Book of Abstracts

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II. SUSTAINABLE RAW MATERIALS

International Project Week and Scientific Conference

EFOP-3.6.2-16-2017-00010

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LECTURES OF MAY 07.

EXPLOITATION OF MICROBIAL PHOTOSYNTHESIS FOR ENVIRONMENTALLY SUSTAINABLE BIOTECHNOLOGICAL PROCESSES

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Abstract

Microbial photosynthesis can be exploited for developing sustainable and environmentally friendly processes. In this lecture, the exploitation of exopolysaccharide (EPS)-producing cyanobacteria for the removal of heavy metals from industrial waste waters and the utilization of purple non sulfur bacteria (PNSB) for the production of hydrogen will be reviewed.

Many cyanobacterial strains possess, outside their outer cell membrane, additional surface structures, mainly of polysaccharidic nature. A large number of researches demonstrated the very good efficiency of some of the EPS-producing cyanobacteria in the biosorption of positively charged metal ions. A number of attempts was also done at pilot scale, showing the potential of the use of EPS-producing cyanobacteria for metal bioremoval from real wastewaters.

The exploitation of PNSB for the production of hydrogen has been frequently claimed as very promising. Indeed, PNSB are generally considered among the most promising microbial systems for the biological production of hydrogen owing to (i) their high theoretical substrate-to-hydrogen conversion yields, (ii) their lack of O_2-evolving activity, (iii) their capability to metabolize organic substrates derivable from industrial wastes or agricultural residues. Recent results obtained in the production of hydrogen with PNSB growing on substrates derived from the fermentation of vegetable or food residues will be presented.

Acknowledgments

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SUSTAINABILITY - FROM BIOREMEDIATION TO BIOPRODUCTION

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Abstract
The historically suboptimal practices of industries and communities that have produced extensive anthropogenic pollution and adverse effects of global change are prompting the generation of new fundamental knowledge and innovative technologies to combat contamination and minimize waste or even re-use waste streams. As these treatments merge with environmentally friendly industrial processes a sustainable economy is becoming feasible. A major driver in this transition is the increasing use of microorganisms or their isolated enzymes in pollution control and in industrial processes due to lower consumption of energy and chemicals, i.e. features that make such bioprocesses "green". We highlight specific examples of microorganisms and their oxidoreductive enzymes involved in aromatic hydrocarbon degradation which have led to bioremediation technologies for environmental cleanup. These same enzymes and their cognates provide new opportunities as biocatalysts for the production of chiral chemicals and other high-value compounds. For both types of applications the scalability of the process and the application space can be mapped in terms of catalytic activity and stability by applying multivariate analysis and optimization methodologies. Multi-enzyme biocatalyst configurations in immobilization matrices and novel robust enzyme formulations by biomimetic approaches are possible by integrating principles from biocatalysis, chemical engineering fundamentals and nanotechnology.

Acknowledgments
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The support of European Union and Hungarian State (grant agreement no. EFOP-3.6.2-16-2017-00010) is gratefully appreciated.

NANOREMEDIATION: IN SITU REMEDIATION OF GROUNDWATER BY INJECTING SUSPENSIONS OF ZERO-VALENT IRON NANOPARTICLES

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Abstract
Among the various nanomaterials, nanoscale zero-valent iron (nZVI) is currently the most widely used for the *in situ* remediation of soils and aquifers from a variety of toxic pollutants (e.g. chlorinated solvents). Aqueous suspensions of nZVI were synthesized by the sodium borohydride method and stabilized with carboxyl-methyl-cellulose (CMC-coated nZVI). A systematic parametric study was done in batch reactors to measure the kinetics of dissolved tetrachloro-ethylene (PCE) dechlorination by nZVI. A true-to-the mechanism statistical shrinking-core model (SSCM) was developed to compute the global rate of PCE reduction by nZVI as a function of reactant concentrations and all pertinent parameters, with special emphasis to the particle size distribution (PSD). The SSCM was used to interpret the results of batch tests, and estimate the mass-transfer and reaction kinetics parameters with inverse modeling. Visualization experiments of the *in situ* remediation of trapped PCE ganglia (non-aqueous phase liquid - NAPL) under the continuous injection of CMC-coated nZVI suspensions were performed on a glass-etched pore network, and enabled us to suggest two mechanisms of the PCE source zone remediation. Analogous experiments of residual NAPL remediation with the injection of CMC-coated nZVI were done on a sand column. A column-scale macroscopic model was developed by coupling the multiphase transport with reactive processes during the injection of nZVI suspension through a porous medium, partially saturated with NAPL. Both mechanisms of NAPL remediation were modeled, and the SSCM was used to compute the local reaction rate of dissolved PCE with suspended nZVI. Sensitivity analysis was done with respect to dimensionless parameters (*Damköhler, Peclet, Sherwood, NAPL saturation*) and PSD, whereas the model numerical predictions were compared with results of soil column tests. Green synthetic routes have recently been adopted to synthesize nZVI from ferrous sulfate heptahydrate by exploiting the polyphenols of plant extracts (green tea, pomegranate) as reductants and stabilizers.

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BIOHYDROGEN PRODUCTION: ARTIFICIAL ENZYMES IN ACTION

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Hydrogen gas is an exciting alternative to our fossil-fuel based society. Burning of hydrogen releases the highest energy-per-mass of any known fuel and its combustion yields nothing but pure water. Current industrial techniques using platinum catalysts for hydrogen production are unsustainable.
The ability of living microbes to produce biohydrogen offers the prospect of fully renewable energy carrier freed from any dependence on fossil fuel. Nature`s platinum, the hydrogenase enzyme has key role in in the process.
[FeFe] hydrogenases are the most effective hydrogen producers. The reaction occurs at the H-cluster containing an organometallic dinuclear [2Fe] subsite. Here I show how synthetic complexes mimicking the composition of the [2Fe] subsite can be introduced into the natural protein, resulting in an active semi-artificial enzyme. The artificial maturation provides direct link between biomimetic chemistry and biology, and allows us to manipulate the enzyme using synthetic chemistry.
I will present how the concept of artificial maturation can be extended to in vivo conditions and the protein activated with synthetic cofactors inside living cells. I will provide an overview how the catalytic cycle of semi-artificial hydrogenases can be followed and modified inside the living cells, giving us a novel tool for studies of [FeFe] hydrogenases.

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The supported of European Union and Hungarian State (grant agreement no. EFOP-3.6.2-16-2017-00010) is gratefully appreciated. The ERC (StG contract no. 714102) and the Olle Engkvist Byggmästare foundation are gratefully acknowledged for funding.

MEMBRANE DESALINATION AND FILTRATION TECHNOLOGIES USING RENEWABLE ENERGY AND WASTE HEAT

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Abstract

In the past two decades, there has been worldwide improvement in the installation and use of several desalination technologies due to the global freshwater shortages. For the last few years, membrane desalination (MD) processes which adds filtration units to their systems have been favored because of their promise as a low-cost desalination technology and for its potential energy versatility by using both heat and electricity. However, high electrical requirements have over the years become unsustainable and unfriendly to the environment. This is due to the interdependence of water and energy as the current practice of using fossil fuels to generate energy has mostly led to environmental degradation and loss of water through evaporation and cooling processes, a major contributing factor to global warming. It is also projected that the only sustainable future of mankind is to develop and rely on limitless renewable energy and waste heat to purify its water sources. These concerns and others have necessitated the need for integrating the evolved MD processes with the readily available, clean and safe renewable energy (RE) sources such as solar collectors, tidal energy, geothermal, photovoltaic arrays and wind. Use of RE solves the problem of environmental degradation and high Green House Gas (GHG) emissions in line with achieving the Sustainable Development Goal 13 (climate action).

Over the years, RE deployment costs have dropped significantly while the fossil fuels prices continue to rise causing a shift in the desalination industry while enabling a sustainable way to produce fresh water by integrating renewable energy with MD desalination. This work therefore aims to give an overview assessment of the current energy requirements of the MD and filtration technologies available together with their feasibility on using RE and industrial waste heat as energy source while ensuring high efficiencies in large-scale productions to enable commercialization of the same. It will also cover the different challenges encountered so far in the application of RE's from the point of sustainable development, production, environmental concerns and globalization. Lastly there will be a section on factors to consider when choosing suitable RE's technology to match the various MD and filtration processes.

Keywords: *Renewable energy, Sustainable development, Environmental concerns.*

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MATERIAL MASS BALANCE AND MATERIAL COMPOSITION OF SOLID-STATE DRIVE (SSD)

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Abstract
Hard Disk Drive (HDD) – a spinning disk that holds data as magnetic charges – has been the accepted standard for computer file storage for several decades. It is inexpensive and can store an abundance of data. However, nowadays people start to use a faster, efficient, and more powerful device, Solid-State Drive (SSD). Unlike the HDD, there are no parts in SSD that need to spin up to read data. Instead, SSD stores its data in trillions of tiny NAND transistor attached in a Printed Circuit Board (PCB). Moreover, due to the unique build of the NAND, SSD can read data randomly from any point instantaneously which accelerate the data processing.
In 2016, the number of SSD shipped worldwide was 140 million units and was expected to increase by 50 million units each year. Combining this number of the SSD, it is possible that there will be a considerable amount of SSD that will enter the waste stream in the future. To ensure the effectiveness in recycling the SSD waste, one needs the material composition and the mass material balance of the SSD, which is introduced in this paper.

Keywords:
Solid-state drive (SSD), NAND, comminution, material composition, mass material balance, recycling

Acknowledgements
The described article was carried out as part of the "Sustainable Raw Material Management Thematic Network – RING 2017", EFOP-3.6.2-16-2017-00010 project in the framework of the Széchenyi 2020 program. The realization of these projects is supported by the European Union, co-financed by the European Social Fund.

METAGENOMIC INSIGHTS INTO THE ANAEROBIC DIGESTION OF SHORT ROTATION COPPICE WILLOW REVEALS ITS EXCELLENT POTENTIAL AS BIOGAS SUBSTRATE

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Abstract

Current trends switch biogas production towards the utilization of second generation biomasses (e.g. lignocellulosic substrates). Willow can be cultivated as a short-rotation coppice for the rapid production of biomass, with a production cost of around one-fifth of that of maize silage. Early harvesting of green biomass (termed green willow biomass, GWB) has the advantage of better degradability in anaerobic digesters, however, according to our knowledge the biogas potential of this lignocellulosic substrate was not evaluated before. In order to do so, batch and continuous AD (C-AD) experiments were carried out, with an organic loading rate of 1 g oTS/L/day in the case of C-AD for 4 months, reaching a total methane yield of 255 mL CH_4 / g VS. Also, as total community DNA (metagenome) sequencing from complex environmental samples and the consequent binning of assembled contigs were shown before to be an effective approach to deepen our understanding of the underlying microbial functioning and composition, we analyzed the microbial consortium, carrying out the C-AD fermentation, via applying metagenomic and bioinformatic techniques. Read-based evaluation was also carried out on the samples, that was in accordance with the binning results. We also compared the microecology of fed fermentors with the original inoculum sludge, and also with the starved-out (starter) sludge. We found remarkable differences, mainly in the composition of cellulose-degraders and in the so-called CAZy-ome (Carbohydrate Active Enzymes). The fermentation results showed that GWB can termed as a good substrate for AD, and our metagenomic results highlighted the function of the underling microbiological processes.

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PURIFICATION OF OILY WASTEWATERS WITH MEMBRANE FILTRATION: OPPORTUNITIES, PROBLEMS AND POSSIBLE SOLUTIONS

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Abstract

Development of highly efficient purification methods for the treatment of oily wastewaters has become an urgent necessity since these wastewaters are produced in high quantity and have harmful effects on both the environment and population. Free (or floating) oil and dispersed oil can be eliminated by conventional techniques (such as flotation, centrifugation, skimming, etc.), but finely dispersed (emulsified) oil droplets require more effective methods to be eliminated, such as membrane filtration, which is an intensively developing water treatment method, due to its advantageous properties such as facile operation, no chemical addition and easy integration. Micro- and ultrafiltration can be applicable, however the formed hydrophobic cake layer and fouling of the pores causes significant flux reduction and extra cost. These phenomena prevent the economic utilization, therefore, the suppression of fouling and cake layer formation is one of the most important challenges in the field of membrane separation achieved purification of o/w emulsions. The present work gives a short overview about the utilization of membrane filtration for treating oily wastewaters, showing opportunities, understanding difficulties and explaining the main problems of this technique. This review also discusses promising solutions to improve this treatment method and to find feasible technologies, such as suitable pretreatment methods and more likely, membrane surface modifications with photocatalytic and/or hydrophilic nanoparticles and nanocomposites that offer the possibility to prepare highly hydrophilic "antifouling" membranes and to decompose the organic foulants on the membrane surface by UV or even by solar irradiation.

Acknowledgements

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MICROBIAL ENHANCED ENERGY RECOVERY FROM HYDROCARBON CONTAMINATED SOIL AND GROUNDWATER

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Abstract

Elimination of hydrocarbon contaminations in the deeper soil/water layers is difficult due to the lack of oxygen. However, oil pollutions at the anoxic ground water level can still be utilized by microorganisms. Alternative electron acceptors should be used for the oxidation of the target compounds or other anaerobic pathways such as biodegradation coupled methanogenesis should be activated. In the latter case, a portion of the mineralized hydrocarbon is used to produce methane by methanogenic Archaea. This mechanism is of key importance for the microbial enchanced energy recovery in the form of biomethane.

In this study, samples from a diesel oil contaminated soil were taken from four depth. Metagenomic analysis revealed the presence of few hydrocarbon degraders (*Rhodoferax sp*. *Smithella spp.*) alongside with methanogenic archaea (*Methanosarcina sp.* and *Methanosaeta sp.*) at the groundwater level. Biogas formation of the microbial population was tested in enrichment batch cultures. 14-15% methane in the headspace was detected within three weeks.

In conclusion, microbial populations obtained from the hydrocarbon contaminated soil are capable of methane production from hydrocarbons. Therefore, these communities have a great potential in microbial enhanced energy recovery processes.

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PREPARATION AND CHARACTERIZATION OF LANTHANIDE DOPED $NAYF_4$-TIO_2-AU COMPOSITES

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Abstract

In the present study ternary composite photocatalysts were prepared and tested. These composite systems are made of $NaYF_4$ (NYF) doped with lanthanide cations (Yb^{3+}, Er^{3+}, Tm^{3+}), TiO_2 and gold nanoparticles. NYF and TiO_2 were prepared with hydrothermal method. The gold nanoparticles were obtained by chemical reduction.

X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), diffuse reflectance spectroscopy (DRS), nitrogen adsorption/desorption and photoluminescence measurements were performed in order to detect the morpho-structural and optical properties of the as obtained composites. Using XRD we have determined the crystal phases (hexagonal β-$NaYF_4$ and anatase titania), calculating the particle sizes using Scherrer equation. From micrographs obtained by electron microscopy (SEM, TEM) information was obtained about morphology and particle size of the obtained materials (NYF~3-5 μm, TiO2~1-2 μm, Au nanoparticles~5-10 nm). With DRS, the optical properties were examined and the bandgap energies (between 2.73-2.97 eV) were calculated. With nitrogen adsorption/desorption measurements (using BET theory) the specific surface area was calculated. Photoluminescence measurements were used to investigate the fluorescence ability of NYF.

The photocatalytic activity of the composites was also tested using rhodamine B solution, as a model pollutant. The concentration of samples taken during the tests were monitored in time by a spectrophotometer.

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UTILIZATION OF FERMENTATION RESIDUE FOR BIOGAS UPGRADING WITH H_2

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Abstract
The accelerated technological, ecological development generate growing energy demand. Renewables supply an increasing share of our energy needs. The rapidly increasing renewable capacities are wind and photovoltaics based electricity production, but these technologies operate inherently in fluctuating mode. Finding a solution to the problem of the storage of the surplus electricity generated by these renewables is indispensable. The excess power can be employed in splitting water in an electrolyzer to H_2 and O_2. The technologies to store and transport the H_2 are not cost-effective and handling is complicated, therefore conversion H_2 to CH_4 is a preferable solution. CH_4 can be transported, stored easily via the existing natural gas grid. The chemical methods to reduce CO_2 with H_2 are well developed, but the same results can be reached in an environmentally friendly and economically feasible way with the help of biological systems. Hydrogenotrophic methanogens catalyze the conversion of H_2 and CO_2 to CH_4. These microbes are present in the biogas producing natural and man-made systems. An inexpensive source for hydrogenotrophic methanogens is the fermentation effluent of any industrial biogas plant.
In our present study, laboratory scale experiments at mesophilic temperature were carried out in fed-batch reactors. The fermentation effluent from a mesophilic biogas plant was used directly as catalyst. Based on the results a strategic alliance between the various methods of producing renewable electricity and the biogas technology is proposed. The proposed novel strategy suggests the utilization of the biogas effluent reservoir, which is part of most industrial-scale biogas facilities and stores the digested material until its utilization as organic fertilizer. The biogas effluent microbial community serves the bioreactor, transforming green electricity-derived H_2 into bioCH_4, and thus acquiring an entirely new function for the biogas plant.

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ADSORPTION AND RECOVERY OF AMMONIUM FROM MILKING PARLOUR WASTEWATER USING POMEGRANATEPEEL

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Abstract

Nitrogen compounds are widely used in agriculture as fertilizers and very essential elements for the growth of living organisms, however, excessive ammonium nitrogen (NH^{4+}) discharged in water source can cause eutrophication leading to depletion of dissolved oxygen and toxicity to fish and other aquatic organisms[1].

In our previous work, pomegranate peel (PgP) proves high ability to adsorb ammonium (NH^{4+}) from the simulated wastewater under various experimental parameters such as pH, contact time, adsorbent dose, initial ammonium concentration, and stirring speed. Moreover, in addition to the abundant availability, low-cost and eco-friendly advantages, this biosorbent offers the possibility to recycle ammonium back for agricultural purposes, however, a study of the effect of interfering ions in the adsorption mechanism still missing and presents an important issue.

In this work, the efficiency of pomegranate peel adsorption was investigated in order to remove ammonium from wastewater of a milking parlour. It consists of water, complex carbohydrates, and nutrients, i.e. nitrogen, phosphorus, and potassium. The intial concentration of total nitrogen (TN) and ammonium (NH^{4+}) in our sample were 66mg/L and 56 mg/L respectively in addition to other salts found in this type of wastewater mainly include Sodium (Na), Calcium (Ca), Magnesium (Mg), Chloride (Cl), Sulfate (SO_4) and Carbonate (CO_3) which could affect the final adsorption process efficiency. After the adsorption, a process of microfiltration is planned to separate the adsorbent from the wastewater and test its efficiency as fertilizer.

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EXPLOITATION OF EXTRACELLULAR ORGANIC MATTER FROM *MICROCOCCUS LUTEUS* FOR SOIL AND WATER DECONTAMINATION

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Abstract

The rehabilitation of hydrocarbon contaminated ecosystems is controlled by various environmental and biological factors proper to each site. One of the keys to an efficient bioremediation is the growth and the survival of the indigenous potential hydrocarbon-degrading microbial communities and the pollutants bioavailability.

Among the native microflora, only a small fraction can be cultivated using culture-dependent methods; most of them remain unrecovered. The yet-to-be-cultured bacterial strains are viable but frequently adopt a survival strategy known as the **v**iable **b**ut **n**on-**c**ulturable state (VBNC) from which they can revert through a resuscitation process when environmental conditions are favorable again, or triggered by resuscitation promoting factors such as found in the **e**xtracellular **o**rganic **m**atter (EOM) of *Micrococcus luteus*. The most promising hydrocarbon-degraders remain yet-to-be-cultured.

Hydrocarbons-degrading consortia were recovered from a train station oil-contaminated soil. The indigenous enrichment cultures were characterized and the EOM effect on the diversity and composition of the bacterial communities was evaluated using metagenomic tools. The assessment of biodegradation efficiency in response to EOM was performed in both soil and aqueous matrices.

Our preliminary results suggest that EOM could increase: the diversity and relative abundance of genera previously reported to be predominant in bioremediation of aromatics and consequently enhanced the bioconversion efficacy in soil and liquid matrices; and the uncultured bacteria fraction suggesting stimulation of potentially yet-to-be-cultured hydrocarbon-degraders.

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BIODEGRADABILITY OF ACTIVATED SLUDGE: THE ROLE OF MICROWAVE IRRADIATION PRE-TREATMENT ON THE SLUDGE SOLUBILITY AND POTENTIAL BIOGAS PRODUCTION

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Abstract

Microwave (MW) irradiation is one of the new and possible methods used for sludge pre-treatment and stabilization. Nonetheless, MW irradiation has been proven to be appropriate in the field of wastewater treatment. In this study, we focused on the effects of MW irradiation on solubilisation, biodegradation and potential biogas production during the anaerobic digestion of dairy, meat processing and municipal (primary and secondary) waste activated sludge. As a first stage, and in terms of an energetic aspect, the most economical pre-treatment of sludge at 250 W, was 5 min irradiation time (200 ml of sludge, 3:10 solid: water). At this point of treatment, the dissolved organic carbon (DOC) values were found to be 160%, 104% and 100% higher than the control for municipal, meat processing and dairy activated sludge respectively. While for the soluble chemical oxygen demand (sCOD); microwave pre-treatment led to 192%, 219% and 62% of sCOD higher than the control for municipal, meat processing and dairy activated sludge respectively. Therefore, biogas production is expected to be higher and therefore, energy output is expected to increase for same amount of sludge and shorter retention time as observed. However, the energy per unit weight of sludge is significantly higher after MW pre-treatment, making the quality of the sludge better suited for anaerobic digestion. The theoretical calculations demonstrated that the energy input required to carry out the microwave treatment in lower than what obtained from biogas combustion, demanding use of 60% of produced energy as input for microwave pre-treatment. This amount does not include losses in energy transformations, nor account for heat losses during the pre-treatment process. However, with an optimized design and operational procedure, these amounts can be kept to minimum.

Keywords*: microwave irradiation, waste activated sludge, biodegradability, biogas production, anaerobic digestion*

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DETERMINATION OF APPLIED PRESSURE ON BIOMASS DURING PELLETIZING BY HYDRAULIC PISTON PRESS

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Abstract
The parameters of biomass agglomerate production are especially important in aspects related to product quality and economics. To find the optimal production parameters, the exact relation between moisture content, temperature and applied pressure should be known. Pelletizing is currently one of the most frequently used methods for producing agglomerates, using either a ring die or a flat die pelletizer. This process can increase bulk density, reduces storage and transportation costs and makes easy handling of biomass. Applied pressure is an important process parameter that greatly influences the density of biomass pellets. The aims of this study were to determine applied pressure on biomass during pelletizing. The compressibility of ground post-agglomerated spelt chaff by hydraulic piston press (25 mm diameter) and pellets produced by flat die pelletizer are also introduced. The results show that the average pellet density could be calculated which is 1005 kg/m^3, the applied pressure of flat die pelletizer can be calculated of 338 MPa.

Keywords: *applied pressure, pelletizer, agglomerate, piston press.*

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MATERIAL BALANCE OF END OF LIFE BUSSES, FOCUSING ON ELECTRIC AN ELECTRONIC PARTS

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Abstract

End of Life Commercial Vehicles (EoLCVs) contain metal alloys, plastic parts, composite materials and electrical and electronic parts. The number and ratio of electric and electronic parts in vehicles are increasing, displays, batteries (hybrid drive), dashboard, driver assistance systems, control modules are built in, which results in generation of a large quantity of electronic waste (e-waste) in EoLCVs. Proper handling of this waste requires good recycling designs and improved machineries. If the individual countries are not intended on the ever growing material recycling of complex technical product wastes (End of Life Vehicles, Waste Electrical and Electronic Equipment), than the material bases runs out much faster. To take this aspects into consideration, there is very important to concentrate on the sustainable development steps. There is little literature available on the composition of vehicles (M1 M2) and the quantity of electronic components. It generates a problem of formulation to demolition plans of commercial vehicles.

One task of the research work is to determinate the material composition of EoLCVs. In this paper the composition data of bus type IKARUS-SCANIA 395 are introduced, focusing on electric and electronic parts.

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PUBLIC TRANSPORT BASED ON BIOMETHANE, AS AN ALTERNATIVE POSSIBILITY TO REDUCE CARBON-DIOXIDE EMISSON

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Abstract

According to recent estimates, transport accounts the quarter of the world's energy demand, thus contributes significantly to the release of greenhouse gases. Most of it comes from fossil fuels, and therefore it is important that governments support the users to choose one of the environmentally friendly modes of transport. One of the main causes of air pollution is primarily the amount of gases emitted by gasoline and diesel engines. The air pollution of road traffic is determined by the number of vehicles, their modernity, technical condition and the type of used fuel. The legal and technical measures created to reduce the environmental pollution include tightening the regulation of vehicle entry, propagating new generation of vehicles that meet environmental requirements and mandating an environmental review. The goal of my research is to sum up the causes of air pollution in large cities, focusing on the traffic loads. The use of alternative energies such as bio-methane can provide a temporary solution to the problems outlined. In addition, bio-CNG technology may be an additional solution. CNG (Compressed Natural Gas) fuel is rapidly spreading in the automotive industry and in transport worldwide. The gas must be compressed and stored economically. In the research I will evaluate and quantify the environmental impact of the CNG / bio-CNG in transport based on statistical analyses and description of the related technologies.

Acknowledgements

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LECTURES OF MAY 08.

CD, CU AND ZN MASS BALANCES OF AGRICULTURALLY USED SOILS IN SWITZERLAND

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Abstract
The intensification of agricultural practices has led to unintended Cd (via mineral P fertilizers) Cu and Zn (via manure application) inputs into agricultural soils. This is problematic because Cd is highly toxic to all biota. Cu and Zn in contrast are micronutrients but are also toxic to microorganisms, invertebrates and plants at elevated soil concentrations. The Cd fluxes were determined at three arable sites, the Cu and Zn fluxes at three grassland sites in Switzerland by a detailed analyses of all inputs (atmospheric deposition, mineral P fertilizers, manure, and weathering) and outputs (seepage water, wheat, barley and grass harvest) during one hydrological year. The Cd mass balances revealed net Cd losses for the cultivation of wheat (-0.01 to -0.49 g Cd ha^{-1} yr^{-1}) but net accumulations (+0.18 to +0.71 g ha^{-1} yr^{-1}) for that of barley. The Cu (+25 to +209 g ha^{-1} yr^{-1}) and Zn (+456 to +1478 g ha^{-1} yr^{-1}) mass balances revealed net accumulations at all three sites. Furthermore, stable isotope analyses enabled the identification the natural long-term processes "soil-plant cycling" and "parent material weathering" which acted over the entire time of soil formation (13700 years) and mostly determined the Cd and Zn distribution in the soils.

Acknowledgments
The study was funded by the Swiss Parliament via the National Research Program (NRP) 69 „Healthy Nutrition and Sustainable Food Production" (SNSF grant no. 406940_145195/1). The Zn isotope data was obtained on a Neptune MC-ICP-MS acquired with funding from the NCCR PlanetS supported by the Swiss National Science Foundation (grant no. 51NF40-141881).
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THE AMMONIA AND GREENHOUSE GAS FLUXES OF THE ORGANIC MANURE APPLIED AGRICULTURAL SOILSL

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Abstract
One of the most relevant environmental problem is how we can reduce the greenhouse gas (GHG) concentration and mitigate the emission of these gasses. The agricultural sector – compared with the industrial sector – should improve the mitigation techniques. Therefore it is an important goal to reduce greenhouse gas (and ammonia) emission from crop production and adopt new, low-emission application techniques for liquid organic manure. Germany has several new regulations to mitigate the agricultural crop field GHG emission but further investigation is necessary.
The biogeochemical models can be adequate tools for testing the new treatments for different environmental conditions. One of the disadvantage of the models is that they were developed around 20-25 years ago and the improvement of them is a must. New and ongoing projects in Germany will provide these data for the model developers to improve the existing models or develop new approaches.
This presentation shows the current status of the greenhouse gas and ammonia emission of the German agricultural crop fields, the advantage and disadvantage of the biogeochemical model application and the relevant ongoing projects.

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CRITICAL MATERIALS AND FUTURE CHALLENGES OF WASTE MANAGEMENT

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Abstract

Critical materials share the same insufficiencies in their life cycles: low recycling rates and a high degree of dissipative losses. Additionally, many critical materials have competing uses. The focus in this research is metals critical for both consumer electronics and renewable energy technologies, such as solar photovoltaics. Geological scarcity is not the key issue for their criticality. Of greater relevance are the geopolitical and economic frameworks that impact supply and demand. Many critical metals are available in countries with developing economies, where the demand for these materials is growing ever more. Europe may face shortage of virgin materials, which calls for more efficient recycling strategies. The limitations for the secondary use of critical materials are their minor concentrations in final products, their dissipative applications, such as in nanoscale, and the fact that they are irreversibly mixed with other material flows in current recycling practices. Ineffective collection, losses in pre-treatment and lack of awareness leads to future challenges in waste management. It is argued that we need to revise priorities in recycling and give higher priority to avoid dissipation of critical materials. As well, sustainable energy strategies should consider the limitations of critical materials and include considerations for sustainable end-of-life management.

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UTILIZATION OF SUGAR INDUSTRY BY-PRODUCTS: CHARACTERIZATION OF SUGAR BEET FIBERS AND MOLASSES

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Abstract

The great demand in terms of higher utilization rates of by-products and waste streams from industrial or handicraft processing plant material through added-value products has been highlighted recently. Introduction of sugar industry by-products (sugar beet pulp, molasses) can be successfully tackle the deficiencies in dietary fiber intake and provide important minerals and bioactive compounds in human diet. Sugar beet pulp is excellent source of soluble and insoluble fiber and molasses represents very valuable raw material which can be valorised in many ways. Sugar beet fibers, besides their addition to bread and confectionary products, can serve for other purposes as well. The fibers can also be used as stabilizers in oil-water emulsions, or as carriers of aromatic compounds, or some antioxidants. Pectin, from sugar beet pulp, can also be successfully used as a stabilizer in emulsions. Beside sugar beet fibers, molasses are also a very valuable byproduct. Nowadays researches are carried on towards isolation of betaine from molasses, which can be used in many ways in food and pharmaceutical industry. Betaine reduces the risk factors for cardiovascular disease, helps to increase the absorption of nutrients in the digestive tract and participates in normal functioning and detoxification of the liver.

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NOVEL TECHNOLOGIES FOR WASTEWATER TREATMENT AND ODOUR REMOVAL

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Abstract

The odors associated with different industrial wastewaters arose from the different amounts of benzothiazole, geosmin, 2-methylisoborneol, mercaptans, sulfides, and some aromatic compounds of acetic, propionic, *n*-butyric and isobutyric acids, C_1-C_4 primary mercaptans, methyl sulfide, 2,3-butanedione, 3-hydroxy-2-butanone, indole, and skatole. Due to unpleasant nature of the odor compounds, their removal need to be studied with the treatment methods of H_2O_2, photocatalytic degradation (e.g., UV), ozonation, pulsed electric fields (PEF), etc. Mechanism of action differ from each other for the abovementioned treatment methods, thus different compounds were formed and removed simultaneously after each treatment. Moreover, effectiveness of each treatment is also differ from each other. For example, use of ozonation performed better than that of photocatalytic degradation for poultry slaughterhouse waste water when both effluents were concurrently considered. The use of photocatalytic degradation performed better in the chicken than turkey effluent. The complexity of quantifying and controlling the interaction among odor compounds remains to be explored through a more rigorous multidisciplinary analysis towards the technically, economically, and environmentally compatible practices for both dry and liquid poultry wastes.

Key words: odor removal, ozone, photocatalytic degradation, poultry waste, pulsed electric fields

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ASSESSMENT OF CURRENT TREATMENT METHODS AND CAPACITY OF RECYCLING OF SPENT MUSHROOM SUBSTRATE AT SMALL MUSHROOM GROWING REGIONS IN THE NORTH OF VIETNAM

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Abstract

Spent mushroom substrate (SMS) is becoming one of the factors causing pollution for not only mushroom growing regions but also the neighbor areas. However, SMS is a nutrient-rich material with available nutrients and high porosity which can be used for various purposes to cope with agricultural by-product, support organic agriculture development without environmental pollution. In the North of Vietnam, at the small mushroom growing regions, farmers usually leave the SMS outdoor for several months to several years, this exerts impacts on the environment, aesthetics and rural landscapes and affects people's health. SMS then would be applied directly to the plants without treatment, so the efficiency is low. There are such ways to recycle SMS as keeping heat and moisture in soil, biofertilizer, making SMS biochar. SMS also is the suitable material for producing good quality compost, especially when it combines with animal manure, maize stalks and leaves, and probiotic. In addition, the making organic soil, which is derived from the combination between SMS, urban soil and other additives, is the new method to take full advantage of SMS and supplies safe organic soil for clean agriculture production. The combination of SMS and other agricultural wastes in compost and organic soil production can enhance the quality of products after treatment, as well as reduce the risk of environmental pollution.

Keywords: *Spent mushroom substrate, nutrient-rich material, agricultural by-products*

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EXPERIMENTS ON USING SUNFLOWER SEED HULLS AS A BIOSORBENT FOR HEAVY METAL REMOVAL FROM EFFLUENTS

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Abstract

The pollution in wastewater due to toxic heavy metals is a serious environmental and public health problem. The removal of heavy metals from wastewater and industrial effluents has become important to maintain water quality. Biosorption is developing process regarding the removal of of heavy metals from industrial effluents. Different researchers have already accomplished a large number of laboratory investigations on biosorption aimed at the pollution removal from aqueous solutions with different kinds of biomass.Sunflower seed hulls is one kind of by-products, therefore they are cheap and available in large quantities, especially in Hungary.The objective of this research is to investigate the efficiency of lead and cadmium ions removal from aqueous solution using sunflower seed hulls without special treatment and with it. In the work presented the sorption abilities of sunflower seed hulls is being determined in case of Cd^{2+} and Pb^{2+} without and with treatment. The present study can be used to conclude that instead of pure chemical effluent treatment, non-hazardous agricultural by-products like sunflower seed hulls can be used as heavy metal removers from wastewaters and industrial effluents to create green chemistry for environmental protection.

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POSSIBILITIES OF AN OPTICAL IDENTIFICATION SYSTEM USED TO IDENTIFY SECONDARY MINING RAW MATERIAL EXTRACTED FROM E-WASTE

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Abstract
The definition of e-waste may include computers, mobile phones, monitors, televisions and other electronic devices that are no longer in use. E-waste is a growing problem in our growing technology world. It is worrying that e-waste, as predicted by experts, could grow to 52.2 million tons by 2021. Less than 10% of dropped computers are currently being recycled. 80% of the collected e-waste is shipped abroad.
There are already companies that do not leave any residual fractions as a result of the operation. Materials are processed so widely that every gram can benefit the company. The ultimate goal is to get zero waste. In our research we also have a similar separator, tested with an optical camera.
Keywords: Optical separating, WEEE, Electronical waste, shape identifying, recycling

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MEMBRANE-LESS MICROBIAL FUEL CELL'S PRODUCTIVITY WITH USING WASTE WATER AND SLAUGHTER-HOUSE WASTE

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Abstract
Wastewater pollution has become an alarming issue, especially in the past few decades, due to the growing industrialization and domestic waste water. In view of this, the conversion of organic wastes into energy has been a dedicated point of research for the scientific community for the treatment of wastewater and harvesting energy instead of using energy. In order to achieve this conversion, the membrane-less microbial fuel cell (ML-MFC) chosen as it is an eco-friendly, renewable energy technology. This system functions as a bioreactor, relying on the microorganisms that convert the chemical bond energy into electrical energy by consuming the organic matter inside wastewater. In this work, the main physical, chemical and microbial approaches from previous studies will be compared. Special focus will be laid on evaluating the production capacity of electricity by using wastewater and meat factory wastes by using ML-MFC.

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CELLULOSE AS A SUBSTRATE FOR MODIFICATION WITH FUNCTIONAL MATERIALS

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Abstract
Cellulose has garnered growing attention of the scientific community in view of its excellent properties for use in virtually every sector. Its natural abundance, biocompatibility, porosity, hydrophilicity, flexibility and low-cost make it a perfect candidate for applications in packaging, sensing, biomedical healthcare and electronics. The beauty of this biopolymer is further augmented by the fact that it can be chemically modified with various functional materials for the desired end-use. The structure of cellulose with end hydroxyl groups has facilitated its surface modification with functional species. Various metal and metal-oxide nanoparticles, biomolecules and carbon materials can be functionalized onto cellulose using physical adsorption or covalent bonding by different approaches for targeted applications. Special focus will be laid on the functionalization of cellulose with green synthesized graphene using plant extract.

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MACRO- AND MICROSTRUCTURAL ANALYSIS OF BIOMASS-FIBRE REINFORCED FLY ASH GEOPOLYMER

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Abstract
The use of various types of fibres to increase the flexural strength of geopolymers is an established method. These studies focus on the use of both organic and inorganic fibre materials (e.g. steel, PP, PE etc.). However, the application of biomass fibres for the production of reinforced geopolymers is a less investigated topic in the spite of the good heat insulating properties of biomass and the high fire resistance of geopolymer.
Lignite type fly ash was used for geopolymer production with crushed woody biomass as fibre reinforcement. Fly ash was mixed with biomass fibres in 30 wt.%, 50 wt.% and 70 wt.% and geopolymer-biomass composite specimens were prepared.
The FT-IR and SEM analysis of the biomass-fibre reinforced geopolymer composites were carried out to examine the compatibility of the materials. According to the results of the micro- and macrostructural analyses, the wood particles and the geopolymer matrix showed good adhesion, with decreased amount of unreacted fly ash particles as the fibre quantity was increased. The obtained results serve as a valuable basis for further systematic investigation, as well as for additional mechanical and flexural performance tests.

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INVESTIGATION OF RHEOLOGICAL BEHAVIOUR OF DIFFERENT BENTONITE-WATER SUSPENSIONS FOR ENVIRONMENTALLY FRIENDLY TUNNEL BORING APPLICATION

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Abstract
When tunnels for highways are bored the exploited rocks might contain asbestos. When the liberated asbestos bearing rocks meet air, hazardous substances might be formed and this is a serious challenge for such construction works. However, if there is a nearby ocean or sea and the exploited rocks can be used for making engineered objects such as port or airport, the transport can be solved in a hydraulic pipeline and the rocks do not contact with air. Therefore, the hydraulic transport is a favourable option; however the high energy demand of high pipe velocity needed for the transport of coarse rock particles in seawater is disadvantageous. A possible solution might be the application of a carrier suspension by with the safe carrier pipe suspension velocity and therefore the pressure loss can be decreased. Systematic physical testing of different bentonite and water suspensions had been carried out. Rheological tests were realised in a tube- and a rotational rheometer. After mixing in the bentonites and waters, a gelling process was found, but after that stable Bingham plastics suspensions were produced. Pressure loss calculation methods for Bingham plastics fluids pipe flow had been summarised and were experimentally proven for laminar flows.

Keywords: *Bentonite – water suspension, Bingham plastics fluids, tube rheometer, yield stress, plastic viscosity.*

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DEVELOPMENT OF A SINGLE PELLETISER UNIT TO MODEL BIOMASS RAW MATERIALS PROCESSING IN FLAT DIE PELLETISERS

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Abstract
Pressure is an important process parameter that greatly influences the density of biomass pellets. The positive number of biomasses Poisson's ratio makes pelletising possible in the ring dye and flat dye types of pelletisers, because as consequence of a longitudinal direction of load the material strains into the radial direction. The radial strain is obstructed by the channel wall and therefore a radial pressure and wall friction are born and that supports (backs) the compression of the further sequentially loaded biomass. A novel test device, namely a single pelletising unit and a novel sensor, namely the back pressure measurement disc (BPMD) had been developed and calibrated. Pelletising experiments have been carried out with a flat dye pelletising machine and with the single pelletiser unit with ground post agglomerated spelt chaff (GPA-spelt chaff) samples. The body density and radial pressure values in different pelletising unit segments have been measured. The introduced dimensionless relative density-, radial pressure as function of the relative position equations fit well into the measured data.

Keywords: *Press channel, flat die pelletiser, single pelletiser unit, active segment, radial pressure distribution.*

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THE IMPACT OF SEWAGE SLUDGE DISPOSAL ON THE BACTERIAL ACTIVITY, NUTRIENT AND HEAVY METAL CONTENT OF CHERNOZEM SOILS AND ON THE PLANT PRODUCTIVITY, SE HUNGARY

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Abstract

Field application is one of the major means of utilizing sewage sludge. Sludge disposal onto agricultural soils can enhance soil productivity by the addition of nutrients, however can bring along metal (Zn, Cu, Cd, etc.) contaminants, as well as pathogens, that may ultimately impair soil fertility. Therefore, it is essential to understand the impacts of long-term sludge applications on the physico-chemical and biological properties of agricultural soils and plant productivity.

Our study focused on examining the changes in the nutrient, the heavy metal and the pathogen contents of chernozem soils impacted by repeated municipal sewage sludge disposal (with a yearly amount of 2.5 m^3/ha). Additionally, the Sentinel 2B vegetation index series were collected and analyzed to monitor the biomass production on the study area (Újkígyós, Hungary). Sampling campaigns were done in 2018 near Újkígyós during which composite samples (0-30 cm and 30-60 cm) and soil depth profiles were collected from sludge-treated and control sites. Soils were analyzed for the basic pedological parameters (pH, salt content, organic matter and carbonate content, etc.), furthermore, heavy metal (Zn, Cd, Pb, Co, Ni, Cr and Cu) and nutrient concentrations (K_2O, P_2O_5, N-forms and humus) were determined in the soil samples following standard extraction procedures. In addition to the physico-chemical analyses, biological parameters, such as the number of living cells, the catalase enzyme and the dehydrogenase activities were quantified in the chernozem soils.

The processed Sentinel 2B EVI and NDVI data (over 2016-2018) revealed that under unfavorable, dry weather conditions (in 2017) spatial differences in the biomass production can be observed with a higher productivity on the sewage-treated site. These observations can be partly explained by the results of the nutrient analyses that show a significantly increased soil-bound K_2O, P_2O_5 and NO_2+NO_3 contents linked to the sewage sludge treatment. However, the humus content did not vary markedly compared to the control site. Heavy metal analyses revealed the slight increase of Zn, Cd and Cu contents of the surface soils treated with sewage sludge. The bacteriological analysis showed that the sewage sludge disposal increased the aerob colony forming units (CFU), but not that of the anaerob microbes. However, the catalase enzyme activity increased in both the aerob and the anaerob samples for the sewage-impacted soils. Conversely, the dehydrogenase enzyme did not show an enhanced activity in the sludge-treated samples. Overall, according to the collected data the sewage sludge treatment seems to increase soil fertility which outweighs the negative impacts in terms of metal pollutant and pathogen inputs.

Acknowledgements

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STABILITY INVESTIGATIONS OF AgBr PHOTOACTIVE MATERIALS

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Abstract
An ideal catalyst can be easily synthesized with low cost and must to be harmless, shouldn't be consumed during the process [1]. Therefore, this work focused on investigation of catalyst after the photodegradation processes. Hydrothermal synthesis method was used for the synthesis of AgBr microcrystals and it investigated the influence of the different alkalic metal cation ion radii on catalysts size and effect of different functional group containing surfactants on the morphology of the catalysts. The as obtained catalysts were used for degradation of methyl-orange under visible light.
The structural and optical parameters of the obtained catalysts were investigated by using several techniques: XRD (X-ray Diffractometry), SEM (Scanning Electron Microscopy), and DRS (Diffuse Reflectance Spectroscopy) before and after the degradation processes. On the silver-based materials surface, Ag nanoparticles can appear if they are irradiated with visible light. These nanoparticles can play the role of charge separator. We found that the obtained catalysts changed during the catalytic processes, forming $AgBrO_3$ on the surface of the materials, beside Ag nanoparticles. Therefore, we analyzed the catalysts reusability by two different methods, where we noticed that the deposited materials (Ag nanoparticles, $AgBrO_3$) can inhibit the photocatalytic activity of the catalyst.

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OPTIMIZATION OF SOLVOTHERMAL SYNTHESIS OF ZNO FOR THE ENHANCEMENT OF THE PHOTOCATALYTIC EFFICIENCY USING BOX-BEHNKEN DESIGN

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Abstract

In this study, ZnO photocatalysts were synthesized via solvothermal method. The process parameters were optimized using the Box-Behnken experimental design to maximize the photocatalytic efficiency of the obtained catalyst. This black-box model based statistical prediction method was chosen to decrease the number of the experimental runs necessary to build the empirical model, resulting significant economies in the allocated resources and time for the research (Sergio Luis Costa Ferreira et al., 2007). The input variables of the model were the parameters of the reaction (the composition of the used solvent and the precursor) associated to the solvothermal crystallization parameters (temperature and duration), while the output was selected as the photocatalytic degradation efficiency of methyl orange under UV light irradiation, with two different set-ups to ensure the models adequacy and independence of the measurement conditions. In order to minimize the number of experiments necessary to build the mathematical model we used a fractional factorial experimental design (Box-Behnken design) as described in (Muneer Mohammed Ba-Abbad et al., 2015). Thus, a specific set of experiments were carried out to feed the model with the necessary amount of data for model building. The fitting of a full quadratic equation has been carried out with ANOVA analysis in both photocatalytic degradation set-ups. This was followed by the optimization of the model to calculate the optimal synthesis parameter values to maximize the photocatalytic efficiency. These predicted optimal conditions were verified by new experimental data. The new experimentally resulted values successfully verified the model predictions. The present work pointed out the applicability of semi-empirical predictive models in the synthesis of photocatalysts to minimize time and resource consumption of highly active photocatalyst synthesis.

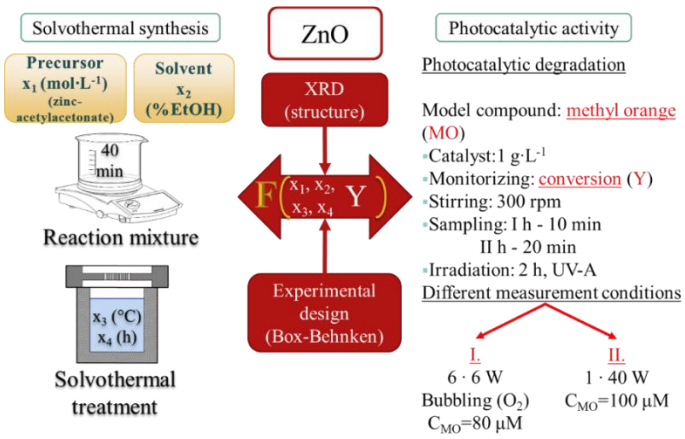

Figure 1. Graphical representation of the photocatalytic optimization of the solvothermal synthesis of ZnO.

Acknowledgements

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PREPARATION AND CHARACTERIZATION OF NOBLE METAL MODIFIED TITANIUM DIOXIDE HOLLOW STRUCTURES

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Abstract
In our recent study [1] it was demonstrated, that the photocatalytic activity of titanium dioxide (TiO2) can be enhanced by forming hollow spheres (HSs). Multiple reflections within the hollow cavity can lead to the enhanced utilization of the light source resulting in the production of more photogenerated charge carriers, thus increasing the photocatalytic efficiency of the semiconductor.
The modification of titanium dioxde by noble metal nanoparticles can result in the inhibition of electron-hole recombination and the extension of excitability to the visible light region due to surface plasmon resonance. On the basis of these considerations in this study Au and Pt nanoparticles were deposited on the surface of titanium dioxide hollow structures (wt.% = 0.25) to further increase the photocatalytic activity.
CS templates were prepared by the hydrothermal treatment of ordinary table sugar (sucrose), and purified by centrifugation using acetone. The CSs were applied as templates to synthesize titanium dioxide hollow structures using titanium(IV) butoxide [2] as precursor (sample 'TiO2-HS'). CS templates were eliminated by calcination at 500 °C.
Au and Pt nanoparticles were synthesized by using gold(III) chloride trihydrate and hexachloroplatinic acid solution as precursors, respectively, trisodium citrate to stabilize the growth of noble metal nanoparticles, and sodium borohydride as reducing agent to deposit the noble metals on the as-prepared TiO2-HSs by chemical reduction (samples 'TiO2-HS-Au' and 'TiO2-HS-Pt').
The samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), diffuse reflectance spectroscopy (DRS), infrared spectroscopy (IR), and X-ray photoelectron spectroscopy (XPS). Their photocatalytic activity was investigated by the photocatalytic degradation of phenol and oxalic acid model pollutants under both UV and visible light irradiation. As reference photocatalyst our own identical non-hollow structural 'TiO2-ref' and commercial Evonik Aeroxide P25 TiO2 was used.

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DEVELOPMENT OF A DRAG FORCE MEASURING DEVICE TO TEST SINGLE WASTE PARTICLES IN AN AIR STREAM

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Abstract
The circular economy concept requires that once used materials should get back to the production – consumption cycle again and again. The separators - working mainly on physical principles - play a key role in the processing of different wastes. Air flow separators are widely applied for many waste streams processing, namely municipal solid wastes, construction and demolition wastes, plastic and rubber wastes and so on… The phenomena of single and multi-particles movement (settling) in air streams fundamentally determine the operation of such machines. There are many papers in the literature dealing with the theoretical and experimental determination of settling velocities of waste particles in air streams. However, to test the motion of real waste particles requires large areas of tests and big devices. An idea was born, namely that a particle can be fixed on a force sensor and can be put into an air stream and this way the drag force can be measured in an equilibrium state. The knowledge of the drag force on a particle in a constant velocity air flow helps for a much better understanding of these separators. At the Institute of Raw Materials Preparation and Environmental Processing at the University of Miskolc a new test device is under preparation. The test device consists of a fan, a vertically upward and a downward pipe sections with a transparent section, an arm with a force transducer and a computer data acquisition system. This paper reports about the design and preliminary work about the construction and research plan of this new test device.

Keywords: *waste processing, airflow separator, drag force, terminal settling velocity*

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LECTURES OF MAY 09.

SOLAR AOPs FOR WASTEWATER TREATMENT: OVERVIEW OF PROCESSES AND PHOTOREACTORS

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Abstract (max 200 words)
Conventional and advanced biological treatments used as secondary step in wastewater treatment have been demonstrated to be inefficient in the elimination of many contaminants. Therefore, technical solutions with an appropriate treatment and an acceptable cost-efficiency should be developed. In this sense, advanced oxidation processes (AOP, designed to remove organic contaminants by oxidation through hydroxyl radicals) are proposed as treatments for the elimination of biorecalcitrant pollutants. Promising AOP are the solar driven treatments, which involves heterogeneous photocatalysis (by solid semiconductors) and homogeneous photocatalysis (photo-Fenton and other processes based on iron complexes). Solar processes use near-UV sunlight (300 to 400 nm), but in some processes, up to 600 nm sunlight can be absorbed as in photo-Fenton or when new modified/doped photocatalysts are applied. The hardware for solar applications is based on the collection of short-wavelength photons to promote photoreactions at ambient temperature. But, the key matter is the design of photoreactors accordingly to the wastewater to be treated. Despite the limitations of the process, the efficiency of the technology for the treatment of wastewater has prompted its investigation at pilot-scale in combination with other technologies as biotreatment and membrane processes. All these key topics will be revised.

Acknowledgments
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SYNTHESIS AND CHARACTERIZATION OF K-DOPED TIOX NANOSTRUCTURES FOR THE PHOTOCATALYTIC DEGRADATION OF ORGANIC DYES

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Abstract (max 200 words)

We apply the wet corrosion process (WCP) for the synthesis of $KTiO_x$ nanostructures. WCP is a simple one-step process at room-temperature without any supplementary treatments[1,2] involving the potassium hydroxide (KOH) treatment of Ti metal. The formation of $KTiO_x$ nanowires is directly affected by the KOH concentration, which also changes the K content in the nanostructures formed on the surface. WCP has demonstrated high efficiency and high reproducibility in producing nanostructured surface with a high surface area and with various potassium doping[3]. It can be applied to Ti metal substrates as well as to Ti-containing alloys[1]. The K doping particularly promotes the stabilization of the crystalline 1D structure and gives rise to a higher efficacy of photocatalytic activity. The photocatalytic performance of the nanostructures was derived from degradation of organic dyes.

The produced $KTiO_x$ nanostructures are also highly suitable for recycling and re-use because they are attached to Ti substrate and do not agglomerate. Especially for MB dyes a high recovery performance of about 97% was obtained. By additional treatment with diluted hydrochloric acid, $KTiO_x$ can be converted to $HTiO_x$ via ion-exchange leaving behind highly porous nanostructures. These structures show very high adsorption of organic dyes but also improved photocatalytic performance.

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CATALYSIS REVOLUTION: WITH NANOTECHNOLOGY AND MOLECULAR LEVEL UNDERSTANDING TOWARDS A GREEN FUTURE

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Abstract

Billions of dollars are investigated into information industry. Its less known, that similar budget is used for planning catalysis and industrial catalytic processes. The increasing demand for high activity and selectivity products needs new technologies and understanding of heterogeneous catalysis. The former trial-and-error method can be exchange with new techniques using in-situ methods for molecular level understanding under reaction conditions as well as controlled nanotechnology. These techniques may be exploited in CO_2 activation as well as other green methods.

In our research, mono and bimetallic nanoparticles with controlled average sizes were synthesized and anchored them on different 3D mesoporous oxide materials (SiO_2 – MCF-17, SBA-15, Co_3O_4, MnO_2, Fe_2O_3, NiO, CeO_2) prepared by the soft and hard template (replica) method. HRTEM-ED-EDX, SEM-EDX, DRIFTS, XRD, BET, H2-TPR, NH3-TPD etc. was used for characterizations. Catalytic tests were performed in a flow reactor in the gas phase connected to a HP GC-FID-TCD.

Tuning the size of the particles as well as the oxide/metal interfaces high activity and selectivity processes are favorable. NAP-XPS as well as DRIFTS techniques helped for molecular level understanding of the processes for future catalysts design. I will show plenty of results on the field of nanocatalysis and CO_2 activation reactions towards a new sight into green catalysis.

Acknowledgments

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EFFECT OF TITANIA PHOTOCATALYSTS ON AN UNUSUALGROUP OF TEST ORGANISMS, THE ANTS

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Abstract

Photocatalytic materials, and semiconductors generally are widely spread in different application areas. It is very well-known that semiconductive materials which are desired to be applied in photocatalysis or in adjacent research fields must have a high charge carrier generation/separation rate. These can produce reactive radicals which could take part in the oxidation of compounds.

It is a basic requirement for all these materials, that they should be inert, stable and environmentally friendly. The latter concept is, however narrowly considered in modern materials science as most of the publications are using standard ecotoxicological tests, which are covering only short impact effects, such as mortality, growth, etc. These tests however might not reveal the finer sublethal effects. Despite the availability of these tests, none of them are covering long, ecologically significant effect, therefore a potential knowledge void appeared.

In the present work an unusual set of ecotoxicological tests were created for different ant species, ranging for simple mortality tests to behavioral tests which test the photocatalytic alteration of the ants' cuticular hydrocarbon (CHC) and pheromone-based communication system.

These tests proved that a material usually marked as non-toxic (in this case Evonik Aeroxide P25) can adversely affect the ecological balance of our environment.

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EFFECT OF THE SYNTHESIS PARAMETERS (TEMPERATURE AND DURATION) ON THE MORPHOLOGY AND PHOTOCATALYTIC ACTIVITY OF BIOX (X= CL, BR, I) MATERIALS

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Abstract
Bismuth-oxyhalides (BiOX, X=Cl, Br, I) are semiconductor materials which showed great potential in the photocatalytic removal of organic pollutants (e.g. phenol, pharmaceuticals etc.) and dyes (e.g.: methyl orange, rhodamine-B). The BiOX materials possess a tetragonal matlockite structure, built of [X–Bi–O–Bi–X] layers, which are held together by Van der Waals interactions.
The aim of this research was to prepare bismuth-oxyhalides using hydrothermal crystallization. The influence of synthesis temperature (120 °C, 140 °C and 160 °C) and duration (3 h, 24 h, 48 h) was investigated on the structural (crystal size, phase composition etc.), morphological (crystal shape), optical (band gap values) properties and on the resulting photocatalytic efficiency in removal of methyl orange and rhodamine-B.
The obtained samples were characterized by X-ray diffractometry (XRD), scanning electron microscopy (SEM), and diffuse reflectance spectroscopy (DRS). The photocatalytic activity of the synthesized materials was tested under both visible (≥400 nm) and UV light irradiation (≈365 nm). The degradation of methyl orange and Rhodamine-B was carried out and followed by UV-Vis spectrophotometry. The results pointed out the importance of the crystallization temperature and duration in achieving the highest photocatalytic activity. Also, the primary degradation intermediates of the rhodamine-B were evaluated [1].

Acknowledgements
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DAIRY WASTEWATER TREATMENT USING PHOTOCATALYTIC POLYMER NANOCOMPOSITE MEMBRANE

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Abstract

Membrane application in dairy industrial wastewater purification may offer several advantages over conventional treatments, such as less pollution footprint, reliable and more selective contaminant removal, more economical, ease of operation and integration with other processes and smaller spaces required for installation. However, membrane fouling is still a limiting issue for its widespread industrial application[1].

In our study ultrafiltration (UF) PVDF with 30kDa and PVDF 100kDa molecular weight cut off (MWCO) membranes were coated with TiO_2. The membranes were modified using the physical deposition method[3] in which TiO_2 suspension were filtered through membrane in a dead end cell. The membrane separation experiments were carried out with the pristine and coated membranes using model dairy wastewater of 1g/L bovine serum albumin (BSA) [2] at pH 4.7, 6.2 and 8.

Water and permeate fluxes of the neat and modified membranes were compared, organic content (COD: chemical oxygen demand), and BSA rejection also were investigated. In order to get more information about the fouling mechanism, reversible and irreversible filtration resistances were calculated and compared using resistance-in-series model. The hydrophilicity of the membranes were determined by measuring contact angles using a computer based analyzer based on the sessile drop method with a digital camera. The experimental results of TiO_2–PVDF composite membranes revealed variations in flux, pollutant removal and antifouling properties, depending on the pore size and the pH.

Acknowledgements

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HYDROTHERMAL SYNTHESIS OF BiOBr/MWCNT COMPOSITES AND SIGNIFICANCE OF EARLY FORMATION OF $Bi_6O_6(OH)(NO_3)_3 \cdot 1.5H_2O$ AS AN INTERMEDIATE COMPOUND

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Abstract

Treating and reusing wastewater is extremely important as the clean water sources are depleting. Heterogenous photocatalysis has gained huge popularity because of its ability to degrade and mineralize the organic pollutants effectively and the benefit of utilizing solar UV and visible-light spectrum. Bismuth oxyhalides (BiOX) is among one of the efficient visible-light-driven photocatalysts. BiOBr have shown promising results in degrading pollutants such as phenol, methyl orange, etc. under visible light.

In this work, BiOBr/MWCNTs composites were synthesized hydrothermally at different time and temperature conditions (4:30 and 6:30 hours at 120°C and 150°C each). At the initial stage of synthesis, $Bi_6O_6(OH)(NO_3)_3 \cdot 1.5H_2O$ formation was observed, in nearly all samples, but disappeared with increase in the degree of crystallization as confirmed by X-Ray diffraction (XRD). The morphology of composites was nano-plates-like structures covered with CNTs, studied by Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). The Diffuse Reflectance Spectroscopy (DRS) showed that the presence of $Bi_6O_6(OH)(NO_3)_3 \cdot 1.5H_2O$ influenced the band-gap value causing a blue-shift, and a short-circuiting mechanism shown by MWCNTs. Photocatalytic degradation of phenol was done under visible light irradiation for the composites with degradation efficiency of 42%. This intermediate compound proved to be an efficient component in enhancing the photocatalytic activity.

Acknowledgements

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DESIGNED AND CONTROLLED SYNTHESIS OF VISIBLE LIGHT ACTIVE COPPER(I)OXIDE PHOTOCATALYST: FROM THE CUBES TOWARDS THE POLYHEDRONS - WITH CU NANOPARTICLES

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Abstract

In this moment the TiO_2 is one of the most frequently used semiconductor photocatalysts, because of its several beneficial properties (physical and chemical stability, safety, low cost, and resistance to photocorrosion) but this compound has also some draw-backs (possible carcinogen and low activity under visible light). For this reason, it is important to find a low cost and nontoxic semiconductor with visible light driven photocatalytic activity.

In the present work we have successfully synthesized differently shaped Cu_2O microcrystals applying various precursor salts ($CuCl_2$, $Cu(CH_3COO)_2$) and shape controller agents ($(C_6H_9NO)_n$ – PVP, ethylenediaminetetraacetic acid – EDTA). The synthesis was performed at different temperatures on oil bath reactor.

The nanocrystals were investigated by specific characterization methods (scanning electron microscopy, X-ray diffraction analysis, diffuse reflectance spectroscopy and dynamic light scattering) to uncover morphological (crystal shapes and crystal size), optical (band-gap values), and structural peculiarities (crystal structure, particle size distribution).

The photocatalytic activity of these materials was successfully investigated in the photodegradation of methyl orange and in photocatalytic (with oxalic acid as a sacrificial agent).

Acknowledgements

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INVESTIGATIONS OF PHOTOCATALYTIC ACTIVITY AND ECOTOXICOLOGY OF Au, Pt/TiO_2 COMPOSITE CATALYSTS

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Abstract

The most frequently used semiconductor is TiO_2 because of its high photocatalytic performance, chemical inertness, low cost, and nontoxicity, although the nontoxic nature of titania is still challenged by several papers. It is also well-known that the photocatalytic activity can be increased if different (noble) metals/metals or nanocarbons are deposited on the surface of semiconductors.

Considering the above-mentioned aspects, in the present research gold and platinum nanoparticles were deposited simultaneously on three different commercial titania photocatalysts (Evonik Aeroxide P25, Aldrich rutile and Aldrich anatase). For the synthesis of the composites two noble metal reduction methods (*in situ* and impregnation) and three noble metal deposition routes (i.e. by changing their deposition order, Au/Pt, Pt/Au, and Au–Pt simultaneously) were used. The photocatalytic performances of the nanocomposites were evaluated under UV irradiation, through degradation of oxalic acid and photocatalytic hydrogen production. The morphological and structural properties were studied/investigated by using DRS, TEM, HRTEM, EDX and XRD. Furthermore, the ecotoxicity of the composites was investigated using *Lemna minor* growth inhibition tests using static "lake" approach. The toxic effect of the composites which showed the highest photocatalytic activity did not differ from that of their commercial counterparts, showing that these nanoparticles were eco-friendly.

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INVESTIGATING RAW MATERIALS FOR MODERN BATTERIES FROM THE ECONOMIST'S PERSPECTIVE - COBALT

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Abstract
The use of batteries is now inevitable in our daily activities. While decades ago, only a few dry batteries were used in households, batteries almost could only be found in passenger cars, now the aggregation of areas of use can be a serious task for the researcher.
In our study, we focus on cobalt commonly used in lithium batteries, we will examine which parts of the world have the most important cobalt resources, with the help of the literature we the collect past events and the expected trends in the volume of use and for the (predicted) market prices.

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The research was supported by the EFOP-3.6.2-16-2017-00010 project "Sustainable Raw Materials Management Thematic Network - RING 2017". The project is co-financed by the European Union’s European Social Fund and Hungary.

HUNGARIAN LECTURES OF MAY 07.

MEMBRÁN ELTÖMŐDÉS CSÖKKENTÉSE VIBRÁCIÓVAL AZ ÉLELMISZERIPARI SZENNYVÍZTISZTÍTÁSBAN

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Összefoglalás

A különböző szennyvizek kezelése környezetvédelmi szempontból kiemelt figyelmet érdemel. A hagyományos szennyvízkezelési technikákhoz viszonyítva a membránszűrés több oldalról is előnyös módszer lehet, azonban a membráneltömődés nagyban behatárolja az alkalmazhatóságot, de ez csökkenthető vibráció alkalmazásával, ami a szűrő felületen megnövelt felületi nyíróerővel teszi szabadabbá a pórusokat. A membránok hidrofil vagy hidrofób tulajdonságának mértéke szintén befolyásolja a szűrés hatékonyságát. Munkánk során a polimer membránok karakterének jellemzésére a szűrőfelület kontakt szög méréses analízisére került sor, melyek alapján választottuk ki az ultra- és nanoszűrő membránokat. A modul vibrációs szűrési kísérleteket modell és ipari szennyvizekkel is elvégeztük. A működtetési paramétereket, a transzmembrán nyomást és a vibrációs amplitúdót is fokozatosan változtattuk és figyeltük, hogy hogyan hatnak a szeparáció intenzitására, a szűrlet fluxusára és a visszatartási értékekre. Utóbbit kémiai oxigénigényre, összes oldott anyag tartalomra, sókra és fehérjékre határoztuk meg. Eredményeink alapján a vibráció alkalmazása meghosszabbítja a hasznos szűrési folyamatot és többszörös fluxus értékek érhetők el. A visszatartási értékek esetén megállapítható egy kritikus transzmembrán nyomás, amely esetén a szervesanyagok visszatartása maximális és a nyomást csökkentve vagy növelve a visszatartási hatékonyság nem javul.

Köszönetnyilvánítás

Az Emberi Erőforrások Minisztériuma UNKP-18-2 kódszámú Új Nemzeti Kiválóság Programjának támogatásával készült.” A TÉT_16-1-2016-0138 számú projekt a Nemzeti Kutatási Fejlesztési és Innovációs Alapból biztosított támogatással, a Kétoldalú Tudományos és Technológiai (TÉT) Együttműködés támogatása (TÉT_16) pályázati program finanszírozásában valósult meg (SRB project szám: 451-03-02294/2015-09/4). A kutató munka a „Fenntartható Nyersanyag-gazdálkodási Tematikus Hálózat – RING 2017” című, EFOP-3.6.2-16-2017-00010 jelű projekt részeként a Szechenyi2020 program keretében az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósult meg.

HULLADÉKBÓL SZÁRMAZTATOTT TÜZELŐANYAG SZEMCSEMÉRETE ÉS NEDVESSÉGTARTALMA KÖZÖTTI ÖSSZEFÜGGÉS VIZSGÁLATA

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Összefoglalás

A hulladékból nyert tüzelőanyag (SRF/RDF) általában papírból, műanyagból, textilből és egyéb éghető anyagokból tevődik össze. Ezeket egyre gyakrabban használják különböző együtt-égető művekben és fosszilis üzemanyagok helyettesítésére több ipari ágazatban is. Függetlenül attól, hogy melyik ágazatban, külön- vagy együtt-égetőkben kívánják hasznosítani, meg kell felelnie az általános minőségi követelményeknek a biztonságos és hatékony felhasználás érdekében.

A Pécs-Kökényi Regionális Hulladékkezelő Központban található mechanikai-biológiai hulladékkezelő műben keletkező hulladékból nyert tüzelőanyag nedvességtartalmára és szemcseméret-eloszlására végeztünk vizsgálatokat. Ennél az anyagnál kulcsfontosságú, hogy megfelelő nedvességtartalommal bírjon, hiszen szoros összefüggés mutatható ki e között és a fűtőérték között.

Célunk, hogy a Pécs-Kökényi Regionális Hulladékkezelő Központban működő MBH technológiára fejlesztési javaslatokat találjunk annak érdekében, hogy az üzemben jobb minőségű tüzelőanyag kerüljön előállításra. Az országban jelenleg keresleti-kínálati piac egyensúlya a hulladékból származtatott tüzelőanyagok terén felborult. Sokkal több anyagot termelnek a hulladékkezelő művek, mint amennyit a hasznosítók befogadnak, így a termelők rákényszerültek, hogy a tüzelőanyag nemesítésének lehetőségén gondolkodjanak.

Kutatásaink során összefüggéseket kerestünk a hulladékból származtatott tüzelőanyag szemcseméret-eloszlása és nedvességtartalma között. A mért adatok alapján egyértelműen megállapítható, hogy a szemcseméret eloszlása fordított arányosságban van a nedvességtartalommal. A kutatási eredményekből elmondható, hogy a hulladékból rostált magasabb átlagos szemcseméretű frakciók körülbelül 20%-al kevesebb abszolút nedvességtartalommal rendelkeznek, mint a kisebbek, ami azt jelenti, hogy például a <10 mm frakció relatíve kétszer akkora nedvességtartalommal bír, mint a >40 mm frakció.

Köszönetnyilvánítás

A munka az Emberi Erőforrás Fejlesztési Operatív Program (EFOP-3.6.2-16-2017-00010, RING-2017) által nyújtott anyagi támogatásával készült.

HULLADÉKBÓL SZÁRMAZTATOTT TÜZELŐANYAG SZEMCSEMÉRET ANALÍZISE ÉS AZ EGYES SZEMCSEMÉRET FRAKCIÓK ÉS A FŰTŐÉRTÉK KAPCSOLATA

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Összefoglalás

Az elkövetkező időszakban a környezetvédelemben és ezen belül a hulladékgazdálkodásban is jelentős fejlődéssel, új technológiák és eljárások megjelenésével kell számolnunk. A hulladékok keletkezésének megelőzése, valamint minél nagyobb arányú hasznosítása, a lerakás minimalizálása a hulladékgazdálkodási politikák legfontosabb célkitűzései közé tartoznak.

A hulladékkezelésen belül a mechanikai-biológiai hulladékkezelés részaránya az EU tagállamokban, így Magyarországon is, fokozatosan növekszik. Mechanikai kezeléssel a vegyesen gyűjtött települési szilárd hulladék gépi feldolgozásával és osztályozásával eltérő tulajdonságú - méret, fajsúly, anyag - frakciók választhatók le további kezelés, hasznosítás, vagy ártalmatlanítás céljából.

A mechanikai-biológiai kezelő üzemekben előállított hulladékból származtatott tüzelőanyag felhasználhatóságát az dönti el, hogy milyen minőségű anyagkeveréket sikerül előállítani. A cementgyárak és az erőművek, mint a hulladékból származtatott tüzelőanyag felhasználói bizonyos fűtőérték alatt, ill. nedvesség- és szennyezőanyag-tartalom felett azonban nem veszik át a tüzelőanyagot.

A bemenő hulladékáram összetételére, fizikai és kémiai tulajdonságaira csak minimális hatásunk van, a tüzelőanyag minőségét inkább a feldolgozási technológiai elemeinek és sorrendjének, illetve a leválasztási határok beállításainak meghatározásával tudjuk befolyásolni. A korábbi kutatások főként a mechanikai-biológiai kezelés bemenő anyagáramaira, a biológiai kezelés módszerei és eredményeire, valamint a tüzelőanyagok energetikai hasznosítására fókuszáltak. Ezzel szemben a kutatásunk egy más területre, a már előállított tüzelőanyag minőségének javítására irányul.

A kutatásunk célja, hogy megállapítsuk a mechanikai kezelés során előállított tüzelőanyag minőségét befolyásoló tényezőket és utólagos technológiai beavatkozásokkal javítsuk rajta. Ennek érdekében elvégeztük a tüzelőanyag szemcsemért analízisét, majd megvizsgáltuk és elemeztük az egyes szemcseméret kategóriák nedves és száraz anyagra vonatkoztatott fűtőértékét. Kísérleteink egyértelmű összefüggést mutattak ki a tüzelőanyag szemcsemérete és a fűtőértéke között. A méréseink szerint átlagosan a tüzelőanyag 41 m/m %-át kitevő kisméretű, <10 mm és 10-20 mm közötti részek nedves fűtőértéke mintegy fele, a 30-40 mm és a >40 mm szemcseméretű hányadénak. A száraz anyagra vonatkoztatott fűtőérték esetében a trend iránya hasonló, de az eltérés a két csoport között mintegy felére csökkent. Ez azt is mutatja, hogy nem csak a szemcseméret és a fűtőérték, hanem a nedvességtartalom között is szoros összefüggés ismerhető fel.

Köszönetnyilvánítás

A munka az Emberi Erőforrás Fejlesztési Operatív Program (EFOP-3.6.2-16-2017-00010, RING-2017) által nyújtott anyagi támogatásával készült.

A HAZÁNKBAN KELETKEZŐ KOMMUNÁLIS HULLADÉKOK TELEPÜLÉS ÉS RÉGIÓ SZINTŰ, ILL. A HULLADÉKFORRÁS TÍPUSA SZERINTI JELLEMZŐ ÖSSZETÉTELE

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Összefoglalás
2017-2018 során, a Miskolci Egyetem, Nyersanyagelőkészítési és Környezeti Eljárástechnikai Intézete egy téli és egy tavaszi országos hulladékösszetételi kampányt végzett el a települési szilárd hulladékok vonatkozásában. Minden egyes régióban egy központi hulladékkezelő telephely került kiválasztásra, amelyek mindegyikében 17 - 17 gyűjtőjármű került mintavételezésre mindkét kampány során. A vizsgálat során a különböző településekről beérkező gyűjtőjárművekben lévő hulladékot elemezték az Intézet és a hulladékkezelő cégek munkatársai. A mérési adatok alapján, külön, célzott statisztikai kiértékelést végeztünk el, amely során egyrészt az egyes települések lakosainak száma alapján történő súlyozással megyére, ill. régióra vonatkozóan meghatároztuk a jellemző hulladékösszetételeket, ill. nevezetes mutatókat definiáltunk (pl. összes élelmiszerhulladék-tartalom, összes csomagolóanyag-tartalom, stb…) és értékeltünk ki. Ezen kívül, azokban a nagyvárosokban, ahol a mérés során a minták forrása (pl. családi házas övezet, bérházas övezet, közülettel érintett) is rögzítésre került, azokban elvégeztük az adatok súlyozását a felmérendő terület szektorainak lakosságszáma alapján is.
Keywords: Települési szilárd hulladék (TSZH) mintavételezése, felmérendő terület, szektor, anyagkategória, elsődleges- és másodlagos válogatás

Köszönetnyilvánítás
The described work/article was carried out as part of the „Sustainable Raw Material Management Thematic Network – RING 2017”, EFOP-3.6.2-16-2017-00010 project in the framework of the Széchenyi 2020 Program. The realization of this project is supported by the European Union, co-financed by the European Social Fund.

SILÓZOTT KUKORICA ÉS CELLULÓZ ADAGOLÁS HATÁSA SZENNYVÍZISZAP KOFERMENTÁCIÓS DEGRADÁCIÓJÁNAK KINETIKÁJÁRA

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Összefoglalás
Kísérleteinkben mezőgazdasági termékek biogáztermelésben való energetikai felhasználhatóságát modelleztük laboratóriumi körülmények között. Silózott kukorica és cellulóz biogáz szubsztrátként és kofermentációs adalékként való hasznosíthatóságát vizsgáltuk. Laboratóriumi kísérleteinkhez zárt, 1 literes batch reaktorokat használtunk. Az állókultúrát tartalmazó fermentoraink légköri nyomáshoz viszonyított nyomásváltozását Oxitop C/B mérőfejek regisztrálták 4, illetve 6 napos kísérleteink során. A képződött biometán mennyiségét Pentilla et al. (2009) módszerével határoztuk meg. A mezofil körülmények biztosítására a fermentációt 37 °C-os termosztátban végeztük. A szubsztrátok önálló biogázkihozatalának vizsgálatához szennvvízalapú biogázüzem kirothasztott iszapja szolgált oltóiszapként. A sűrített szennyvíziszappal való kofermentáció során az oltóiszap nélkül is regisztráltuk a két szubsztrát együttes biogáz- és biometán-kihozatali kinetikáját. A biogáz termelődés kinetikájának alakulását összehasonlítottuk nitrogén atmoszférában végzett mérések eredményeivel is. Kísérleteink eredményei hasznos információval szolgálnak a szennyvíziszap alapú biogázüzemben végezhető kofermentációs technológiában alkalmazható növényi eredetű mezőgazdasági termékek és szerves hulladékok szubsztrátként történő felhasználásának lehetőségeiről.

Köszönetnyilvánítás:
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SZENNYVÍZISZAP ÉS ÉLELMISZERIPARI HULLADÉK BIOGÁZ SZUBSZTRÁTKÉNT VALÓ HASZNOSÍTÁSÁNAK TESZTELÉSE OXITOP REAKTORBAN

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Összefoglalás
Munkánk során élelmiszeripari hulladék és sűrített szennyvíziszap önálló biogáz szubsztrátként való felhasználhatóságát vizsgáltuk. A kísérleteket laboratóriumi körülmények között, 37 °C-os termosztátban 1 literes, zárt batch fermentorokban végeztük. A gázképződés kimutatására WTW OXITOP C/B mérőfejeket h0asználtunk, melyek a légköri nyomáshoz viszonyított nyomásváltozást regisztrálják. Míg a sűrített szennyvíziszap önmagában is észlelhető biogázkihozatallal rendelkezett, az élelmiszeripari hulladéknál oltóiszap használatára volt szükség, amelyet szennyvízalapú biogázüzem kigázosított fermentációs iszapja szolgáltatott a kísérletünkhöz. A biometán-termelés megállapítására a zárt reaktorokba helyezett NaOH-dal kötöttük meg a keletkezett CO_2-t, majd Pentilla et al. (2009) módszerével számítottuk ki a keletkezett biometán pontos mennyiségét.

Köszönetnyilvánítás:
A kutató munka a „Fenntartható Nyersanyag-gazdálkodási Tematikus Hálózat – RING 2017” című, EFOP-3.6.2-16-2017-00010 jelű projekt részeként a Szechenyi2020 program keretében az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósult meg.

POSTERS

A UNIQUE ISOLATE CAPABLE TO ELIMINATE XENOBIOTICS FROM INDUSTRIAL WASTEWATER

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Abstract

The amount and diversity of artificially synthesized compounds contaminating the environment are increasing due to the growing industrial production. In most cases, these substances are xenobiotics, their chemical structures do not occur in nature, thus their degradatation might be problematic for microbes.

Our target molecule was the sulfanilic acid (4-aminobenzensulfonic acid, SA), which was released into a canal and finally to the Balaton lake in Hungary. SA is an aromatic sulfonated amine and manufactured as an intermediate for the production of azo dyes, plant protectives, and numerous sulfonamide anti-microbial drugs. Degradation of SA is difficult, due to its specific chemical nature.

Only very few studies were published about a successful biodegradation of SA. Moreover, in their cases, just bacterial consortia were able for the complete bioconversion. We were able to isolate an unique Gram-negative strain from a heavily contaminated soil sample, which was identified as *Novosphingobium resinovorum SA1*. The bacteria was able to remediate the SA polluted wastewater from the plant and use SA as sole carbon and nitrogen source. Then, its whole genome has been sequenced, annotated and metabolic routes involved in the SA degradation has been disclosed.

Acknowledgements

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HIDDEN RESERVES OF OILY WASTES: BACTERIAL STRAINS FROM MAZUT CAN BE POTENTIALLY APPLIED FOR OIL SPILL BIOREMEDIATION IN AQUEOUS SYSTEMS

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Abstract
Extraction of crude oil and transportation or usage of oil-refinery products can inevitably lead to the pollution of the environment and natural habitats. Bioremediation is a cost-effective and environmentally friendly technique that involves the use of microorganisms or plants in order to neutralize environmental pollutants. Considering that bacteria occur not only in aqueous but even in oil phase, intermediates, by-products or wastes can pose hidden reserves of effective microbial degraders with the potential application in oil bioremediation. Using mazut (a residual fuel oil from atmospheric distillation of crude oil) as an origin matrix, thirteen bacterial strains were isolated. The best performing strain, identified as *Rhodococcus* sp. PAE1, was able to degrade structurally variant hydrophobic compounds, such as hexadecane, cooking oil and mazut. Our work represents a targeted tool for the bioremediation of oil-polluted environments and revealed that oily waste can be considered as valuable sources of new hydrocarbon utilizing isolates.

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A POTENTIAL APPLICATION OF *PSEUDOMONAS AERUGINOSA* PHAGES IN WATER TREATMENTS.

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Abstract

Waterborne bacterial pathogens mean a significant public health concern. Direct observation of a wide range of pipeline used for distribution of water revealed biofilms of pathogens in the tubing systems. Most natural biofilms are formed by multiple bacterial species. Conventional methods for bacterial cleanings, such as applications of disinfectants are often ineffective against biofilms due to their unique physical matrix barrier. The ability of phages to control the bacterial population has held out from the medical application into industries. The lytic bacteriophages are self-amplifying weapons that target and kill explicitly bacteria. Bacteriophages are also known producers of enzymes that degrade the biofilms. Here, we are exploring the potential application of phages on *Pseudomonas aeruginosa* isolated from the contaminated pipeline. In our study, we isolated *Pseudomonas aeruginosa* from pipe joints where we observed thick biofilm formation. We used lytic bacteria phages isolated from clinical samples to treat and study the phage efficiency on water contaminated *Pseudomonas aeruginosa*. The effectivity of phage cocktails on isolates was studied by various techniques. such as confocal microscopy. It was clearly proven that a defined cocktail composed of 3 phages was a powerful tool to disrupt biofilms and kill the target strains.

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EFFICIENT REMOVAL OF HYDROPHOBIC MATERIALS FROM WASTE WATER BY RHODOCOCCUS AND PSEUDOMONAS STRAINS

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Abstract
Hydrophobic materials such as petroleum hydrocarbons and their derivatives are widespread contaminants in natural aqueous systems, furthermore in fats, vegetable oil, grease (FOGs) usually present in discharged wastewaters from households, restaurants and food industry. Their removal using environmental friendly processes is one of the main objectives of environmental projects.
The ability of the hydrocarbon degrading strains for biodegradation of various animal fats (pig lards, poultry fats) as well as butter, margarine and sunflower cooking oil was studied. The selected *Rhodococcus* and *Pseudomonas* strains could utilize all substrates were tested but their bioconversion efficiencies varied. Additionally, their distinct strategies for substrate accession were observed.
High extracellular lipase activity of the strains was suggested, thus the *Rhodococcus* and *Pseudomonas* strains are promising candidates in bioremediation fatty/greasy wastes. The development of a "bio" fat decomposing can be a promising technology for biodegradation of FOGs in situ and/or following their collection (e.g. from the restaurant or household grease-traps).

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UTILIZATION OF RUMEN CONTENT WASTES FOR METHANE PRODUCTION

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Abstract
The growing energy demand is mainly supplied by fossil fuels, although the efforts to develop alternative energy carriers are promisingly rising. Here, we focus on one of the common alternative biofuels, biogas production. Due to the intensive animal farming, huge amount of slaughterhouse wastes (e.g. rumen content) are produced annually. We focused on the utilization rumen contents from slaughterhouses to produce bioas. Rumen contents are rich in organics and microbes, therefore their multiple effects on the biogas yields are expected. We carried out anaerobic batch fermentations and examined the effect of sheep and cow rumen content on the methane yield. For the anaerobic digestions we mixed sludge and rumen content from the freshly slaughtered animals according to the VDI standard. The methane contents of the fermenters were measured daily. The sheep rumen contents had significantly higher effect on the biogas yield than the cow rumen materials did. It was shown that rumen content intensified the biogas formation due to its high organic acid load. Therefore, sheep rumen content was pre-incubated for four days to cumulate organic acids and then was used for biogas production. The pretreatment resulted in a significantly higher methane production as compared to the non-pretreated one.

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ISOLATION OF CELLULOSE DEGRADING FUNGI FROM WOODEN WASTES

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It is well-known that fossil fuel stocks are limited and their usage has serious environmental impact leading to global pollution and climate problems. The civilization needs to shift to alternative energy carriers, such as biogas, derived from renewable sources. A huge amount of lignocellulosic waste is produced annualy all over the world, which must be utilized for e.g. production of valuable materials, burning and/or biogas. Currently, due to the intensive wood processing, abounding forestry wastes are generated which have too high moisture content for economical burning.

In this study, our goals were to use forestry wastes for bioenergy, primarily for biogas production. First, different parameters of these substrates (total solid, organic total solid, fiber content, carbon, and nitrogen content) were determined. Then, the biomethane potential of this raw material was determined. As expected, only small amount of methane was evolved, therefore pretreatmet of this substrate seemed to be necessary. Fungi are well-known organisms for lignocellulose degradation, so we aimed to obtain them from punk. Finally, two fungi were successfully isolated from the surface of such wooden wastes. These fungi could be grown on cellulose, xylan and on wood which made them promising candidate for such a substrate pretreatment.

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TOMATO PLANT WASTE AS A NEW SUBSTRATE FOR BIOGAS FERMENTATION

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Fossil fuels are being exhausted, moreover, their extensive use results in a serious environmental crisis. Thus, we need to find another sources to satisfy our energy demands. Besides, huge amount of agricultural waste is piled up globally due to the intensive cultivation of crops. In Europe, 4.4 million tons of tomato plant wastes are yearly produced leading to several economic and environmental problems. Therefore, solutions for their reutitilization are really necessary. Biogas production from organic wastes is acknowledged as one of the most cost effective and ecofriendly technologies to manage plant waste and produce a green/renewable energy.

In this study, our goal was to use various tomato plant wastes as a new substrate for biogas production and then to use the digestate as a high-nitrogen and low-carbon content fertilizer. Several species of tomato plants were used as substrates in batch fermentation system, which had considerably lower carbon and higher nitrogen content than the corn stover applied as positive control. Among the various tomatoes plant waste, the species with the highest nitrogen and lowest carbon content was selected and used in co-fermentation with corn-stover in order to improve C/N ratio. This substrate was also utilized in co-fermentation with corn-stover in order to improve C/N ratio. Several fermentation parameters were measured. The obtained results showed no significant difference could be observed in the methane yield from the two substrates applied in contrast their substatially distinct fiber composition. Additionally, the microbial diversity distribution and changes in the fermenters were assessed by NGS technologies.

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THE ROLE OF THE HYDROGEN IN THE FORMATION OF METHANE IN METHANOGENS

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Abstract

Hydrogen metabolism is one of the rate-limiting processes in anaerobic digestion of organic material. Hydrogenases are the components of the H^+-translocating system in methanogens that is why they have an important role in the methane formation. The effect of hydrogen on the expression of hydrogenases and other genes has not been systematically examined yet.
Two hydrogenotrophic methanogen strains were investigated, the hyperthermophile *Methanocaldococcus fervens* and the mesophile *Methanococcus voltae*. The strains were cultivated under different nitrogen and hydrogen gas concentrations. RNA was isolated and the sequences were analyzed using the PATHVIEW visualization software. Although the expression of most enzymes involved in methanogenesis decreased under nitrogen, enzymes that catalyze the final step in the formation of methane and enzymes, which take part in the conversion of formiate and acetate significantly increased in *M. voltae*. This suggests the turn-on of an escape route for the surviving methanogens, the cells adopted to the new environment, the expression of the enzymes which utilize energy from formiate are increased. In contrast, the expression of all genes, which take part in the methanogenesis decreased in *M. fervens*. This archaeon can utilize only hydrogen and without hydrogen the cell turned into a decaying phase and even the stress gene transcriptions were not observed.

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SOLID STATE ANAEROBIC DIGESTION OF WOODY WILLOW SPECIES

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Abstract

As the global energy demands rises, caused by the global population growth, there has been a need to diversify the sources to ensure reliability and to meet the rising demand. As a result of the negative effects of climate change, attributed to fossil fuels, there has been a call to shift gears to cleaner and greener renewable sources.

While bioenergy is ranked 5th on the list of renewable sources, in it lies a great potential yet to be exploited. Biogas is a promising bioenergy carrier, as it can be utilized in many ways, and can be produced from a variety of substrates. Solid state anaerobic digestion (SS-AD) of hard to degrade lignocellulosic substrates and other organic wastes not only provide energy, but also reduces landfills and requires minimal water which makes it highly sustainable.

In this study, short rotation coppice woody biomass from willow (*Salix viminalis*) variants were evaluated for biomethane production via SS-AD. The substrate was shredded into small pieces, placed into glass vials, amended with inoculum sludge, sealed, anaerobized and incubated for 45 days. The effect of different parameters, such as total solids, substrate-to-inoculum ratio, and fermentation volume on the efficiency of the AD process was tested. According to our results, the volumetric productivity of SS-AD of woody willow can be 2 times higher, than of the wet fermentation's. Thus, in this study we demonstrated that SS-AD of woody willow biomass may represent a viable alternative that is environmental friendly and sustainable.

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ENSILAGED BIOMASS FROM SHORT ROTATION COPPICE WILLOW AS A SUBSTRATE FOR ANAEROBIC DIGESTION

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Abstract
The biggest challenges of our era include climate change and the global energy problem. Extensive utilization of renewable energy sources most certainly should be the part of the solution for both these problems.
Biogas, produced from biomass, is a versatile renewable energy carrier that has the potential to substitute fossil fuels. The most frequently utilized substrates for the anaerobic digestion process (AD) include maize silage, however there is an increasing demand for second-generation energy plants, which don't occupy soil from the cultivation of food cereals. Green biomass from short rotation coppice willow may serve as a promising substrate, as our previous results have suggested.
In order to ensure a sufficient feedstock all year round, we attempted to preserve the willow biomass via ensilaging. We used lactic acid bacterial mixtures to inoculate the substrate in anaerobic jars for 60 days. During the ensiling analytical and microbiological examinations were done. AD fermentations were assembled from the ensilaged biomass and measured the methane production for 56 days. According to our result, in some cases the total methane yields of the ensilaged biomass were 8%-15% higher than that of the control green biomass; and also methane production rates were improved. Our findings suggest that ensiling is not just an excellent preservation method for willow biomass, but also it can stimulate the fermentation of methane.

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NOVEL SULFIDE OXIDASE ENZYME CANDIDATING FOR BIOLOGICAL TREATMENT OF SULFIDE CONTAMINATED WATER

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Abstract

In the sewer anaerobic milieu can be formed by transformation of organic compounds. In this circumstances the reduction of sulfate and degradation of proteins can result the formation of hydrogen sulfide. Sulfide is a smelly toxic gas, it could exchange the place of oxygen in the hemoglobine and causes damages in the proteins of living cells. Oxidation of hydrogen sulfide for sulfuric acid is responsible for corrosion of metal and concrete materials of the industrial and communal wastewater systems. Quantity of microorganisms are ruined by sulfide especially the nitrification bacteria having principal role in the treatment of wastewaters.

The membrane bound flavoproteins, sulfide:quinone oxidoreductase (Sqr) enzymes have important roles in sulfide homeostasis and sulfide-dependent energy conversation processes via sulfide oxidation in numerous bacteria.

The photosynthetic purple sulfur bacterium, *Thiocapsa roseopersicina* possesses a type VI Sqr enzyme (SqrF). Expression analysis of *sqrF* gene and biochemical and enzyme kinetic characterization of homologously-expressed and purified recombinant SqrF indicate that SqrF could play a role in sulfide oxidation at high sulfide concentrations. Based on the catalytic properties of SqrF the wild-type or the mutagenized purified enzymes are suitable candidates for biological treatment of sulfide contaminated wastewater at anaerobic conditions.

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FACTORS INFLUENCING WATER USE OF A DAIRY FARM

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Abstract
Water use assessment on a dairy farm is a comprehensive task. However there are factors which influence it directly or indirectly such as chosen breed, herd size, keeping, feeding and milking technology. Productivity level of milked cows, number of daily milkings and type of litter (straw or liquid manner) have impact on water use of technology and cattles. If these factors are assessed and their proportion within the total water use are identified, dairy farmers are able to analyse water management precisely. As a result, they realise which are the points where they can find more water efficient solutions. Thus water use of their dairy farms become more sustainable environmentally, as they save water and in economic way, since they save the cost of that water use. Challenges related to water are more serious on areas experiencing water scarcity and overexploitation of freshwater resources. Mitigation strategies should consider social, ecological and economic contexts at the same time. In areas where water availability is low there is competition for water between different types of users, thus making water use of dairies more efficient is crucial for future.

Keywords: *water use, dairy, sustainability*

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BOPAC KOAGULÁLÓSZER ALKALMAZÁSA SZUSZPENDÁLT TIO_2 NANORÉSZECSKÉK VISSZANYERÉSÉRE A FOTOKATALITIKUS SZENNYVÍZKEZELÉSBEN

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Összefoglalás

Az ipari fejlődés velejárójaként nagy mennyiségben termelünk olyan vegyi anyagokat tartalmazó szennyvizeket, melyek ártalmatlanítása új vízkezelési módszerek fejlesztését és elterjedését teszi szükségessé. Ezek egyik jelentős csoportja a „nagyhatékonyságú oxidációs eljárások" (Advanced Oxidation Processes - AOPs), melyek közös jellemzője, hogy a szennyezők lebomlása oxidáló hatású gyökök révén valósul meg. Az AOPs csoport egyik tagja a heterogén fotokatalízis, mely módszer olyan félvezető nanorészecskéket alkalmaz, melyek megfelelő fényforrással gerjesztve képesek előállítani az oxidáló hatású gyököket. A félvezetők (pl.: TiO_2) alkalmazhatók egyszerűen szuszpenzióban is, azonban a kezelést követően a nanorészecskék visszanyerése nem kivitelezhető hagyományos ülepítéssel a részecskék méretéből adódóan. A membránszeparáció és a centrifugálás egyaránt alkalmas az elválasztásra, azonban az energia- és költségigények csökkentésére célszerű lenne más megoldást találni, például, ha koagulálószerrel intenzifikáljuk a kezelt vízben a nanorészecskék ülepedését, akkor a derített víz lefölözhető és a TiO_2 újra felhasználható lehet. Jelen munkában TiO_2 nanorészecskék polialumínium-klorid (BOPAC) koagulálószerrel végzett derítését vizsgáltuk különböző Al^{3+} koncentrációk esetén, illetve vizsgáltuk a TiO2 nanorészecskék többszöri ülepíthetőségét is. Ezt követően „Rhodamin B" festékkel szennyezett víz TiO_2–dal végzett fotokatalitikus tisztítását vizsgáltuk a BOPAC jelenlétében és hiányában, annak jellemzésére, hogy a koagulálószer miként befolyásolja a fotokatalízis hatékonyságát. Megállapítottuk, hogy a kellő mértékben ülepedő TiO_2 pelyhek kialakításához célszerű min. 20 ppm Al^{3+} tartalmat eredményező mennyiségben alkalmazni a koagulálószert. A nanorészecskék többszöri ülepítésének vonatkozásában megállapítottuk, hogy az ötször ismételt ülepítési ciklusok alatt 99,7%-ról csak 98,1%-ra csökkent a visszanyerés mértéke. A festékszennyezett víz fotokatalitikus tisztítása kapcsán megállapítható volt, hogy a koagulálószer jelenléte nem befolyásolta számottevően a fotokatalitikus aktivitást.

Köszönetnyilvánítás

A munka a Magyar Tudományos Akadémia Bolyai János Kutatási Ösztöndíjának és az Emberi Erőforrások Minisztériuma UNKP-18-4-SZTE-78 kódszámú Új Nemzeti Kiválóság Programjának támogatásával készült. A szerzők hálásak továbbá a Nemzeti Kutatási, Fejlesztési és Innovációs Hivatal által (NKFI-K-112096; TÉT_16-1-2016-0138), illetve az Emberi Erőforrás Fejlesztési Operatív Program (EFOP-3.6.2-16-2017-00010, RING-2017) által nyújtott anyagi támogatásokért is.

ELŐKEZELT TEJIPARI SZENNYVÍZ ULTRASZŰRÉSÉNEK VIZSGÁLATA

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Összefoglalás

Napjainkban az egyre növekvő vízfogyasztás és keletkező szennyvíz mennyiség komoly problémákat okoz, melynek egyik jelentős oka a modern, fogyasztói társadalom. Ezen vizek tisztításában a membránszeparációs technológia alkalmazása számos előnyökkel rendelkezik a hagyományos tisztítási eljárásokhoz képest. Ezek közé tartozik az alacsonyabb energiafogyasztás, kisebb helyszükséglet, könnyebb és hatékonyabb kombinálási lehetőség más biológiai, fizikai, esetleg kémiai eljárásokkal. Utóbbiak közül hatékonynak bizonyulhat a megfelelő pH értéken használt koaguláló és flokkulálószerek [1, 2], melyek alkalmazása jelentős mértékben növelheti a további membránszűrési hatékonyságot. Munkánk során különböző vágási értékű (egy 5 és kettő 10 kDa-os), valamint különböző anyagú (poliéterszulfon: PES, illetve poliakrilnitril: PAN) polimer ultraszűrő (UF) membránokat vizsgáltuk. Kísérleteink során modell tejipari szennyvizekkel dolgoztunk 5 g/L-es tejpor, valamint 0,5 g/L-es detergens koncentrációkkal. Klasszikus ülepítést, centrifugálást, pH változtatást, valamint a koagulálószer hatását, és az ezt követő ultraszűrési hatékonyságokat hasonlítottuk össze. A membránszűrési kísérletek során a permeátum fluxusait, a membrán visszatartási és ellenállási értékeit határoztuk meg. A membrán felületi tulajdonságainak jellemzése érdekében kontaktszög értékeket is mértünk. A szűréseknél a legnagyobb fluxusokat és a legkisebb ellenállási értékeket 4-es pH-n, koagulálószer használata mellett értük el. A visszatartási értékek változásában nem tapasztaltunk lényeges eltéréseket: szerves anyag tartalomra vonatkoztatva átlagosan 55%-os visszatartásokat kaptunk. Jövőbeni kutatási célunk az eddigi kísérleteink során kapott hatékony kémiai előkezelések részletesebb tanulmányozása.

Köszönetnyilvánítás

A TÉT_16-1-2016-0138 számú projekt a Nemzeti Kutatási Fejlesztési és Innovációs Alapból biztosított támogatással, a Kétoldalú Tudományos és Technológiai (TÉT) Együttműködés támogatása (TÉT_16) pályázati program finanszírozásában valósult meg (SRB project szám: 451-03-02294/2015-09/4). A kutató munka a „Fenntartható Nyersanyag-gazdálkodási Tematikus Hálózat – RING 2017” című, EFOP-3.6.2-16-2017-00010 jelű projekt részeként a Szechenyi2020 program keretében az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósult meg.

Irodalom

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SZÉNHIDROGÉN-SZENNYEZÉSEK ÓZONKEZELÉSSEL INTENZIFIKÁLT MEMBRÁNSZŰRÉSÉNEK TOXIKOLÓGIAI VONATKOZÁSAI

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Összefoglalás
Vizes élőhelyeink és ivóvízkészleteink védelmére napjaink fontos feladata a víz- és szennyvízkezelési technológiák folyamatos fejlesztése. Igen fontos kutatási terület a kőolajjal (illetve szénhidrogénekkel) szennyezett vizek hatékony és gazdaságos kezelésére alkalmas módszerek fejlesztése. A felúszó- és a diszpergált olajszennyezésekkel ellentétben az emulziók nem kezelhetők hatékonyan olyan hagyományos eljárásokkal, mint például a flotálás. Ezen mikro- és szubmikrométeres olajcseppek eltávolítására alkalmas módszer például a membránszeparáció, azonban megoldásra váró probléma a hidrofób olajcseppek okozta jelentős membráneltömődés, ami fluxuscsökkenéshez, membránamortizációhoz és jelentős költségnövekedéshez vezet. Egy kismértékű ózonos előkezelés képes számottevő mértékben megnövelni a fluxust, lecsökkenteni a szűrési ellenállást és meghosszabbítani a membrán élettartamát elsősorban az olajcseppek felületi zeta-potenciáljának változtatása révén. A membránszeparáció során azonban mindig képződik egy koncentrátum, mely még további kezelést igényel. Ismeretes, hogy a szerves anyagok részleges oxidációja számottevően befolyásolhatja azok ökotoxicitását, illetve a cseppaprózódás következtében megnőtt hozzáférési felület, és a molekulák részleges oxidációja a biológiai bonthatóságot is befolyásolhatja. Ezen ismeretekhez kapcsolódóan jelen munkában vizsgáltuk, hogy az ózonos kezelés hatására miként változik a kezelt emulziók, illetve a szűrés során keletkező permeátumok ökotoxicitása, illetve hogy hogyan változik a szűrés szempontjából is előnyös mértékű kezeléssel a szennyezők mikrobiológiai bonthatósága. A toxikológiai vizsgálatok elvégzéséhez Daphnia Magna, Vibrio Fischeri és Selenastrum Capricornutum fajokat alkalmaztunk, míg a mikrobiológia bonthatóságot hagyományos biológiai oxigénigény méréssel és szénhidrogén-fogyasztó baktériumok alkalmazásával is jellemeztük.

Köszönetnyilvánítás
A munka a Magyar Tudományos Akadémia Bolyai János Kutatási Ösztöndíjának és az Emberi Erőforrások Minisztériuma UNKP-18-4-SZTE-78 kódszámú Új Nemzeti Kiválóság Programjának támogatásával készült. A szerzők hálásak továbbá a Nemzeti Kutatási, Fejlesztési és Innovációs Hivatal által (NKFI-K-112096; 2017-2.3.7-TÉT-IN-2017-00016), illetve az Emberi Erőforrás Fejlesztési Operatív Program (EFOP-3.6.2-16-2017-00010, RING-2017) által nyújtott anyagi támogatásokért is.

ISZAP ÉS SZENNYVÍZ BIOLÓGIAI BONTHATÓSÁGÁNAK FOKOZÁSA MIKROHULLÁMÚ KEZELÉSEKKEL

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Összefoglalás

A mikrohullámú energiaközlés az anyagkezelések több területén bizonyította kiemelkedő hatékonyságát a konvencionális termikus eljárásokhoz képest. A szennyvíz és iszapkezelések esetében – többek között az alapanyagok nagy nedvességtartalma és poláris összetevői miatt - a mikrohullám esetében jó termikus hatásfok érhető el. A dielektromos jellemzők vizsgálata a mikrohullámú kezelések termikus és komplex energetikai hatásfokának becslése és az anyagszerkezeti változások nyomon követése szempontjából is lényeges és hasznos információkat nyújthat.

A kutatómunkánk során több-, eltérő eredetű és különböző szennyvíztisztítási eljárásnak kitett, szennyvíz és iszap minta esetében vizsgáltuk a batch és folytonos anyagáramú mikrohullámú kezeléseknek a biológiai lebonthatóságra gyakorolt hatását. Megállapítottuk, hogy mikrohullámú előkezelést alkalmazva, a mezofil anaerob fermentációt tekintve, az iszapok 50%-os szervesanyag kirothasztás időszükséglete 36-43%-al csökkenthető volt. Ezen időszak alatt az előzetes mikrohullámú energiaközlés – a teljesítményintenzitástól és a térfogatáramtól függően – 38-87%-al javította a fajlagos biogáz-kitermelési mutatót. A mikrohullámú sugárzás alkalikus kezelési módszerrel való kombinációja az iszaprészecskék dezintegrációs hatás fokának 65-130%-al való növekedését eredményezte. A szennyvizek esetében vizsgáltuk a különböző tisztítási eljárások közben a dielektromos állandó és dielektromos veszteségi tényező értékét. Megállapítottuk, hogy a szennyvíztisztítási eljárások során a szervesanyag-eltávolítási hatásfok és a dielektromos paraméterek változása között szoros kapcsolat van, ami lehetővé teszi a különböző kezelési és tisztítási eljárások gyors, folyamat közbeni hatékonyság-előrejelzését.

Köszönetnyilvánítás

A kutatómunka a „Fenntartható Nyersanyag-gazdálkodási Tematikus Hálózat – RING 2017” című, EFOP-3.6.2-16-2017-00010 jelű projekt részeként a Szechenyi2020 program keretében az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósul meg.

TEJIPARI SZENNYVIZEK TISZTÍTÁSA HIBRID MEMBRÁNSZEPARÁCIÓS ELJÁRÁSOKKAL

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Összefoglalás

A tejipar igen jelentős mennyiségű, sokszor ivóvíz tisztaságú vizet használ fel, amelynek következménye a technológiai folyamatok végén nagy mennyiségű szennyvíz keletkezése. A szerves vízszennyezők eltávolítására számos területen folynak kutatások, ezek egyik ígéretes területe a membránszűrés alkalmazása. Az alkalmazás egyik korlátja azonban a membrán eltömődése, amely jelentősen megnöveli a szűrés energiaigényét, költségeit, illetve csökkenti a membrán élettartamát, így a kutatások napjainkban főként erre a területre fókuszálnak. A membránszeparáció és a nagyhatékonyságú oxidációs eljárások kombinálása új lehetőségeket nyit meg, mivel az ózon, illetve a hidroxilgyök hatékonyan képesek oxidálni a membrán eltömődését okozó vegyületeket.

Kutatási munkánk alapvető célja a nagyhatékonyságú oxidációs eljárásokkal kapcsolt membránszűrés alkalmazhatóságának vizsgálata modell tejipari szennyvizek tisztítására. Kísérleteink során vizsgáltuk különböző oxidációs előkezelések, így ózon, Fenton reakció és heterogén fotokatalízis hatását a szűrési paraméterekre, a szennyezőanyag-visszatartásra és a membrán eltömődésére.

Azt tapasztaltuk, hogy az ózonos, illetve Fenton-reakcióval történő előkezeléssel az ultraszűrés szennyezőanyag-eltávolítási hatékonysága jelentősen javítható, emellett megnő a membránszűrés után visszamaradó koncentrátum biológiai bonthatósága, amely ezáltal alkalmas lehet pl. biogáz üzemekben történő hasznosításra is. A rövid idejű oxidációs előkezelések minden esetben csökkentették a membráneltömődés mértékét, ugyanakkor a hosszabb ideig tartó kezelések már ronthatják azt. Összehasonlítva az egyes eljárások során alkalmazott kémiai oxidációs kapacitásokat, azt tapasztaltuk, hogy az eltömődés mértékének csökkentése nem függ az alkalmazott módszertől, csak az oxidációs kapacitástól. Ugyanakkor, a Fenton reakció alkalmazásával (annak jobb flokkuláló hatása miatt) kisebb membránellenállások, így magasabb fluxusok érhetők el. Annak vizsgálatára, hogy a membrán felületi tulajdonságainak megváltozása hogyan befolyásolja az eltömődést, a membránok felületét hidrofil tulajdonságú TiO2 fotokatalizátor nanorészecskékkel vontuk be, ezáltal jobb visszatartást értünk el, ugyanakkor a membrán UV fénnyel tisztítható volt, az UV fénnyel megvilágított eltömődött membránokon visszaállítható az eredeti fluxus.

Köszönetnyilvánítás

A szerzők köszönetüket fejezik ki az EFOP-3.6.2-16-2017-00010 „Fenntartható nyersanyag-gazdálkodás tematikus hálózat fejlesztése – RING 2017 és a TÉT 2017-2.3.7-TÉT-IN-2017_00016 azonosító számú pályázatok anyagi támogatásáért.

A MEZŐGAZDASÁGI EREDETŰ POROK LEHETSÉGES KÖRNYEZETI HATÁSAI, KÜLÖNÖS TEKINTETTEL A PESZTICIDEKRE

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Összefoglalás

A talajok fokozódó defláció érzékenysége miatt egyre inkább számolnunk kell a kiporzás következtében a por környezeti- és humánegészségügyi hatásaival. A szél által szállított finomabb talajszemcsék a légköri száraz és nedves kiülepedéssel hozzájárulhatnak a települések porterheléséhez. Ezért fontos megvizsgálnunk az elszállított talajanyag mennyisége mellett, azok elemösszetételét. Ezen hatások hatékonyan vizsgálhatók terepi szélcsatornás kísérletekkel. Jelen tanulmányban 2017 és 2018 nyarán, Szeged mellett, csernozjom talajon végzett vizsgálataink eredményét mutatjuk be, mely során összesen 28 terepi szélcsatornás kísérletet végeztünk. A kísérletek előtt a területek egy részét klórpirifosszal és pendimetalinnal kezeltük, valamint elkülönítettünk kontroll területeket. Az in situ szélcsatorna kísérletek során kétféle csapdát használtunk fel a szuszpendált talajrészecskék összegyűjtésére: MWAC csapda és WAST (aktív nedves csapda). Az elszállított talaj mennyiségét BWS-60 típusú platform mérleggel mértük. Mintákat vettünk a feltalajról a kísérletek előtt és után, melyekből a következő talajvizsgálatokat végeztük el: pH (H_2O), $CaCO_3$, HU%, összsó%, K_A, növényvédőszer (LC-MS) és a nehézfém koncentrációk (Cu, Zn, Mn, Co, Pb, Cr, Ni) (ICP-OES). Meghatároztuk a különböző szélesemények hatására bekövetkező talajveszteség mértékét. Csapdáztuk a fújatás során elszállított talajanyagot, vizsgáltuk ezekben a nehézfém és növényvédőszer koncentrációkat. Dúsulásuk mértékét feldúsulási faktor (FF) segítségével becsültük meg. Az elszállított talajanyag ismeretében számszerűsíthető mennyi szennyezőanyag mozdulhat el, kerülhet ki a szántókról egy-egy szélesemény során.

Köszönetnyilvánítás

A tanulmány a „Különböző talajtípusok defláció érzékenységének in situ szélcsatorna kísérletekre alapozott vizsgálata, on site és off site hatások” című, OTKA 1K 116981 azonosító számú pályázat támogatásával valósult meg.
A szerzők köszönetüket fejezik ki az EFOP-3.6.2-16-2017-00010 „Fenntartható nyersanyag-gazdálkodás tematikus hálózat fejlesztése – RING 2017 és a TÉT 2017-2.3.7-TÉT-IN-2017_00016 azonosító számú pályázatok anyagi támogatásáért.