be covalently cross-links to rhamnogalacturonan I, which has a long backbone and a variety of side chains. Another compound, rhamnogalacturonan II, is highly branched. These pectic polysaccharides are very complex. The group of pectins also includes apiogalacturonan and xylogalacturonan. The fine structure of the pectic polysaccharides governs the biological role of these molecules within the cell wall. Pectin metabolism during fruit ripening is one of the most important process which lead to a reduction firmness and changing a texture in fruit. A comprehension of the relationship between pectin structure and texture is important in the food science. In the experiment the changes of structure of pectins from carrot, during storage in the cold store, were observed. Pectins obtained from three fractions: water-soluble, CDTA-soluble and Na_2CO_3-soluble by means of the atomic force microscope (AFM) were visualized. Measurements were made for 4 terms of the carrot storage. The AFM height imaging and analysis of results by the computer application of image analysis SPIP (Image Metrology, Denmark) were performed. Using a sequence of basic operations in SPIP, pectic fibers and oval shaped elements (in the water-soluble fraction), were extracted and geometrical parameters of them were determined. Values of length, width and area of pectins were obtained. The AFM imagining showed reduction in pectins size as a result of the natural enzymatic activity. This study concentrated on the computer image analysis of height images by AFM which were obtained and the presentation of results without far-reaching conclusions.

Acknowledgement: This work was supported by the Polish national budget for Science 2011-2012 (Project number IP2011 007871).

CHLOROPHYLL MEASUREMENT WITH KONICA MINOLTA SPAD - 502

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The SPAD analysis is a very helpful tool for analysing the chlorophyll content in plants. The chlorophyll meter SPAD 502 measures the absorbance of the leaf in two wavelength regions - the red and near-infrared. These two transmittances are used to calculate a SPAD value which is proportional to the total amount of chlorophyll in the leaf (Markwell et al., 1995). It is not as accurate as the organic extraction method, but it allows for non damaging control of chlorophyll content. This analysis can be used for example for determining the periods of increased need for nitrogen, general health of plants treated with different chemical factors (i.e. heavy metals), comparing the nitrogen usage from different types of fertilizer. Percival et al. (2008) confirmed that higher leaf nitrogen content had a strong correlation with higher chlorophyll concentration.

The purpose of this paper is to show the potential of SPAD analysis in determining the influence of different nitrogen fertilizers and different levels of fertilization on the chlorophyll content with the example of a wheat cultivar "Monsun".

The research was conducted in a two-factor field experiment. The first factor of the and European Beech (Fagus sulvatica). Arboriculture & Urban Forestry 34, 89-100.

experiment was the type of used fertilizer (Sulfamo 30 and Ammonium Nitrate). The second factor used in the experiment was the level of nitrogen fertilization(0, 40, 80, 120). The experiment was led in a split-plot with four repetitions The amount of chlorophyll was measured with the Konica Minolta chlorophyll meter SPAD 502. The measurements were taken from the flag leaf in 10 replications from which the mean value was derived. Variance analysis was applied to the results. Homogenous groups were created with the use of Tuckey test.

The analysis shows that the plants which were fertilized with sulfamo 30 had significantly higher chlorophyll content than the plants that were fertilized with ammonium nitrate. Also the higher level of nitrogen fertilization had a positive correlation with the chlorophyll content. The gathered results and known research show that the Konica Minolta chlorophyll meter SPAD 502 is a useful tool for determining the influence of different factors on the chlorophyll content in plant leaves in controlled experiments and has potential use in field practice.

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PROBLEMS AND FORECAST ABOUT DEVELOPING RENEWABLE ENERGY IN POLAND

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In the 20th century industrial processes increased rapidly. The main problem that occurred during the process of industrialization was the higher level of environment pollution and green house gasses emitted to the atmosphere during fuel combustion (1). The factors that are responsible for the green house effect are methane, carbon dioxide and nitrous oxide. The pollution and green house effect are not the only problems. Future forecasts warn us that in the near future our civilization will have to face the problem of energy shortage (2). Because of the above problems modern countries started looking for and developing renewable sources of power. Poland is the country with a significant sector of agriculture, which is the main advantage for biofuels production (3). One of the main problems is the lack of legal regulations in Poland concerning renewable energy sources. It is necessary to start expansion of green energy farms. European Union law regulations established higher levels of green energy in the near future. These regulations made the Polish government increase the percentage of renewable energy sources in the total amount of energy produced in Poland. Up till 2010 the aim to achieve was 7,5%, but till 2020 it will be 15% (4). The most common green energy available at present are wind energy, solar energy (photovoltaic system) and biofuels (biomethanol, biodiesel, biogas). Biofuels are most common for the whole of Poland's territory because of large possibilities of biomass production, high level of solarization and good wind

conditions. Wind and solar energy are possible to use and efficient only for some chosen regions of the country. The best place for wind farms are north and north-east regions of Poland (Kujawy, Pomorze and Podlasie) (5). For photovoltaic installation the best regions are central and southern parts of Poland (2). The divergence of green energy farms in Poland is another important issue. Multiple sources of energy can ensure energetic safety in case of a natural disaster or lack of one of them. The estimation of potential renewable energy in Poland is about 25 GW, which is four times more than it was gained in 2010(2). The most significant ones are: solar energy – 11,7 GW, biomass – 5 GW, heat inside earth – 3,2 GW, wood biomass – 3 GW, water gradient power – 1,4 GW, biofuels – 0,5 GW and wind power – 0,2 GW (6). There are also many other problems that can occur while implementing green energy such as a long time to get necessary permissions or inability of the energetic network to receive large amounts of scattered electric energy.

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MICROALGAE CULTIVATION UNDER VARIOUS CONCENTRATIONS OF CARBON DIOXIDE AND ITS INFLUENCE ON GROWTH AND BIOMASS CHARACTERISTICS

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World's energy demand has been constantly increasing for decades. Yet, fossil fuels stock, which are used most extensively nowadays, may be depleted soon. Moreover, combustion of conventional fuels leads to excessive carbon dioxide emission. This process causes multitude of unfavourable consequences for Earth's climate and biosphere. To reduce dependence on fossil fuels and to reduce climate change, there is a need to make a switch to alternative, renewable energy system. Among renewable energy sources like sun, wind, hydroelectric and nuclear energy, biomass is a very promising source of bioenergy. Currently, scientists all over the world are examining the possibilities of using microalgae as a source of biomass. Microalgae are predominantly single cell photoautotrophic organisms that have the ability to proliferate rapidly and absorb significant amount of carbon dioxide at the same time. That is why it is believed that microalgae could be able to grow under flue gases which contain up to 15% CO_2.

The aim of the experiment was to analyse the ability of microalgae to grow under increased carbon dioxide concentration. Microalgae species *Chlorella vulgaris* was cultivated under optimal environmental conditions (light, temperature) on mineral medium and under two different concentrations of carbon dioxide – the first sample (sample 1) under 0.03% CO_2 (atmospheric air) and the other one (sample 2) under 5.20% CO_2. Higher concentrations were not chosen because they could lower the pH of the culture to an undesirable level. The calibration function as a trend line indicating the relationship of light absorption at 680 nm to varying dry algal biomass concentration (g-DM l^{-1}) was defined. Algae cultivated under 5.20% CO_2 grew considerably faster than those cultivated under 0.03% CO_2. Exponential growth phase of sample 2 finished on 8th day of cultivation while of sample 1, on 22nd day. The maximal density of the cultures in both samples was approximately 0.90 g-DM l^{-1} but it was achieved much earlier in sample 2.

Analyses of biomass characteristics included determination of organic dry mass, ash, total nitrogen (TN), ammoniacal nitrogen (NH_4-N), protein and lipid content.

The results prove that it is possible and favourable to grow microalgae under increased carbon dioxide concentrations. The growth rate is manifold higher in comparison to culture sparged with atmospheric air. Even lower lipid content and heat of combustion could be compensated by such high growth rate.

BIOLOGICAL PRETREATMENT OF LIGNOCELLULOSIC BIOMASS AS AN INNOVATIVE TECHNOLOGY FOR THE PROCESS OF ANAEROBIC DIGESTION

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The aim of this paper is to review promising pre-treatment technologies and to discuss new developments which have greatly improved the production of biofuels. Lignocellulosic biomass includes a number of agriculture residues, coniferous and deciduous woods, waste from pulp and paper industry, municipal solid wastes and herbaceous energy crops. The composition of lignocellulosic biomasses is different, but the main component is cellulose 35-50%, hemicelluloses 20-35% and lignin 10-25%. Overcoming the resistance of plant cell walls to deconstruction of lignocellulosic biomass is a key step in the production of fuels. The recalcitrance is due to the highly crystalline structure of cellulose which is embedded in a matrix of polymers-lignin and hemicellulose. The major purpose of pre-treatment is to overcome this recalcitrance, to separate the cellulose from the matrix polymers, and to make it more accessible for enzymatic hydrolysis. Recent findings have shown that pre-treatment can improve biogas yields to higher than 90% theoretical yield for biomass such as wood, grasses, and corn (Brodeur et al. 2011).

Pre-treatment of lignocellulosic biomass can be performed by physical, mechanical, chemical, and biological methods. Physical/mechanical pre-treatments are based on milling, irradiation, and hydrothermal treatments. Examples of chemical pre-treatments are alkali and acid treatments. Physical/mechanical and chemical pre-treatments are most studied. They effectively reduce biomass recalcitrance in a short time and are thus, attractive for industrial application. These pre-treatments increase accessible surface area and decrease lignin contents and cellulose crystallinity. They also decrease the

degree of polymerization, and sometimes, partially or completely hydrolyze hemicelluloses. However, typical chemical and physical/mechanical pre-treatments require high-energy, and/or corrosion-resistant high-pressure reactors as well as extensive washing, which increases the cost of pre-treatment. Moreover, chemical pre-treatments may produce toxic substances, interfering with the anaerobic fermentation, in addition to producing wastewater that needs treatment prior to its release to the environment. In view of these facts, biological pre-treatment has attracted interest because of its potential advantages over physical and chemical pre-treatments such as: lower energy requirements, greater substrate and reaction specificity and higher yields of desired products (Shi et al. 2008). Compared to physical and chemical pre-treatment methods, biological methods have been less investigated. One possible reason for this could be slow rates of the pre-treatments, which makes the biological method industrially unattractive. Another disadvantage of biological pre-treatment is the potential carbohydrate loss because of cellulose and hemicelluloses degradation. On the other hand, biomass pre-treatment is a global issue that demands an environmentally- friendly process. Thus, interest has been directed towards a biological method, and recent studies show interest in this topic (Yu et al. 2009).

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STUDIES ON BIOCHAR STABILITY THROUGH ISOTOPIC MEASUREMENTS

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Biochar is a stable substance, which enables carbon storage in the soil for a long time and therefore provides a long-lived carbon sink (Lehmann & Joseph 2009). Mineralisation to CO_2 may however occur, as for every carbon pool on Earth, due to the char composition and ambient conditions. Therefore it is important to have some insight into the stability of its carbon structure and the possible decay processes in the soil.

Within this project we aim to investigate the decay of biochar upon its usage on cultivated fields: in particular, the decay kinetics (lifetime, number of steps, total matter loss), the effect of structure and of environmental factors (*e.g.* temperature).

The main questions to be tackled are: How long does biochar retain carbon in the soil – and so contribute to CO_2 sequestration? How long does it retain nutrients in the soil?

The mineralisation is tracked measuring the concentration and isotopic signature ($\delta^{13}C$) of the emitted carbon dioxide from several soil/char mixtures for two years. The experiments are performed both in the lab, under controlled conditions, and on a

cultivated field. The procedure of gas emissions measurements is well established (Hellebrand et al. 2003; Zimmerman 2010) and the quantification of the isotopic signature of specific carbon pools / fluxes has shown to be successful to determine the source of organic and inorganic carbon (Glaser 2005; Werner et al. 2011). In our case, the separation of the flux due to biochar from the background is achieved through the usage of a cavity ring-down spectrometer (Bai et al. 2011) in combination with a natural isotopic labelling of the biochar. This method will allow ultimately to investigate the longevity of biochar and its suitability for greenhouse gas sequestration and soil enrichment.

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BASIC SYMMETRY PROPERTIES OF SURFACE WAVES AT CONVECTION-DIFFUSION PROCESSES THROUGH POROUS MEDIA

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The partial differential equations describing surface gravity waves, turbulent flow within frame of the Landau-Hopf theory, as well as simultaneous convection and diffusion through porous media are discussed in detail, particularly from the point of view of their general nonlinear character.

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 may be treated in a refined manner, by taking into account the genuine dispersive character of the porous bulk.

Some further possible applications of its in the turbulent flow theory are also indicated on base of the representations of Möbius-type groups.

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

PECTINOLYTIC ENZYMES MECHANISMS: CHANGES IN PECTIN STRUCTURE DURING POSTHARVEST RIPENING OF CARROT

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Pectins are the heterogeneous group of polysaccharides and they are presented as the components of cell walls and middle lamella of higher plants. Pectins are a class of polysaccharides, which are rich in galacturonic acid. Generally, pectins consist of three pectic polymers: homogalacturonan (HG), rhamnogalacturonan I (RG-I) and rhamnogalacturonan II (RG-II). There are three main fractions of pectin substances classified according to their solubility in water: water soluble pectin (WSP), chelates soluble pectins (CSP) and diluted alkali soluble pectins (DASP).

Pectinolytic enzymes (pectinases) cause degradation of the pectins presented in middle lamella and primary cell walls of plant tissues. There are three major classes of pectin degrading enzymes present in nature: pectin methyleserases, polygalacturonases and lysases.

Pectin methylesterase (PME) is one of the most abundant pectinases that act on the pectin fraction of the cell walls of plants. PME catalyses the specific hydrolysis of the methyl-esther group at the C-6 carboxyl of galacturonic acid in pectin chains.

Polygalacturonase (PG) is the second major enzyme that acts on the pectin fraction of the cell wall. PG catalyzes the hydrolytic cleavage of α(1→4) galacturonan linkages of pectin introducing water across the oxygen bridge.

The comprehensive study of the properties of the cell-wall modifying enzymes included also the action of β-galactosidase (β-Gal) and α-L-arabinofuranosidase (α-L-Af). These enzymes are responsible for removing galactosyl and arabinosyl residues from cell wall polysaccharides.

The objective of this study is to examine changes in enzyme activity and biochemical properties of carrot during their ripening and storage. During the whole storage period the activity of PG, β-Gal and α-Af increased, whereas the activity of PME persisted at the constant level with a small decrease. The total pectin content which is connected with galacturonic acid content increased by varying degrees with increasing storage time. WSP visibly increased during the storage, while CSP and DASP tend to increase with small oscillations.

Acknowledgement: This work was supported by the Polish national budget for Science 2010-2011 (Project number IP2011 007871).

INTERPRETING IMPEDANCE SPECTROSCOPY MEASUREMENTS USING EQUIVALENT ELECTRICAL CIRCUITS

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Impedance spectroscopy (IS) is an experimental technique based on recording changes of the impedance of the investigated system which result from frequency variations of an applied voltage (Barsoukov & Macdonald, 2005). The method is widely used in electrochemical measurements to characterize the structure of electrode surfaces, investigate mechanisms of electrochemical reactions and various processes such as adsorption or diffusion taking place in the system, as well as to control the quality of metal surfaces, batteries and fuel cells. Moreover, because IS is non-invasive it is being employed in biophysical, pharmacological and geophysical analyses. The long-term aim of our research is to extend its applicability to testing the quality of materials of natural origin by investigating their composition with special emphasis on artificial additives.

The most straightforward way of interpreting the IS result is to construct an equivalent electrical circuit (EEC), whose impedance spectrum is the same as the one obtained during the experiment (Harrington & van den Driessche, 2011). Although the EEC's interpretation is usually ambiguous, in some cases its structure may suggest what kinds of phenomena or processes occur in the corresponding electrochemical system (Macdonald, 2006). Possible constituents of EECs along with their physicochemical interpretations and certain rules governing the construction of the circuits will be described. Additionally, a set of various EECs each of which has direct physical interpretation will be presented.

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Acknowledgements: The research was supported by the National Centre for Research and Development (NCBR) grant No. PBS1/A9/12/2012.

CARBON DIOXIDE UTILISATION BY MICROALGAE *CHLORELLA VULGARIS* AND *CHLAMYDOMONAS REINHARDTII*

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Carbon dioxide being consumed by phototrophic organisms is converted into biomass. Microalgae which have short generation time and do not have high medium requirements are most useful for CO_2 capture. Algal biomass generated due to consumption of carbon dioxide can be used to produce biofuel, biodiesel, biomathane, biohydrogen, and other valuable compounds such as alcohols and alkanes, therefore additional profits are gained.

Our research area covers carbon dioxide removal by the use of microalgae. The desired application is to utilize carbon dioxide from biogas which would increase calorific value of biogas.

In our research we compared two microalgae species: *Chlorella vulgaris* and *Chlamydomons reinhardtii* to assess its potential application in CO_2 utilization. The microalgae were cultivated with initial carbon dioxide concentration up to 18% of CO_2 in air, both in stationary and in continuous culture. CO2 concentration in gas was measured by gas chromatography (Agilent Technologies, 7890A GC System, detector TCD).

Based on calculations and observation we can conclude that:
In *Chlamydomonas reinhardtii* stationary culture assimilated carbon dioxide faster than the compared species *C. vulgaris*

1. *Chlorella vulgaris* showed a similar increase in both the medium in salt water and fresh water.
2. 18% of carbon dioxide in the gas has no toxic effect on the culture of algae.
3. Biomass growth is correlated with loss of nitrate and increasing the pH.
4. Nitrate is a required component of the culture of *Chlorella vulgaris*.
5. The pH increase is not caused by ammonium ions.

THE INFLUENCE OF MUNICIPAL WASTEWATER IRRIGATION ON CHANGES IN SPECIFIC SURFACE AREA OF ORGANIC SOILS

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Soil irrigation with municipal wastewater could have a great economic importance. It is related to the properties of wastewater which may have a positive effect on the quality of soil. However, improper use can result in damaging soil environment including its surface properties. The specific surface area can be used as one of the parameters describing the physicochemical changes during the irrigation and help in understanding processes which lead to those changes.

In this work we would like to present the studies of water vapour adsorption on several samples of organic soils irrigated with municipal wastewater. The study was conducted on peat-muck samples taken from depths of 5 to 10, 5 to 15 and 5 to 25 cm, located at

Hajdow Research Station near Wastewater Treatment Plant of the city of Lublin. Experimentally measured adsorption isotherms were used to evaluate the specific surface area according to Brunauer-Emmet and Teller (BET) equation and the Polish Standard PN-Z-19010-1. Calculation were based upon water vapor adsorption at relative pressure from 0-0.35. During the measurements, the temperature was kept constant at 298±0.1 K. The samples were placed in a vacuum chamber over sulphuric acid solutions of different concentrations. The amount of adsorbed water vapour was computed as a difference between the weight of the sample with water and dry sample.

The relations between the specific surface area and wastewater dose as well as depth were observed. The specific surface area of the irrigated samples increased in relation to control samples. The highest values were noted for lower dose but better regularity of the increase was observed for more intensive irrigation.

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THE IMPACT OF NITROGEN FERTILIZATION ON THE CONTENT AND UPTAKE OF SELECTED HEAVY METALS BY VARIOUS ENERGY CROPS

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Energy crops can be successfully applied as a good substrate both for the combustion and biogas production. Besides, their ability to reclaim soil is increasingly highlighted. The plants such as willow, virginia mallow, jerusalem artichoke, miscantus and other grasses are capable of taking up large amount of heavy metals from soil (Kabala et al., 2010). The control of these elements content in the biomass is important, mainly in the case of biogas production, because their excess is able to inhibit methane fermentation process. Concentrations of heavy metals, resulting in performance decrease or total inhibition of biogas production has been reported to range from several to several hundred mg per dm^3 (Dąbrowska, 2010).

This paper focuses on content and uptake of lead, cadmium, nickel, copper and zinc in corn, sunflower, and reed canary grass silages, grown at three nitrogen fertilization levels. The research material was obtained from Agricultural Experimental Station Osiny of the Institute of Soil Science and Plant Cultivation, Pulawy, Poland (51°27´N, 21°39´E). Ammonium nitrate was used as a nitrogen fertilizer. After harvest, the plants were ensiled, and then analyzed by ICP OES. The research has shown, that the content and uptake of lead for each crop significantly increased with the increase in nitrogen fertilization level. The highest amount of lead was taken by reed canary grass, whereas cadmium and zinc by sunflower. There was no increase in nickel and copper content. This remains in consistence with the previous studies which showed an increase in heavy metals content with

increasing doses of nitrogen fertilizer (Hu-lin et al., 2007, Kalembasa & Wiśniewska, 2010). This is due to the fact, that ammonium nitrate fertilizer can contribute to the decrease in pH of soil. At low pH, availability and assimilability of heavy metals to plants is amended, which explains the increase in the concentration and uptake (Gruca-Królikowska & Wacławek, 2006).

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ALGAE – POTENTIAL BIODIESEL FEEDSTOCK. THE INFLUENCE OF ENVIROMENTAL CONDITIONS ON BIOMASS PRODUCTION AND LIPID CONTENT

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The production of biofuel from algae is dependent on the microalgal biomass production rate, lipid content and structure of cell wall. Therefore, microalgae system with thin cell walls could be more appropriate for lipid production from algae. Microalgae have been suggested as potential candidates for fuel production because of a number of advantages including higher biomass production, higher growth rate and higher photosynthetic efficiency compared to other energy crops. Furthermore, algae have an ability to adapt to environmental conditions. Modifying environmental factors can affect the efficient biomass production. Adaptation to the factors is reflected in a variety of lipid patterns and causes a number of synthetized unusual compounds. It is known that inorganic carbon (CO_2) and organic carbon sources e.g. glucose can be utilized by microalgae for lipids production. Algae are extremely rich in triacylglycerols which reach 43% of total fatty acids in the logarithmic phase and increase in the stationary phase. However, both the quantity and quality of lipids produced will vary with the identity of algal species.

Triacylglycerols are a major energy material used for the current needs of the cell and constitute the main material in the production of biodiesel. As a result of the change in the lipids metabolism, triacylglycerols may account for as much as 80% of the total lipid content in the cell. Under unfavourable environmental conditions microalgae change

their biosynthesis pathways towards the formations of their neutral lipids. One of the most important factors in the production of lipids is the type of nutrition. The cultures with heterotrophic growth and mixotrophic growth have greater efficiency of oil production than photoautotrophic growth, but on the other hand, mixotrophic growth produces the highest amount of cellulose in cell wall compared to photoautotrophic and heterotrophic growth. Carbon dioxide and nitrate concentrations have a meaningful effect on growth, biomass production and lipid concentration. The reduction of the source of nitrogen in the medium and very high levels of nitrogen causes rise in the lipid productivity. The nitrogen source not only affects lipid content but also low biomass growth. Other nutrients which stimulate the accumulation of lipids include phosfates and sulphates. The lipid content of microalgae is strongly influenced by temperature and light. Temperature has an influence on composition of intracellular fatty acids and free fatty acids into medium. Algae growing under various light conditions differ in their chemical composition. High intensity of light causes increase in TAGs, which can be used to synthesize biodiesel fuels via simple transesterification reactions. Mostly, all the stress conditions investigated led not only to the accumulation of lipids, but also to a reduction in microalgae growth.

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THE INFLUENCE OF THE POST-FERMENTATION SLUDGE ON HYDROPHYSICAL SOIL PROPERTIES

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Hydrophysical soil properties such as soil water retention and water conductivity coefficient have an impact on the growth and yield of crops. Sludges from biogas installations, which contain organic matter can be used as an addition to soil. They can modify hydrophysical and physical properties of soil. The organic matter and macro and micro elements contained in post-fermentation sludge ensure that plants have access to the necessary nutrients. However, it is essential to verify the impact of the changes.

In this work the studies on hydrophysical properties of the soil with post-fermentation sludge will be presented. Undisturbed samples have been taken from the experimental field to determine such properties as the particle size distribution, the porosity, the retention curve and the conductivity coefficient.

Studies have shown small deviations in the properties comparing to the untreated control field, however it is too early for the conclusions. The studies are scheduled for three years to investigate the effects in the long term.

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ESTIMATION OF PROTEIN AND WATER CONTENT OF SELECTED PLANT RAW MATERIALS USING HYPERSPECTRAL IMAGING

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Grain moisture and protein content affect the processing, storage and technological value of grain. The objective of this study was to investigate the use of hyperspectral imaging system in range 400-2500 nm to predict water and protein content in the grains of oilseeds like sunflower, rape and soybean as well as cereal plants like wheat and barley. Hyperspectral imaging provides both spatial and spectral information about the analyzed object which allows the use of this technique for detection of bruises in apples (Baranowski et al., 2012). In grain quality evaluation this technique has been experimented with for moisture and oil content prediction in corn (Cogdill et al., 2004), detection of fungi in wheat (Singh et al., 2007), and detection of insect damage in wheat (Singh et al., 2009).

The present study has focused on the development of algorithms for the analysis of spectral characteristics of plant raw materials to identify the most important wavelengths for predicting moisture and protein content in samples. The water content and protein content in the samples were determined by conventional methods. The relationship between grain reflectance spectra and corresponding individual chemical properties was determined using the multivariate regression model. The coefficient of determination of protein content in grain was 0,87 for oilseeds and 0,74 for cereal grains. However, the coefficient of determination was 0,94-0,98 for grain moisture, depending on the type of product to be analyzed.

These results demonstrated that hyperspectral imaging system is a promising technique to predict the protein and water content in grains.

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APPLICATION OF IMPEDANCE SPECTROSCOPY FRO ESTIMATING ELECTRICAL PARAMETERS OF CARBOHYDRATES AQUEOUS SOLUTIONS

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Electrical properties of materials can be defined by the electrical complex impedance of a sensor-sample setup. The impedance spectroscopy allows one to obtain electrical parameters of tested materials, which can be correlated with their physical and chemical properties. It is a fast and non-destructive measurement technique. The electrical properties of liquid materials were widely studied (Olmi et al., 2007; Xiangjung Liao et al., 2002).

The purpose of this study was to investigate differences among electrical parameters of aqueous solutions of carbohydrates and the ability to distinguish them using a prototype sensor.

The examined objects were water solutions of glucose, fructose (monosaccharides) and sucrose (disaccharide) of various concentrations. The experimental setup consisted of an LCR meter Agilent E4980a and a prototype sensor. The measurements were carried out within the frequency range 20 Hz – 2 MHz. Data analysis was performed using the EIS Spectrum Analyser. The program fits an impedance spectrum of an electrical equivalent circuit to the experimental data. The applied equivalent circuit consisted of three elements: capacitor, resistor and a constant phase element. Values of these elements can be connected with the type of carbohydrates solutions' concentrations and temperatures. The next stage of the research will be an attempt to identify the sugar solution of an unknown concentration using obtained mathematical relationships and the measurement of electrical parameters of several sugar mixtures of different concentrations.

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Acknowledgements: The research was supported by the National Centre for Research and Development (NCBR) grant No. PBS1/A9/12/2012.

THE PROPER PHOTOVOLTAIC TECHNOLOGY FOR HOT CLIMATES

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Presently, the most commonly used of photovoltaic (PV) technologies are crystalline (wafer based) and thin film. A deep consideration should be taken into account in order to select the most appropriate PV technology, for a predetermined location.
The PV efficiencies, η (both in terms of energy, exergy or power conversion) is not absolutely use as a main parameter, both in establish the PV system installation or in evaluation an existing of the PV system. The average operating voltage (V) and current (I) of a PV system is important to be considered for safety concerns, equipment capabilities and choices, and minimizing the amount of wire required for construction. By using the weather data, including the historical temperature (T) and solar irradiation/irradiance (G) information, we can estimate how much energy generated by PV power plant over predetermined period.

In this paper, comparison of two PV modules technologies (i.e. polycrystalline silicon and amorphous silicon) based on their characteristics, will be shown based on energetic point of view. As an outcome from this study, a suitable PV technology for hot climates can also be predicted and proposed.

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Acknowledgement: The research was carried out with the support of the OTKA K84150 project.

ADSORPTION KINETICS OF PROTEINS ON SURFACES

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Proteins are copolymers of 20 to 23 different amino acids linked together to form a polypeptide chain. They are generally naturally occurring compounds. Proteins are numerous applications in various fields of life (Xu & Damodaran, 1994).

A significant phenomenon is the adsorption process of proteins. This process is determined by many factors, such as pH, temperature, the ionic strength, the properties of the protein and the surface also the nature of the solvent. Adsorption of proteins is a multi-step process as follows: transport of a protein molecules toward a surface, insertion of a protein at a surface, conformational change of the protein, ablation of a protein from the surface and migration from the surface. The above-mentioned processes affect various adsorption stages in different ways, which determines the overall kinetics of the adsorption of proteins. Protein adsorption on solid surfaces plays important role in biology and in numerous technical, pharmaceutical and food processing applications. Therefore, it is important to know the kinetics of the adsorption of proteins (Xu & Damodaran, 1994; Kleijn & Norde, 1995; Nakanishi et al., 2001).

The aim of this study is to review information on the overall kinetics of protein adsorption process and detailing the various stages of the process.

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TRANSMISSION OF BIOMEDICAL SIGNALS

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Tactile activator system has been designed as an aid for the blind, but the whole systemis applicable in any industry. For use in agriculture is suitable as the control of machines,which are collected individual information on the surrounding environment, which are processed and evaluated the positioning of objects in the perimeter sensor and information are controlled by actuators. Sensing information is done using a camera and a laser measuring sensors. Evaluation done control unit, which sends impulses to theactuators.

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THE INFLUENCE OF PEAT ON THE SURFACE PROPERTIES OF SANDY SOIL - THE ANALYSIS OF WATER VAPOUR ADSORPTION ISOTHERMS

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The primary task in agriculture is to care for the fertility of soil, which is the basis for plant growth and development. Maintaining proper qualities is difficult and depends on different factors. This applies to both sandy soils (loose and dry) as well as peat soils (with a high content of organic matter (susceptible to degradation processes). Physicochemical properties of the surface are one of the most important parameters affecting the fertility of soil.

The aim of our work was the dependence between the content of organic matter and the surface properties of mixed sandy and peat soils in different rations.

The study was carried out on forest sandy soil (taken from Koepenick, Berlin region, content of organic carbon was 0.8%) and peat soil (Grunewald, Berlin region, containing 47.1% of organic carbon). Before the measurements, the samples were stirred in a mortar, sieved through a sieve of 1mm mesh and mixed in a wet state in proper weight proportion. The sorption isotherms of water vapour were measured by the gravimetric method in accordance with the Polish standard PN-Z-19010-1. Before adsorption samples were dried at 105°C with concentrated sulphuric acid to constant weight. The amount of adsorbed water vapour was calculated as a difference between the weight of sample with water and the dry sample. Then two parameters: specific surface area and fractal dimension were determined from adsorption of water vapour data. The Brunauer-Emmet and Teller (BET) equation was used to analyze the results and to calculate the specific surface area whereas Frenkel-Hill-Hasley (FHH) isotherm equation was used for the evaluation of the fractal dimension.

The obtained data confirm the conclusion that the studied systems can be treated as mechanical mixtures, with marginal interactions between components. However, the influence of the amount of organic matter on the geometric heterogeneity of the investigated samples has been confirmed. The linear correlations may exist in systems based on mixtures containing a small amount of organic material with the samples rich in organic carbon.

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USE OF THE LASER DIFFRACTION METHOD FOR ANALYSIS OF SPATIAL VARIATION OF PARTICLE SIZE DISTRIBUTION AS EXEMPLIFIED BY SEDIMENTS WITHIN POCKET INFILLS IN THE CHEŁM CHALK QUARRY (E POLAND)

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Laser diffraction is one of the modern optical methods for determination of particle size distribution. Light falling on a particle undergoes diffraction. Measurements of the angle of diffraction and light intensity provide information about the size of the particle that caused diffraction.

The present study was focused on the possibility of employing the laser diffraction method for determination of spatial variation of particle size distribution of sediments and analysis of geomorphological processes that the sediments have undergone.

Measurement of particle size distribution (PSD) by laser diffraction can be a valuable supplement to lithofacies description, providing rapid and reproducible PDS measurements in very small samples (up to 1 g). Such analysis is not possible using classical methods of PSD determination (e.g. pipette or aerometric), which require large-volume samples. The PSD analysis was carried out based on an arbitrary spatial net of samples that was independent of lithofacies delimitation.

The study material was sedimentary infills sampled from three pocket forms in a chalk quarry in Chełm (E Poland). The sedimentary infills were intensively collected (between 31 and 53 samples) in order to examine the spatial variation of particle size distribution within the pockets.

PSD was determined using the Mastersizer 2000 (Malvern, UK) apparatus. The measurement range of this diffractometer was 0.02-2000 mm. Each sample was mounted onto the measurement unit in such a way that obscuration (optical concentration) was in the range of 10–20 percent. Obscuration is defined as the 'percentage or fraction of incident light that is attenuated due to extinction (scattering and/or absorption) by the particles' (ISO 13320 : 2009).

The isopleths were generated with the use of ArcGIS 9.3 software. For all the pockets investigated, the particle size of the sedimentary infill was found to fine gradually towards the walls, with distinct central cores of coarser (sand) fractions (constituting up to 80%) (Dobrowolski et al., 2012).

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OXIDATIVE PROCESSES IN INTACT CHLOROPLASTS MEASURED BY CHLOROPHYLL A FLUORESCENCE

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Photosynthesis is a well-established source of reactive oxygen species (ROS) in plants. The major generation site of ROS in the thylakoid membrane of chloroplast is photosystem I (PSI), mainly via the Mehler reaction, although various types of ROS also occur in photosystem II (PSII) (Foyer & Shigeoka, 2011). The direct involvement of oxygen radicals in photosynthetic processes exposes the photosynthetic apparatus to high probability of damage, thus an efficient antioxidant system is essential to maintain the intracellular ROS pool at a low level (Asada, 1999). However, changes in the photosynthetic electron transport chain (PET) under various stress factors (e.g. high light, heavy metals, drought) may lead to a rapid increase in ROS formation (oxidative stress) and, as a consequence, impair photosynthesis efficiency (Pandey et al., 2009).

Determination of the amount of light energy absorbed but neither utilised in the photosynthetic reactions nor dissipated as heat by analysis of chlorophyll (Chl) *a* fluorescence allows a conclusion about the condition of PSII. Therefore, this research method has become one of the most powerful and widely used techniques available to plant physiologists and ecophysiologists (Maxwell & Johnson, 2000).

In the present study, we investigated the effect of DCMU (3'-(3,4-dichlorophenyl)-1',1-dimethylourea), an inhibitor of the acceptor side of PSII, on Chl *a* fluorescence in intact chloroplasts isolated from pea (*Pisum sativum* L.) leaves in order to determine appropriate concentrations of DCMU for further research in the field of plant redox biology.

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THE EFFECT OF THE TYPE OF PHOTOSYNTHESIS (C_3 AND C_4) ON THE ISOTOPIC COMPOSITION OF CARBON DIOXIDE EMITTED FROM SOIL

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Photosynthesis is one of the most important processes on Earth. Only photoautotrophic organisms, including higher plant, are able to carry out this process. There are two basic types of photosynthesis: C_3 and C_4. In C_3 photosynthesis the binding of carbon dioxide takes place directly in the cycle of Calvin - Benson. 3-phosphoglycerate (3 carbon atoms in chain - hence the name C_3) is the first detectable product. To this type of plants belong most plants in our climatic conditions (e.g. wheat). Whereas in C_4 plant, in addition to the traditional cycle of Calvin - Benson, there is an extra so called C_4 cycle. Fixation of CO_2 in the process of photosynthesis takes place in the cycle of Hatch and Slack (cycle C_4), and the first detectable binding products are compounds consisting of 4 carbon atoms in chain. This type of plant includes e.g. sugar cane, maize and millet.

The products of photosynthesis are used by the plant in various ways. Some of them are transported to the root system and are released outside as root exudates - chemical compounds which facilitate soil penetration and growth of roots. After fulfilling their function root exudates are used by soil microorganisms inhabiting the rhizosphere as a source of carbon or energy. The part of carbon compounds is consumed in respiratory processes and excreted as Co_2.

In our experiment we used two mineral soils as the research material. On one of them wheat (C_3)was cultivated, and on the other one maize (C_4). The results show that depending on what type of photosynthesis the plant growing on the soil leads, the CO_2 emitted has a specific isotopic composition.

For the analysis of the isotopic composition of CO_2 the IRMS (Isotope Ratio Mass Spectrometry) technique was used. This technique is based on the separation of different isotopes in stable, strong magnetic field, which allows us to determine the ratio of selected isotopes in the ionized gas.

EFFECT OF THE CRACKS ON THE EGGSHELL RESPONSE TO NON – DESTRUCTIVE IMPACT

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This work investigates the influence of an existing crack in hen eggs exposed to light impact on the eggshell response. In order to study this effect an experimental device has been design. This experimental arrangement enables to study the egg behaviour under impact by the different bodies accelerated to different velocities. Eggshell response is measured in terms of the eggshell surface displacement. In this paper impactors in form of flat cylinders and ball have been used. The effects of excitation point, egg mass, impact intensity and shell crack on the frequencies response signals were investigated.

Two groups of hen`s eggs have been tested. About 100 intacted eggs have been selected by the visual inspection. The second group involves eggs with artificially prepared cracks. An initial crack was induced to the eggshells by two weak mechanical impacts close enough to induce a macro-crack oriented mainly along the meridian direction. Eggs were excited by the impact of projectile at three different positions: on the egg equator, on the blunt end and on the equator.

The response signals were transformed from the time domain to the frequency domain and the frequency domain was analyzed. The specific objectives of the research were to (1) analyze the response time signals and the frequency signals of the intact and cracked eggs, (2) find the main factors which are most sensitive to the eggshell crack occurrence.

The results show that the presence of cracks may affect the surface displacement by the increase in the displacement amplitude. This effect occurs namely if the crack lies between the point of the egg excitation and the point of the displacement measurement. The presence of the cracks also affects number of oscillations in the displacement / time record. Our results suggest that this number increases with the crack length. The orientation of the crack plays also meaningful role.

The frequency response function is characterized by many peaks. The first peak frequencies (maximal magnitude value of frequency domain signal) of intact eggs were prominent and generally appeared in some place round 2900 Hz. In addition, the differences among the first peak (f1), second peak (f2), and third peak (f3) were remarkable (f1, f2, f3 mean of the first, second and third maximal magnitude value of frequency domain signal, respectively). In contrast, eggs with cracks have heterogeneous frequency response signals and their peak frequencies were disperse and not prominent. Differences among the first peak f1, second peak f2, and third peak f3 were much smaller than that of intact eggs. It could be explained by the difference of stiffness of the intact and cracked eggs. Differences in response signals between intact and cracked eggs were remarkable when the distance of impacting location and crack was less than about 30 degrees. Based on the difference of frequency domain response signals, five excitations resonant frequency characteristic of signals were extracted. They were: area of amplitude value, value of first peak frequency (resonance frequency), index of first peak frequency, mean of magnitude values from top three peak frequencies and standard of magnitude values from top three peak frequencies respectively. The resonance frequency is independent on the egg weight.

The values of the quantities mentioned above enable to distinguish between intacted and cracked eggs. Contrary to the results some previous paper our results suggest that there is a great influence of the impactor shape. The ball impact leads to much more significant difference between the frequency response of intacted and cracked eggs than that found for the impact of the cylindrical impactor. The possibility of the more detail analysis of the response functions e.g. in terms of wavelet transform is also briefly outlined.

Acknowledgements: The research has been supported by IP 2/2013 IGA MENDELU.

CHARACTERISTICS OF PLANT ROOTS CEC MONO AND DICOTYLEDONOUS

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The main function of plant roots are: uptake and transport of water and ions. With regards to the physicochemical properties this function is characterized by two quantities: the surface area (S) and total cation exchange capacity (CEC). Starting from the sixties of the last century, the main factors responsible for roots CEC are carboxyl groups of pectin. The negative charge of the roots is a result of the dissociation of the formed groups. To measure the CEC several methods are currently uses; these generally can be divided into three main groups: the method of titration, ion exchange, and isotope methods.

Potentiometric titration method allows the determination of the total cation exchange capacity and also characterizing the degree of heterogeneity of the surface charge of the variable. It is caused by the presence of the roots of the various functional groups with the acid-base characteristics on the surface and therefore different surface charge generated by roots.

Dicotyledonous plants usually have about twice the total Cation Exchange Capacity (CEC) of roots than monocots, therefore different charge multivalent cations. The CEC is linked to the type of the resistance of plants to soil contamination by heavy metals and aluminium. Literature data reports that plants with a lesser cation exchange capacity have a lower resistance to stress due to the presence of heavy metals. Phytotoxic concentrations of heavy metals affect the changes in the structure of the cell wall. One of the major defense mechanisms of the plant is immobilizing these metals in the root cell wall by binding to the carboxyl groups of pectins and hemicelluloses.

EFFECT OF pH AND IONIC STRENGTH ON THE ADSORPTION PROPERTIES OF THE HUMAN SERUM ALBUMIN/CHROMIUM (III) OXIDE SYSTEM

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Decomposition processes of organic matter are the source of most proteins in the soil (Burns and Dick, 2001). The adsorption of these proteins on soil particles may affect the soil structure, change protein susceptibility to enzymatic degradation and cause the local soil pollution in the case of pathogenic proteins adsorption (Schramm et al., 2006). Therefore, it is extremely important to know the mechanism of protein adsorption on the soil particles and its dependence on the physicochemical factors. In this study the influence of pH and ionic strength on the adsorption of albumin on the chromium(III) oxide surface was determined. Mineral oxide was chosen due to its prevalence in the environment (Barnhart, 1997). This paper includes the results for human serum albumin (HSA). It should be noted that similar results were obtained for bovine serum albumin (BSA) and ovalbumin (OVA).

The pH and ionic strength of the solution significantly affect the HSA amount adsorbed on the chromium(III) oxide surface. The highest adsorption is observed at pH value close to the isoelectric point, i.e. 4.6. Under these conditions highly packed protein conformation allows to the adsorption of maximum albumin amount on the adsorbent surface. On the other hand, the lowest level of adsorption occurs at pH = 3 which is mainly due to electrostatic adsorbate-adsorbent repulsion and expanded HSA molecules conformation. The comparison of adsorption amount in the solutions of various ionic strength shows that, under electrostatic repulsion conditions, the ionic strength rise is equivalent to increase in the amount of adsorbed albumin molecules. It results from screening of charges accumulated both on the solid surface and in protein molecules.

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COMPARISON OF VERSUS GRAVIMETRIC METHOD AND THE TIME-DOMAIN REFLECTOMETER SOUNDER FOR A AVERAGE ALLUVIAL SOIL FROM VALLEY OF ODRA IN BRZEG DOLNY AREA, IN 2000-2005

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The media presents the comparison of moisture contents measured by versus gravimetric method and TDR Sounder. Research was conducted in soil pit in the Odra valley in the region of Brzeg Dolny. Investigation shows that results of measurements obtained in two different methods are similar and comparable. Analysis shows that TDR and versus gravimetric method can becomes practical in use.

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EXAMINATION VISCOSITY VALUES OF REGIONAL WATER SAMPLES

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Nowadays more and more important question is the high-quality drinking water, as it is the base of the healthy lifestyle. The importance of the drinking water is shown the widespread usage of bottled mineral water, domestic water treatments and water energizing equipment. Beside the water comes from remote locations or is restructured, it is important to know the natural water in around our environment. The knowledge of the parameters of this water, gives a chance to contribute to the general knowledge of the water.

In the present work the viscosity was examined from physical properties of water samples, because it is especially important for biophysical view point. The water samples (spring-waters, well water, tap water, slush, rain water) were taken from Gödöllő area, Hungary. The measurements were carried out in the laboratory of the Department of Physics and Process Control, Szent István University, Gödöllő. Water samples were taken from six different locations. The temperature dependence was studied in case of the different samples in several temperatures between 20 and 60 °C. With examination of samples in three different times but from the same places the time stability of the results was also studied. The viscosity data were determined from sedimentation time of balls in the given water with Höppler viscosity meter with thermostat.

The viscosity values by source places are typical. The correlation between viscosity and also the measured surface tension values were examined. The measurement data give possibility for detection of similarity, difference and behavioural trends between the several types of water samples. The results were also compared with the available literature data. The measurements, results and conclusions are detailed in the presentation.

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

METHANE OXIDATION IN FOREST AND FERTILIZED SOILS

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Methane (CH_4) is an important greenhouse gas which has a 25-fold higher global warming potential than carbon dioxide (Co_2). Aerated soils contain methanotrophic microbes able to oxidize atmospheric CH_4 annually consuming 1-10% of the global emission of this gas (Saari et al., 2004). Land use exerts a strong influence on soil uptake of atmospheric CH_4 (Guckland et al., 2009). According to literature, well – aerated forest soil has been proved having the biggest capacity in oxidizing this gas (Steudler et al., 1989). Their consumption each year is equivalent to the annual increase of CH_4 in the atmosphere (Morishita et al., 2004). Agricultural practices drastically decreased the oxidation rates of methane in arable soils (Prieme & Ekelund, 2001). Supplied with fertilizers ammonia ions (NH_4^+) cause inhibition of methanotrophic activity (Acton & Baggs, 2011). Recent reports also give information on possible inhibition by nitrate ions (NO_3^-) (Mochizuki et al., 2012).

The presentation includes the results of the experiment whose aim was to measure methane oxidation activity in a deciduous forest soils and in agricultural soil. The forest is located next to an apple orchard with soil fertilized for 25 years. Samples were taken approximately 5 months after fertilization, at the end of the growing season 2012. The study was conducted in the laboratory conditions using fresh soil samples incubated with 2% of methane in the headspace. Concentrations of the gases (CH_4, CO_2, O_2) in the headspace were measured using gas chromatography method. Studies confirmed that the analyzed forest soils and fertilized, arable soils significantly vary in their ability to oxidize added methane. The soil samples exhibit different physical and chemical properties, and thus create various conditions for the growth of methanotrophic bacteria. The highest methanotrophic activity had forest soil collected from the bottom of the ravine. In all the samples of fertilized soil (with higher nitrate deposition) methanotrophic activitiy inhibition continued until the 64th day of analysis.

The results of the study confirm the recent reports that not only the ammonium ions but also nitrate ions from the fertilizers, can cause strong inhibition of microbial methane oxidation in soil. The ability of soil to methane oxidation is one of the natural ways to prevent global climate change. Therefore the presented kind of studies is needed and justified.

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