Resistant ammonia-oxidizing archaea endure, but adapting ammonia-oxidizing bacteria thrive in boreal lake sediments receiving nutrient-rich effluents

Climate change along with anthropogenic activities changes biogeochemical conditions in lake ecosystems, modifying the sediment microbial communities. Wastewater effluents introduce nutrients and organic material but also novel microbes to lake ecosystems, simulating forthcoming increases in catchment loadings. In this work, we first used 16s rRNA gene sequencing to study how the overall sediment microbial community responds to wastewater in six boreal lakes. To examine forthcoming changes in the lake biogeochemistry, we focused on the ammonia-oxidizing archaea (AOA) and bacteria (AOB), and examined their functional and compositional community response to wastewater. Although we found the least diverse and least resistant prokaryotic communities from the most wastewater-influenced sediments, the community changed fast toward the natural composition with the diminishing influence of wastewater. Each lake hosted a unique resistant AOA community, while AOB communities were adapting, responding to environmental conditions as well as receiving new members from WWTPs. In general, AOB dominated in numbers in wastewater-influenced sediments, while the ratio between AOA and AOB increased when moving toward pristine conditions. Our results suggest that although future climate-change-driven increases in nutrient loading and microbial migration might significantly disrupt lake sediment microbiomes, they can promote nitrification through adapting and abundant AOB communities.

General information

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Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Jyväskylän yliopisto, University of Eastern Finland
Contributors: Aalto, S. L., Saarenheimo, J., Mikkonen, A., Rissanen, A. J., Tiirola, M.
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Source ID: 85053358837
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Formation and use of biogenic jarosite carrier for high-rate iron oxidising biofilms

Jarosite precipitates formed in iron oxidising bioreactors have been shown to harbour iron-oxidisers. The aim of this study was to develop an iron oxidising bioprocess where microorganisms are retained solely on biogenic jarosite particles. Based on preliminary experiments using a fluidised-bed bioreactor (FBR), the formed jarosite particles started to disintegrate and wash out at upflow velocities of ≥0.21 cm/s. Therefore, the generation and use of biogenic jarosite carrier was studied in an expanded-bed bioreactor (J-EBR) with an upflow velocity of 0.19 cm/s. Inside J-EBR, the jarosite particles formed granules of 0.5–3 mm containing 200–460 mg/g of attached biomass. The performance of J-EBR was compared with an activated carbon biofilm FBR at 0.82 cm/s upflow velocity (AC-FBR). At 35 ± 2 °C with a feed ferrous iron concentration of 10 g/l, the highest obtained iron oxidation rate of J-EBR (6.8 g/l/h) was 33% lower than that of AC-FBR (10.1 g/l/h). This was likely due to the 80% lower recirculation rate and subsequently higher oxygen mass transfer limitation in J-EBR compared to AC-FBR. The present study demonstrates that biogenic jarosite can be used for retainment of iron oxidising biofilms in expanded-bed bioreactors that oxidise iron at high rates.

General information

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Organisations: Research group: Bio- and Circular Economy, Materials Science and Environmental Engineering, Physics, Civil Engineering
Contributors: Ahoranta, S., Hulkkonen, H., Salminen, T., Kuula, P., Puhakka, J. A., Lakaniemi, A. M.

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Research output: Contribution to journal › Article › Scientific › peer-review

Sensory properties of Nordic edible mushrooms
Edible mushrooms are a global food with a history of consumption spanning several millennia. However, studies utilizing modern sensory methods on mushrooms are still scarce. In this study, the sensory properties of Nordic edible mushrooms were analyzed by two methods. In the sensory profile, sous vide processed wild mushroom species Cantharellus cibarius, Craterellus tubaeformis, Boletus edulis, and Lactarius camphoratus were studied with cultivated Agaricus bisporus as a control species. The sensory profile consisted of 18 descriptors, and the 5 mushrooms differed from each other in all of them. Only B. edulis and A. bisporus were linked to typical mushroom-like odor. In projective mapping, consumers evaluated blanched wild C. cibarius, C. tubaeformis and Suillus variegatus as well as cultivated Lentinula edodes and both blanched and fresh A. bisporus based on odor and on flavor. The consumers intuitively grouped the samples into three groups: wild, fresh cultivated and processed cultivated mushrooms. Wild mushrooms had a high odor intensity and various odor descriptions but a low flavor intensity. Cultivated mushrooms had opposite descriptions. Both tests showed differences in the sensory descriptors between the cultivated and wild mushrooms with the former linked to typical ‘mushroom’, indicating the importance and need for descriptive profiles for different mushroom types.

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Organisations: Chemistry and Bioengineering, Turun Yliopisto/Turun Biomateriaalikeskus
Contributors: Aisala, H., Laaksonen, O., Manninen, H., Raittola, A., Hopia, A., Sandell, M.
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Research output: Contribution to journal › Article › Scientific › peer-review

Searching for a robust strategy for minimizing alkali chlorides in fluidized bed boilers during burning of high SRF-energy-share fuel
To meet the increasing volume of waste to be treated via energy recovery, high SRF-energy-share fuel is being fired in conventional waste-to-energy facilities. In this work, corrosion related risk during firing of 70 e-% share (target fuel) is studied and compared against the base case fuel containing 50 e-% share. Cl and S concentration is highest in the target fuel as a direct result of increasing the proportion of SRF in the fuel mixture. Br, Zn and Pb showed the same trend. Meanwhile, the concentration of Na, K, Al and Si are highly dependent on the type of the SRF fired. The corrosion risk of the base and target fuels are analyzed using the composition of the fine aerosol fraction and deposit samples measured near the vicinity of the superheater. Surprisingly aerosols for the target fuel are less risky - having less Cl and more S,

than that of the base fuel. The effects of sulfur based additives - elemental sulfur and sulfate injection, and fuel substitution on the risk of superheater corrosion are likewise analyzed. All these strategies can reduce the concentration of Cl in the aerosols, however it is concluded that sulfate injection is considered as a robust strategy for mitigating alkali chloride formation. Sulfate injection is able to reduce Cl in the aerosols and deposits regardless of the quality of the fuel mixture. Robust strategies are important in ensuring the boiler performance during high SRF-energy share firing. An attempt of linking the quality of the deposits and the properties of the flue gas and aerosols around the superheater using partial least squares regression is also presented.

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Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), University of Jyväskylä, Valmet Technologies Oy, VTT Technical Research Centre of Finland, Department of Chemistry, Renewable Natural Resources and Chemistry of Living Environment, Stora Enso
Contributors: Bajamundi, C. J. E., Vainikka, P., Hedman, M., Silvennoinen, J., Heinanen, T., Taipale, R., Konttinen, J.
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Source: Scopus
Source ID: 84928243284
Research output: Contribution to journal › Article › Scientific › peer-review

Fe2O3-TiO2 nanosystems by a hybrid PE-CVD/ALD approach: controllable synthesis, growth mechanism, and photocatalytic properties
Supported Fe2O3-TiO2 nanocomposites are fabricated by an original vapor phase synthetic strategy, consisting of the initial growth of Fe2O3 nanosystems on fluorine-doped tin oxide substrates by plasma enhanced-chemical vapor deposition, followed by atomic layer deposition of TiO2 overlayers with variable thickness, and final thermal treatment in air. A thorough characterization of the target systems is carried out by X-ray diffraction, atomic force microscopy, field emission-scanning electron microscopy, energy dispersive X-ray spectroscopy, transmission electron microscopy, and X-ray photoelectron spectroscopy. High purity nanomaterials characterized by the co-presence of Fe2O3 (hematite) and TiO2 (anatase), with an intimate Fe2O3-TiO2 contact, are successfully obtained. In addition, photocatalytic tests demonstrate that, whereas both single-phase oxides do not show appreciable activity, the composite systems are able to degrade methyl orange aqueous solutions under simulated solar light, and even visible light, with an efficiency directly dependent on TiO2 overlayer thickness. This finding opens attractive perspectives for eventual applications in wastewater treatment.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Padova University, Padova University and INSTM, Department of Physics and Astronomy, University of Turku, Univ Antwerp, University of Antwerp, EMAT, CNR-IENI and INSTM, Department of Chemistry, Department of Chemical and Pharmaceutical Sciences, ICCOM-CNR Trieste Research Unit - INSTM Research Unit, Trieste University
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Original language: English
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Source: Scopus
Source ID: 84938522112
Research output: Contribution to journal › Article › Scientific › peer-review

Structural photoactivation of a full-length bacterial phytochrome
Phytochromes are light sensor proteins found in plants, bacteria, and fungi. They function by converting a photon absorption event into a conformational signal that propagates from the chromophore through the entire protein. However, the structure of the photoactivated state and the conformational changes that lead to it are not known. We report time-resolved x-ray scattering of the full-length phytochrome from Deinococcus radiodurans on micro- and millisecond time scales. We identify a twist of the histidine kinase output domains with respect to the chromophore-binding domains as the dominant change between the photoactivated and resting states. The time-resolved data further show that the structural changes up to the microsecond time scales are small and localized in the chromophore-binding domains. The global structural change occurs within a few milliseconds, coinciding with the formation of the spectroscopic meta-Rc state. Our findings establish key elements of the signaling mechanism of full-length bacterial phytochromes.

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, University of Jyväskylä
Contributors: Björling, A., Berntsson, O., Lehtivuori, H., Takala, H., Hughes, A. J., Panman, M., Hoernke, M., Niebling, S., Henry, L., Henning, R., Kosheleva, I., Chukharev, V., Tkachenko, N. V., Menzel, A., Newby, G., Khakhulin, D., Wulff, M., A. Ihalainen, J., Westenhoff, S.
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URLs:

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Research output: Contribution to journal › Article › Scientific › peer-review

Microbial electrochemical technologies with the perspective of harnessing bioenergy: Maneuvering towards upscaling
Microbial electrochemical technologies have gained much attention in the recent years during which basic research has been carried out to provide proof of concept by utilizing microorganisms for generating bioenergy in an electro redox active environment. However, these bio-electrocatalyzed systems pose significant challenges towards up-scaling and practical applications. Various parameters viz., electrodes, materials, configuration, biocatalyst, reaction kinetics, fabrication and operational costs, resistance for electron transfer etc. will critically govern the performance of microbial catalyzed electrochemical systems. Majorly, the surface area of electrode materials, biofilm coverage on the electrode surface,

enrichment of electrochemically active electrode respiring bacteria and reduction reactions at cathode will aid in increasing the reaction kinetics towards the upscaling of microbial electrochemical technologies. Enrichment of electroactive microbial community on anode electrode can be promoted with electrode pretreatment, controlled anode potential or electrical current, external resistance, optimal operation temperature, chemical additions and bioaugmentation. Inhibition of the growth of methanogens also increases the columbic efficiency, an essential parameter that determines the efficacy of bioelectricity generation. Considering the practical implementation of these microbial electrochemical technologies, the current review addresses the challenges and strategies to improve the performance of bio-electrocatalyzed systems with respect to the operational, physico-chemical and biological factors towards scale up. Besides, the feasibility for long term operation, the scope for future research along with the operational and maintenance costs are discussed to provide a broad spectrum on the role of the system components for the implementation of these bio-electrochemical technologies for practical utility.

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MoE publication type: A2 Review article in a scientific journal
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, CSIR-Indian Institute of Chemical Technology, Indian Institute of Technology, Delhi, India, Department of Environmental Engineering, Yildiz Technical University, Department of Chemical Engineering, Bioengineering and Environmental Sciences (BEES), CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Sustainable Environergy Research Laboratory (SERL), Indian Institute of Technology Delhi
Contributors: Butti, S. K., Velvizhi, G., Sulonen, M. L. K., Haavisto, J. M., Oguz Koroglu, E., Yusuf Cetinkaya, A., Singh, S. , Arya, D., Annie Modestra, J., Vamsi Krishna, K., Verma, A., Ozkaya, B., Lakaniemi, A., Puhakka, J. A., Venkata Mohan, S.
Pages: 462-476
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Ratings:

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Original language: English
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment
Keywords: Biocatalyst, Bioelectrochemical system, Electrode materials, Fuel celldesign, Microbial fuelcell
DOIs:

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Source: Scopus
Source ID: 84942275042
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Electricity production by a microbial fuel cell fueled by brewery wastewater and the factors in its membrane deterioration
Electricity production from brewery wastewater using dual-chamber microbial fuel cells (MFCs) with a tin-coated copper mesh in the anode was investigated by changing the hydraulic retention time (HRT). The MFCs were fed with wastewater samples from the inlet (inflow, MFC-1) and outlet (outflow, MFC-2) of an anaerobic digester of a brewery wastewater treatment plant. Both chemical oxygen demand removal and current density were improved by decreasing HRT. The best MFC performance was with an HRT of 0.5 d. The maximum power densities of 8.001 and 1.843 μW/cm² were obtained from reactors MFC-1 and MFC-2, respectively. Microbial diversity at different conditions was studied using PCR-DGGE profiling of 16S rRNA fragments of the microorganisms from the biofilm on the anode electrode. The MFC reactor had mainly Geobacter, Shewanella, and Clostridium species, and some bacteria were easily washed out at lower HRTs. The fouling characteristics of the MFC Nafion membrane and the resulting degradation of MFC performance were examined. The ion exchange capacity, conductivity, and diffusivity of the membrane decreased significantly after fouling. The morphology of the Nafion membrane and MFC degradation were studied using scanning electron microscopy and attenuated total reflection-Fourier transform infrared spectroscopy.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Portland State University, Department of Civil and Environmental Engineering, Yildiz Technical University
Contributors: Çetinkaya, A. Y., Köroğlu, E. O., Demir, N. M., Baysoy, D. Y., Özkaya, B., Çakmakçi, M.
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Original language: English
ASJC Scopus subject areas: Catalysis, Chemistry(all)
Keywords: Anaerobic processe, Biofilm, Microbial community, Microbial fuel cell, Wastewater treatment
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EXT="Çakmakçi, Mehmet"
Source: Scopus
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Research output: Contribution to journal › Article › Scientific › peer-review

Remediation of sedimented fiber originating from pulp and paper industry: Laboratory scale anaerobic reactor studies and ideas of scaling up
Anaerobic treatment of sedimented fibers collected from bottom of a bay that had been receiving pulp and paper mill wastewater for about 70 years were studied for the first time in semi-continuously fed continuously stirred tank reactors (CSTR). Anaerobic treatment of the fiber sediment was shown to be feasible, without dilution and with nitrogen and buffer supplement, at organic loading rates (OLR) up to 2.5 kg VS/m^3d and hydraulic retention times (HRT) of 60 d resulting in methane yields of 201 ± 18 L CH_4/kg VS. Co-digestion of sedimented fiber with sewage sludge at an OLR of 1.5 kg VS/m^3d and HRT of 20 d resulted in a methane production of 246 ± 10 L CH_4/kg VS. The techno-economic feasibility of mono and co-digestion process together with several case dependent factors such as maximum operable OLR, digestate utilization needs to be evaluated before making further conclusions for larger scale remediation applications.

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Finnish Consulting Group (FCG Suunnittelu ja tekniikka Oy)
Contributors: Chatterjee, P., Lahtinen, L., Kokko, M., Rintala, J.
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ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution
Keywords: Anaerobic digestion, Co-digestion, CSTR, Methane, Pulp and paper industry, Sedimented fiber
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Source: Scopus
Source ID: 85053165247
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Selective enrichment of biocatalysts for bioelectrochemical systems: A critical review

Microbial electrochemical technologies (MET), also known as bioelectrochemical systems (BES), use microorganisms as biocatalysts to recover valuable resources like bioelectricity, hydrogen, nutrients, metals, and industrial chemicals from wastes and wastewaters. MET are therefore expected to play a key role in waste management and reduction of the carbon footprint in the near future. However, considerable fundamental and technological challenges still need to be addressed before using MET in practice. Rapid start-up, as well as an efficient and stable performance, are the pre-requisites to achieve commercialization of MET. Although considerable advancements have been made in this field in the past two decades, no general conclusion has been drawn about how to start-up BES in the most efficient manner. This review aims to survey and critically analyze start-up strategies proposed in the literature to favor a fast and efficient establishment of electrochemically active microorganisms onto bioanodes or biocathodes and promote their activity over a long period of operation. Various aspects of BES start-up, including inoculum selection, elimination of competitive microorganisms, and selection of operational parameters for enrichment of electroactive biofilms are covered. In summary, inoculation with already enriched culture, imposing of an anode potential or using polarity reversal at the cathode are the potential methods for ensuring fast and efficient BES start-up. Electrode configuration and hydrodynamic conditions are also major aspects to be considered for biofilm formation and development.

General information

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Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, Indian Institute of Technology, National University of Ireland Galway
Contributors: Chatterjee, P., Dessì, P., Kokko, M., Lakaniemi, A., Lens, P.
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Source ID: urn:B1F2B89A69369CE2DD75698B4E3471CE
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Inhibitory effects of substrate and soluble end products on biohydrogen production of the alkalithermophile Caloramator celer: Kinetic, metabolic and transcription analyses

In this study the tolerance of the alkalithermophile Caloramator celer towards substrate (glucose) and soluble end product (acetate, formate and ethanol) inhibition was assessed employing nonlinear inhibition models. In addition, the effects of subinhibitory concentrations of end products on fermentative metabolism and regulation of 12 key genes involved in pyruvate catabolism were studied. Optimal growth and H_2 production were found at 50 mM of glucose and the critical substrate concentration was observed at 290-360 mM. Two inhibition models revealed that ethanol had a higher inhibitory effect on growth rate, whereas H_2 production kinetics was more sensitive towards increasing concentrations of acetate and formate. Acetate, the main soluble metabolite of the fermentation, inhibited the H_2 production by increasing the ionic strength in the medium. Subinhibitory concentrations of soluble end products induced changes in the metabolite profile of C. celer, specifically exogenous acetate (80 mM) and ethanol (40 mM) slightly increased the H_2 yield by 4 and 7%, respectively. However, despite the observed metabolic shifts, gene regulation was minimal and not always in agreement with the measured product yields. Overall, the results suggest that further optimization of the H_2 production process from C. celer should focus on methods to evolve adapted osmotolerant strains and/or remove soluble metabolites, especially acetate, from the culture.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio)

Contributors: Ciranna, A., Ferrari, R., Santala, V., Karp, M.
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ISSN (Print): 0360-3199
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Original language: English
ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Condensed Matter Physics, Energy Engineering and Power Technology
Keywords: Acetate, Dark fermentation, End product inhibition, Gene expression, Kinetic model, Substrate inhibition
DOIs:

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Portfolio EDEND: 2014-04-29
Publisher name: Elsevier Ltd; International Association for Hydrogen Energy
Source: researchoutputwizard
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Research output: Contribution to journal › Article › Scientific › peer-review

Assessment of metabolic flux distribution in the thermophilic hydrogen producer Caloramator celer as affected by external pH and hydrogen partial pressure

Background: Caloramator celer is a strict anaerobic, alkalitolerant, thermophilic bacterium capable of converting glucose to hydrogen (H_2), carbon dioxide, acetate, ethanol and formate by a mixed acid fermentation. Depending on the growth conditions C. celer can produce H_2 at high yields. For a biotechnological exploitation of this bacterium for H_2 production it is crucial to understand the factors that regulate carbon and electron fluxes and therefore the final distribution of metabolites to channel the metabolic flux towards the desired product.Results: Combining experimental results from batch fermentations with genome analysis, reconstruction of central carbon metabolism and metabolic flux analysis (MFA), this study shed light on glucose catabolism of the thermophilic alkalitolerant bacterium C. celer. Two innate factors pertaining to culture conditions have been identified to significantly affect the metabolic flux distribution: culture pH and partial pressures of H_2 (P_{H2}). Overall, at alkaline to neutral pH the rate of biomass synthesis was maximized, whereas at acidic pH the lower growth rate and the less efficient biomass formation are accompanied with more efficient energy recovery from the substrate indicating high cell maintenance possibly to sustain intracellular pH homeostasis. Higher H_2 yields were associated with fermentation at acidic pH as a consequence of the lower synthesis of other reduced by-products such as formate and ethanol. In contrast, P_{H2} did not affect the growth of C. celer on glucose. At high P_{H2} the cellular redox state was balanced by rerouting the flow of carbon and electrons to ethanol and formate production allowing unaltered glycolytic flux and growth rate, but resulting in a decreased H_2 synthesis.Conclusion: C. celer possesses a flexible fermentative metabolism that allows redistribution of fluxes at key metabolic nodes to simultaneously control redox state and efficiently harvest energy from substrate even under unfavorable conditions (i.e. low pH and high P_{H2}). With the H_2 production in mind, acidic pH and low P_{H2} should be preferred for a high yield-oriented process, while a high productivity-oriented process can be achieved at alkaline pH and high P_{H2}. © 2014 Ciranna et al.; licensee BioMed Central Ltd.

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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Tampere University of Technology, Urban circular bioeconomy (UrCirBio), Lunds Universitet / Lunds Tekniska Högskola, Lund Univ, Lund University, Department of Applied Microbiology
Contributors: Ciranna, A., Pawar, S. S., Santala, V., Karp, M., van Niel, E. W. J.
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Portfolio EDEND: 2014-04-29
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Research output: Contribution to journal › Article › Scientific › peer-review

Temperature control as key factor for optimal biohydrogen production from thermomechanical pulping wastewater
This study evaluates the use of non-pretreated thermo-mechanical pulping (TMP) wastewater as a potential substrate for hydrogen production by dark fermentation. Batch incubations were conducted in a temperature gradient incubator at temperatures ranging from 37 to 80 °C, using an inoculum from a thermophilic, xylose-fed, hydrogen-producing fluidised bed reactor. The aim was to assess the short-term response of the microbial communities to the different temperatures with respect to both hydrogen yield and composition of the active microbial community. High throughput sequencing (MiSeq) of the reversely transcribed 16S rRNA showed that Thermoanaerobacterium sp. dominated the active microbial community at 70 °C, resulting in the highest hydrogen yield of 3.6 (±0.1) mmol H_2 g^{-1} COD_{tot} supplied. Lower hydrogen yields were obtained at the temperature range from 37 to 65 °C, likely due to consumption of the produced hydrogen by homoacetogenesis. No hydrogen production was detected at temperatures above 70 °C. Thermomechanical pulping wastewaters are released at high temperatures (50–80 °C), and thus dark fermentation at 70 °C could be sustained using the heat produced by the pulp and paper plant itself without any requirement for external heating.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Research group: Industrial Bioengineering and Applied Organic Chemistry, Natl. University of Ireland, Galway, Institute for Water Education, UNESCO–IHE
Contributors: Dessì, P., Porca, E., Lakaniemi, A., Collins, G., Lens, P. N.
Number of pages: 8
Pages: 214-221
Publication date: 15 Sep 2018
Peer-reviewed: Yes

Publication information
Journal: Biochemical Engineering Journal
Volume: 137
ISSN (Print): 1369-703X
Ratings:

Scopus rating (2018): CiteScore 6 SJR 0.904 SNIP 1.167
Original language: English
ASJC Scopus subject areas: Biotechnology, Bioengineering, Environmental Engineering, Biomedical Engineering
Keywords: Dark fermentation, MiSeq, Pulp and paper mill wastewater, Thermoanaerobacterium, Thermomechanical pulping, Thermophilic
Electronic versions:

Temperature control as key factor

Dessi et al. 2018 - Temperature control for optimal biohydrogen production from TMP wastewater. Embargo ended: 7/06/20
DOIs:

10.1016/j.bej.2018.05.027
URLs:

http://urn.fi/URN:NBN:fi:tty-201901231145
Source: Scopus
Source ID: 85048157059

Synthesis, crystal structure, physico-chemical characterization and dielectric properties of a new hybrid material, 1-Ethylpiperazine-1,4-diium tetrachlorocadmate

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Carthage University, Laboratoire de chimie des Matériaux, Faculté des Sciences de Bizerte, Université de Carthage
Contributors: Dhieb, A. C., Valkonen, A., Rzaigui, M., Smirani, W.
Number of pages: 7
Pages: 50-56
Publication date: 15 Dec 2015
Peer-reviewed: Yes
Early online date: 22 Aug 2015

Publication information
Journal: Journal of Molecular Structure
Volume: 1102
ISSN (Print): 0022-2860
Ratings:

Scopus rating (2015): CiteScore 2.8 SJR 0.446 SNIP 0.837
Original language: English
ASJC Scopus subject areas: Spectroscopy, Analytical Chemistry, Inorganic Chemistry, Organic Chemistry
Keywords: Dielectric properties, IR-Raman spectroscopies, NMR spectroscopy, Phase transition, Photoluminescence, X-Ray diffraction
DOIs:

10.1016/j.molstruc.2015.08.044
URLs:

http://www.scopus.com/inward/record.url?scp=84940482600&partnerID=8YFLogxK (Link to publication in Scopus)
Source: Scopus
Source ID: 84940482600
Research output: Contribution to journal › Article › Scientific › peer-review

High-rate thiosulfate-driven denitrification at pH lower than 5 in fluidized-bed reactor
Abstract This study investigated the potential of a fluidized-bed biofilm dominated by Thiobacillus denitrificans to sustain thiosulfate-driven denitrification under increasingly acidic conditions. A fluidized-bed reactor (FBR) performing denitrification via thiosulfate ($S_2O_3^{2-}$) oxidation of a nitrate-contaminated synthetic wastewater was first operated under decreasing feed pH values from 7.00 to 5.25. Denitrification efficiency > 99% was observed even at feed and effluent pH of 5.75 and 5.30, respectively. At lower feed pH values, the denitrification efficiency decreased rapidly due to inorganic carbon deficiency. The addition of a carbonation unit continuously feeding anaerobic grade CO_2 to the FBR biofilm allowed to investigate denitrification at pH values lower than 5.0. This new configuration, i.e. FBR with a carbonation unit, was able to sustain a complete and stable denitrification even at pH as low as 4.75. Denaturing gradient gel electrophoresis (DGGE) showed the evolution of the denitrifying biofilm during the FBR operation, resulting in a robust and high-performing mixotrophic consortium of chemolithotrophic and heterotrophic bacteria dominated by T. denitrificans. Batch activity tests performed at three different stages of the FBR operation (feed pH 7.0, 6.0 and 5.25) showed that low pH cultivation enhanced the denitrification activity (mg N/g VS d) of the FBR biofilm at acidic pH values.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Di Capua, F., Lakaniemi, A., Puhakka, J. A., Lens, P. N. L., Esposito, G.
Number of pages: 10
Pages: 282-291
Publication date: Feb 2017
Peer-reviewed: Yes
Early online date: 28 Oct 2016

Publication information
Journal: Chemical Engineering Journal

Volume: 310, Part 1
ISSN (Print): 1385-8947
Ratings:
Scopus rating (2017): CiteScore 10.8 SJR 1.863 SNIP 1.96
Original language: English
Keywords: Acidic wastewater treatment, Autotrophic denitrification, Chemolithotrophic denitrifiers, Fluidized-bed reactor, Mixotrophic biofilm, Thiosulfate
DOIs:
10.1016/j.cej.2016.10.117
Source: RIS
Source ID: urn:63A5AD5846B4CA4F52FF655EE34EB47C
Research output: Contribution to journal › Article › Scientific › peer-review

Anaerobic batch conversion of pine wood torrefaction condensate

Organic compound rich torrefaction condensate, owing to their high water content and acidic nature, have yet to be exploited for practical application. In this study, microbial conversion of torrefaction condensate from pine wood through anaerobic batch digestion (AD) to produce methane was evaluated. Torrefaction condensate exhibited high methane potentials in the range of 430-492mL/g volatile solids (VS) and 430-460mL/gVS under mesophilic and thermophilic conditions, respectively. Owing to the changes in the composition, the methane yields differed with the torrefaction condensates produced at different temperatures (225, 275 and 300°C), with a maximum of 492±18mL/gVS with the condensate produced at 300°C under mesophilic condition. The cyclic batch AD experiments showed that 0.1VSsubstrate:VSinoculum is optimum, whereas the higher substrate loading (0.2-0.5) resulted in a reversible inhibition of the methane production. The results suggest that torrefaction condensate could be practically valorized through AD.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Doddapaneni, T. R. K. C., Praveenkumar, R., Tolvanen, H., Palmroth, M. R. T., Konttinen, J., Rintala, J.
Number of pages: 9
Pages: 299-307
Publication date: Feb 2017
Peer-reviewed: Yes
Early online date: 22 Nov 2016

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Journal: Bioresource Technology
Volume: 225
ISSN (Print): 0960-8524
Ratings:
Scopus rating (2017): CiteScore 10 SJR 2.029 SNIP 1.84
Original language: English
DOIs:
10.1016/j.biortech.2016.11.073

Source: PubMed
Source ID: 27898321
Research output: Contribution to journal › Article › Scientific › peer-review

Performance of a biotrickling filter for the anaerobic utilization of gas-phase methanol coupled to thiosulphate reduction and resource recovery through volatile fatty acids production

The anaerobic removal of continuously fed gas-phase methanol (2.5–30 g/m^3.h) and the reduction of step-fed thiosulphate (1000 mg/L) was investigated in a biotrickling filter (BTF) operated for 123 d at an empty bed residence time (EBRT) of 4.6 and 2.3 min. The BTF performance during steady step-feed and special operational phases like intermittent liquid trickling in 6 and 24 h cycles and operation without pH regulation were evaluated. Performance of the BTF was not affected and nearly 100% removal of gas-phase methanol was achieved with an EC_{max} of 21 g/m^3.h. Besides, >99% thiosulphate reduction was achieved, in all the phases of operation. The production of sulphate, H_2S and volatile fatty acids (VFA) was monitored and a maximum of 2500 mg/L of acetate, 200 mg/L of propionate, 150 mg/L of isovalerate and 100 mg/L isobutyrate was produced.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Institute for Water Education
Contributors: Eregowda, T., Matanhike, L., Rene, E. R., Lens, P. N.
Number of pages: 10
Pages: 591-600
Publication date: 1 Sep 2018
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 263
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2018): CiteScore 11.1 SJR 2.157 SNIP 1.858
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Renewable Energy, Sustainability and the Environment, Waste Management and Disposal
Keywords: Anaerobic, Biotrickling filter (BTF), Gas-phase methanol, Steady and intermittent BTF operation, Thiosulphate reduction, Volatile fatty acid
DOIs:

10.1016/j.biortech.2018.04.095
Source: Scopus
Source ID: 85047081553
Research output: Contribution to journal › Article › Scientific › peer-review

Bi-directional cell-pericellular matrix interactions direct stem cell fate
Modifiable hydrogels have revealed tremendous insight into how physical characteristics of cells' 3D environment drive stem cell lineage specification. However, in native tissues, cells do not passively receive signals from their niche. Instead they actively probe and modify their pericellular space to suit their needs, yet the dynamics of cells' reciprocal interactions with their pericellular environment when encapsulated within hydrogels remains relatively unexplored. Here, we show that human bone marrow stromal cells (hMSC) encapsulated within hyaluronic acid-based hydrogels modify their surroundings by synthesizing, secreting and arranging proteins pericellularly or by degrading the hydrogel. hMSC's interactions with this local environment have a role in regulating hMSC fate, with a secreted proteinaceous pericellular matrix associated with adipogenesis, and degradation with osteogenesis. Our observations suggest that hMSC participate in a bi-directional interplay between the properties of their 3D milieu and their own secreted pericellular matrix, and that this combination of interactions drives fate.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Biomaterials and Tissue Engineering Group, Faculty of Biomedical Sciences and Engineering, King's College London, The Francis Crick Institute, UCL Eastman Dental Institute, Imperial College, London, 24.8.2012, University College London, Uppsala University, University of Toronto, Canada
Contributors: Ferreira, S. A., Motwani, M. S., Faull, P. A., Seymour, A. J., Yu, T. T., Enayati, M., Taheem, D. K., Salzlechner, C., Haghighi, T., Kania, E. M., Oommen, O. P., Ahmed, T., Loaiza, S., Parzych, K., Dazzi, F., Varghese, O. P., Festy, F., Grigoriadis, A. E., Auner, H. W., Snijders, A. P., Bozec, L., Gentleman, E.
Number of pages: 12
Publication date: Dec 2018
Peer-reviewed: Yes

Publication information
Journal: Nature Communications
Volume: 9
Issue number: 1
Article number: 4049
ISSN (Print): 2041-1723
Ratings:

Scopus rating (2018): CiteScore 18.1 SJR 5.992 SNIP 2.86
Original language: English
ASJC Scopus subject areas: Chemistry(all), Biochemistry, Genetics and Molecular Biology(all), Physics and Astronomy(all)
Electronic versions:

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10.1038/s41467-018-06183-4
URLs:
http://urn.fi/URN:NBN:fi:tty-201811012525
Source: Scopus
Source ID: 85054315213
Research output: Contribution to journal › Article › Scientific › peer-review

Storing of exoelectrogenic anolyte for efficient microbial fuel cell recovery

Starting up a microbial fuel cell (MFC) requires often a long-term culture enrichment period, which is a challenge after process upsets. The purpose of this study was to develop low cost storage for microbial fuel cell enrichment culture to enable prompt process recovery after upsets. Anolyte of an operating xylose-fed MFC was stored at different temperatures and for different time periods. Storing the anolyte for one week or one month at +4 °C did not significantly affect power production, but lag time for power production was increased from 2 days to 3 or 5 days, respectively. One month storing at -20 °C increased the lag time to 7 days. The average power density in these MFCs varied between 1.2 and 1.7 W/m3. The share of dead cells (measured by live/dead staining) increased with storing time. After six-month storage the power production was insignificant. However, xylose removal remained similar in all cultures (99-100%) whilst volatile fatty acids production varied. The results indicate that fermentative organisms tolerated the long storage better than the exoelectrogens. As storing at +4 °C is less energy intensive compared to freezing, anolyte storage at +4 °C for maximum of one month is recommended as start-up seed for MFC after process failure to enable efficient process recovery.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy
Contributors: Haavisto, J. M., Lakaniemi, A., Puhakka, J. A.
Publication date: 2019
Peer-reviewed: Yes
Early online date: 2018

Publication information
Journal: Environmental Technology
Volume: 40
Issue number: 11
ISSN (Print): 0959-3330
Ratings:
Scopus rating (2019): CiteScore 3.4 SJR 0.485 SNIP 0.693
Original language: English
Electronic versions:
Storing of exoelectrogenic anolyte for efficient microbial fuel cell recovery
DOIs:
10.1080/09593330.2017.1423395
URLs:
http://urn.fi/URN:NBN:fi:tty-201907151971
Research output: Contribution to journal › Article › Scientific › peer-review

Enabling and Integrative Infrastructure Policy: The Role of Inverse Infrastructures in Local Infrastructure Provision with Special Reference to Finnish Water Cooperatives

Infrastructures are necessary to support the functionality of urban communities. Globalization, increased polycentricity, new trends in governance and tightening public budgets have increased interest in alternative ways of providing such infrastructures. One product of this trend is the ‘inverse infrastructure,’ which refers to a modularized, semi-autonomous and user-driven infrastructure that is a result of the self-organization of local actors. In this study, we discuss the nature of such infrastructures and the challenges they pose to local infrastructure policy with special reference to the case of water cooperatives in Finland. Our conclusion is that inverse infrastructures have a potential to contribute to local infrastructure services either as cost-effective alternative or as supplement to large technical systems. Their full utilization requires, however, enabling and integrative infrastructure policy.

General information
Publication status: Published
MoE publication type: D4 Published development or research report or study
Organisations: Department of Chemistry and Bioengineering, University of Tampere
Contributors: Heino, O., Anttiroiko, A.

Publication date: 28 Nov 2014

Publication information
Publisher: MPRA
Original language: English

Publication series
Name: MPRA Paper
No.: 60276
Keywords: Infrastructure, Infrastructure policy, Public policy , Local government , Inverse infrastructure, Complex adaptive system, Adaptation, Self-Organization, Resilience, Volunteering, Water services, Water cooperative, Finland
URLs:

https://mpra.ub.uni-muenchen.de/60276/
Research output: Book/Report › Commissioned report › Professional

Energy Demands of Nitrogen Supply in Mass Cultivation of Two Commercially Important Microalgal Species, Chlorella vulgaris and Dunaliella tertiolecta

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Contributors: Hulatt, C. J., Lakaniemi, A., Puhakka, J. A., Thomas, D. N.
Pages: 669-684
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: BioEnergy Research
Volume: 5
Issue number: 3
ISSN (Print): 1939-1234
Ratings:

Scopus rating (2012): CiteScore 4.5 SJR 1.349 SNIP 1.668
Original language: English
DOIs:

10.1007/s12155-011-9175-x

Bibliographical note
Contribution: organisation=keb bio,FACT1=1
Publisher name: Springer-Verlag
Source: researchoutputwizard
Source ID: 4239
Research output: Contribution to journal › Article › Scientific › peer-review

Use of diluted urine for cultivation of Chlorella vulgaris

Our aim was to study the biomass growth of microalga Chlorella vulgaris using diluted human urine as a sole nutrient source. Batch cultivations (21 days) were conducted in five different urine dilutions (1:25-1:300), in 1:100-diluted urine as such and with added trace elements, and as a reference, in artificial growth medium. The highest biomass density was obtained in 1:100-diluted urine with and without additional trace elements (0.73 and 0.60 g L(-1), respectively). Similar biomass growth trends and densities were obtained with 1:25- and 1:300-diluted urine (0.52 vs. 0.48 gVSS L(-1)) indicating that urine at dilution 1:25 can be used to cultivate microalgal based biomass. Interestingly, even 1:300-diluted urine contained sufficiently nutrients and trace elements to support biomass growth. Biomass production was similar despite pH-variation from < 5 to 9 in different incubations indicating robustness of the biomass growth. Ammonium formation did not inhibit overall biomass growth. At the beginning of cultivation, the majority of the biomass consisted of living algal cells, while towards the end, their share decreased and the estimated share of bacteria and cell debris increased.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Jaatinen, S., Lakaniemi, A., Rintala, J.
Number of pages: 12

Pages: 1159-1170
Publication date: 2016
Peer-reviewed: Yes
Early online date: 7 Nov 2015

Publication information
Journal: Environmental Technology
Volume: 37
Issue number: 9
ISSN (Print): 0959-3330
Ratings:

Scopus rating (2016): CiteScore 3.1 SJR 0.569 SNIP 0.836
Original language: English
DOIs:

10.1080/09593330.2015.1105300
Source: PubMed
Source ID: 26508358
Research output: Contribution to journal › Article › Scientific › peer-review

Preferential adsorption of Cu in a multi-metal mixture onto biogenic elemental selenium nanoparticles
Preferential adsorption of Cu contained in wastewaters is desirable as the Cu can then be reprocessed and reused more easily. In this study, biogenic elemental selenium nanoparticles (BioSeNPs) were assessed for their ability to preferentially adsorb Cu from an equimolar mixture containing Cu, Cd and Zn. Variations in metal to BioSeNPs ratios and initial metal solution pH improved the preferential adsorption capacity of BioSeNPs toward Cu, with the ratio of Cu adsorbed to combined Cd and Zn adsorbed varying from 2.3 to 6.6. More than 78% of the added Cu was adsorbed at an initial metal solution pH of 5.2 and metal to BioSeNPs ratio of $0.21 mg mg^{-1}$ when the ratio of Cu adsorbed to the sum of Cd and Zn adsorbed was 2.3. Infrared spectroscopy revealed that the Cu, Cd and Zn were interacting with the hydroxyl and carboxyl surface functional groups of the BioSeNPs. The modeling of BioSeNPs' acid-base titration revealed the presence of high concentrations of carboxylic groups ($C=60.3 mol kg^{-1}$) with a pK_a of 3.9, providing further evidence of their interaction with Cu. The adsorption of Cu resulted in a lower colloidal stability of the BioSeNPs as indicated by more than 99% retention of added BioSeNPs after adsorption of heavy metals and filtration. BioSeNPs showed a good preferential adsorption capacity toward Cu as compared to other adsorbent. This study provides a proof-of-concept for the preferential adsorption of Cu onto BioSeNPs which are present in the effluent of a bioreactor treating selenium oxyanions containing wastewater.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Tampere University of Technology, Research group: Industrial Bioengineering and Applied Organic Chemistry, Université Paris-Est
Contributors: Jain, R., Dominic, D., Jordan, N., Rene, E. R., Weiss, S., van Hullebusch, E. D., Hübner, R., Lens, P. N. L.
Pages: 917–925
Publication date: 2016
Peer-reviewed: Yes
Early online date: 2015

Publication information
Journal: Chemical Engineering Journal
Volume: 284
ISSN (Print): 1385-8947
Ratings:

Scopus rating (2016): CiteScore 9.7 SJR 1.758 SNIP 1.952
Original language: English
ASJC Scopus subject areas: Chemical Engineering(all), Chemistry(all), Industrial and Manufacturing Engineering, Environmental Chemistry
Keywords: Biogenic, Copper, FT-IR, Heavy metals, Preferential adsorption, Selenium nanoparticles
DOIs:

10.1016/j.cej.2015.08.144
Source: Scopus
Source ID: 84942540702
Research output: Contribution to journal › Article › Scientific › peer-review

Uranium Removal via Sorption Using Peat and Waste Digested Activated Sludge

General information

Publication status: Published
Organisations: Research group: Bio- and Circular Economy, Chemistry and Bioengineering
Contributors: Jain, R., Lakaniemi, A., Peräniemi, S., Kankkunen, J., Turunen, J., Vepsäläinen, J.
Publication date: 2017
Peer-reviewed: Unknown
Event: Paper presented at 13th International Mine Water Association Congress – “Mine Water & Circular Economy – A Green Congress”, .
Research output: Other conference contribution › Paper, poster or abstract › Scientific

Water supply and sanitation services in finland before world war 2

Water supply and sanitation services in Finland before World War II is reviewed. In Finland, fire insurance companies played a significant role in the initial development of water services. Water was needed for putting out fires as well as for domestic and other community purposes. At first, Finnish houses were insured, if at all, with the General Fire Insurance Fund in Stockholm. Important social and political reforms such as municipal self-government and universal suffrage also influenced positively the development of the sector. After Finnish cities opted for municipal ownership and responsibility, three other technical options were adopted: metering-based billing, a ban on lead pipes, and the acceptance of flush toilets. Several plans for sewer systems were made and some were also constructed in the late 1800s. Although the wettest areas of the towns were drained and hygiene improved, lakes were still being polluted due to untreated wastewater discharges. The bucket was replaced by a drainpipe, and the problems were flushed out of sight, untreated, to the nearest water systems as is typical of protosystems.

General information

Publication status: Published
MoE publication type: A2 Review article in a scientific journal
Organisations: Department of Chemistry and Bioengineering, Tampere University of Technology, Life Cycle Effectiveness of the Built Environment (LCE@BE), Former organisation of the author
Contributors: Juuti, P., Katko, T.
Number of pages: 8
Pages: 80-87
Publication date: 2014
Peer-reviewed: Yes

Publication information

Journal: Flux
Volume: 97-98
Issue number: 4
ISSN (Print): 1154-2721
Ratings:

Scopus rating (2014): CiteScore 0.4 SJR 0.169 SNIP 0.515
Original language: English
ASJC Scopus subject areas: Geography, Planning and Development
URLs:

http://www.scopus.com/inward/record.url?scp=84926623647&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note

EXT="Juuti, Petri"
Source: Scopus
Source ID: 84926623647
Research output: Contribution to journal › Review Article › Scientific › peer-review

UV-Blocking Synthetic Biopolymer from Biomass-Based Bifuran Diester and Ethylene Glycol

A furan-based synthetic biopolymer composed of a bifuran monomer and ethylene glycol was synthesized through melt polycondensation, and the resulting polyester was found to have promising thermal and mechanical properties. The bifuran monomer, dimethyl 2,2′-bifuran-5,5′-dicarboxylate, was prepared using a palladium-catalyzed, phosphine ligand-free direct coupling protocol. A titanium-catalyzed polycondensation procedure was found effective at polymerizing the bifuran monomer with ethylene glycol. The prepared bifuran polyester exhibited several intriguing properties including high tensile modulus. In addition, the bifuran monomer furnished the polyester with a relatively high glass transition temperature. Films prepared from the new polyester also had excellent oxygen and water barrier properties, which were found to be superior to those of poly(ethylene terephthalate). Moreover, the novel polyester also has good ultraviolet radiation blocking properties.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials, University of Oulu, Research Unit of Sustainable Chemistry, P.O. Box 3000, FI-90014 Oulu, University of Oulu, Fibre and Particle Engineering Research Unit, P.O. Box 4300, FI-90014 Oulu
Contributors: Kainulainen, T. P., Sirviö, J. A., Sethi, J., Hukka, T. I., Heiskanen, J. P.
Number of pages: 8
Pages: 1822-1829
Publication date: 21 Feb 2018
Peer-reviewed: Yes
Early online date: 21 Feb 2018

Publication information
Journal: Macromolecules
Volume: 51
Issue number: 5
ISSN (Print): 0024-9297
Ratings:

Scopus rating (2018): CiteScore 9.9 SJR 2.243 SNIP 1.492
Original language: English
ASJC Scopus subject areas: Chemistry(all), Materials Science(all)
Keywords: Biopolymers, Synthesis, Characterization, Thermal analysis, Spectroscopy
Electronic versions:

UV-blocking synthetic biopolymer 2018
DOIs:

10.1021/acs.macromol.7b02457
URLs:

http://urn.fi/URN:NBN:fi:tuni-202002132050
Research output: Contribution to journal › Article › Scientific › peer-review

Culturable psychrotolerant methanotrophic bacteria in landfill cover soil

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering
Contributors: Kallistova, A. Y., Montonen, L., Jurgens, G., Münster, U., Kevbrina, M. V., Nozhevnikova, A. N.
Number of pages: 8
Pages: 847-855
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Microbiology
Volume: 82
Issue number: 6
ISSN (Print): 0026-2617
Ratings:

Scopus rating (2013): CiteScore 1.1 SJR 0.325 SNIP 0.571
Original language: English
DOIs:

10.1134/S0026261714010044

Bibliographical note
Original Russian Text: A.Yu.Kallistova, L.Montonen, G.Jurgens, U.Münster, M.V.Kevbrina, A.N.Nozhevnikova, 2014, published in Mikrobiologiya, 2014, Vol. 83, No. 1, pp. 109-118.
Contribution: organisation=keb,FACT1=1
Portfolio EDEND: 2014-02-15
Publisher name: M A I K Nauka
Source: researchoutputwizard
Source ID: 2479
Research output: Contribution to journal › Article › Scientific › peer-review

Metabolic engineering of Acinetobacter baylyi ADP1 for improved growth on gluconate and glucose

A high growth rate in bacterial cultures is usually achieved by optimizing growth conditions, but metabolism of the bacterium limits the maximal growth rate attainable on the carbon source used. This limitation can be circumvented by engineering the metabolism of the bacterium. Acinetobacter baylyi has become a model organism for studies of bacterial metabolism and metabolic engineering due to its wide substrate spectrum and easy-to-engineer genome. It produces

naturally storage lipids, such as wax esters, and has a unique gluconate catabolism as it lacks a gene for pyruvate kinase. We engineered the central metabolism of A. baylyi ADP1 more favorable for gluconate catabolism by expressing the pyruvate kinase gene (pykF) of Escherichia coli. This modification increased growth rate when cultivated on gluconate or glucose as a sole carbon source in a batch cultivation. The engineered cells reached stationary phase on these carbon sources approximately twice as fast as control cells carrying an empty plasmid and produced similar amount of biomass. Furthermore, when grown on either gluconate or glucose, pykF expression did not lead to significant accumulation of overflow metabolites and consumption of the substrate remained unaltered. Increased growth rate on glucose was not accompanied with decreased wax ester production, and the pykF-expressing cells accumulated significantly more of these storage lipids with respect to cultivation time.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Tampere University of Technology, Urban circular bioeconomy (UrCirBio)
Contributors: Kannisto, M., Aho, T., Karp, M., Santala, V.
Number of pages: 7
Pages: 7021-7027
Publication date: 2014
Peer-reviewed: Yes

Publication information

Journal: Applied and Environmental Microbiology
Volume: 80
Issue number: 22
ISSN (Print): 0099-2240
Ratings:

Scopus rating (2014): CiteScore 7.4 SJR 1.872 SNIP 1.394
Original language: English
ASJC Scopus subject areas: Applied Microbiology and Biotechnology, Food Science, Biotechnology, Ecology, Medicine(all)
DOIs:

10.1128/AEM.01837-14
URLs:

http://www.scopus.com/inward/record.url?scp=84908263110&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note

Contribution: organisation=keb,FACT1=1
Portfolio EDEND: 2014-11-20
Publisher name: American Society for Microbiology
Source: researchoutputwizard
Source ID: 650
Research output: Contribution to journal › Article › Scientific › peer-review

Metabolic engineering of Acinetobacter baylyi ADP1 for removal of Clostridium butyricum growth inhibitors produced from lignocellulosic hydrolysates

Background: Pretreatment of lignocellulosic biomass can produce inhibitory compounds that are harmful for microorganisms used in the production of biofuels and other chemicals from lignocellulosic sugars. Selective inhibitor removal can be achieved with biodetoxification where microorganisms catabolize the inhibitors without consuming the sugars. We engineered the strictly aerobic Acinetobacter baylyi ADP1 for detoxification of lignocellulosic hydrolysates by removing the gene for glucose dehydrogenase, gcd, which catalyzes the first step in its glucose catabolism. Results: The engineered A. baylyi ADP1 strain was shown to be incapable of consuming the main sugar components of lignocellulosic hydrolysates, i.e., glucose, xylose, and arabinose, but rapidly utilized acetate and formate. Formate was consumed during growth on acetate and by stationary phase cells, and this was enhanced in the presence of a common aromatic inhibitor of lignocellulosic hydrolysates, 4-hydroxybenzoate. The engineered strain tolerated glucose well up to 70 g/l, and the consumption of glucose, xylose, or arabinose was not observed in prolonged cultivations. The engineered strain was applied in removal of oxygen, a gaseous inhibitor of anaerobic fermentations. Co-cultivation with the A. baylyi ADP1 gcd knockout strain under initially aerobic conditions allowed the strictly anaerobic Clostridium butyricum to grow and produce hydrogen (H_2) from sugars of the enzymatic rice straw hydrolysate. Conclusions: We demonstrated that the model organism of bacterial genetics and metabolism, A. baylyi ADP1, could be engineered to be an efficient biodetoxification strain of lignocellulosic hydrolysates. Only one gene knockout was required to completely eliminate sugar consumption and the strain could be used in production of anaerobic conditions for the strictly anaerobic hydrogen producer, C. butyricum. Because of these encouraging results, we believe that A. baylyi ADP1 is a promising candidate for the detoxification of lignocellulosic hydrolysates for bioprocesses.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), Rhodes University
Contributors: Kannisto, M. S., Mangayil, R. K., Shrivastava-Bhattacharya, A., Pletschke, B. I., Karp, M. T., Santala, V. P.
Publication date: 1 Dec 2015
Peer-reviewed: Yes

Publication information
Journal: Biotechnology for Biofuels
Volume: 8
Issue number: 1
Article number: 198
ISSN (Print): 1754-6834
Ratings:

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Original language: English
ASJC Scopus subject areas: Energy(all), Management, Monitoring, Policy and Law, Biotechnology, Applied Microbiology and Biotechnology, Renewable Energy, Sustainability and the Environment
Keywords: Acinetobacter baylyi, Biodetoxification, Biohydrogen, Clostridium butyricum, Metabolic engineering, Rice straw hydrolysate
DOIs:

10.1186/s13068-015-0389-6
Source: Scopus
Source ID: 84956930091
Research output: Contribution to journal › Article › Scientific › peer-review

Vesihuolto tarvitsee tutkimusta ja koulutusta

General information
Publication status: Published
MoE publication type: D1 Article in a trade journal
Organisations: Department of Chemistry and Bioengineering
Contributors: Katko, T.
Number of pages: 1
Pages: 17
Publication date: 2015
Peer-reviewed: Unknown

Publication information
Journal: Kuntatekniikka
Issue number: 2
ISSN (Print): 1238-125X
Original language: Finnish
Research output: Contribution to journal › Article › Professional

Mesophilic anaerobic digestion of pulp and paper industry biosludge-long-term reactor performance and effects of thermal pretreatment

The pulp and paper industry wastewater treatment processes produce large volumes of biosludge. Limited anaerobic degradation of lignocellulose has hindered the utilization of biosludge, but the processing of biosludge using anaerobic digestion has recently regained interest. In this study, biosludge was used as a sole substrate in long-term (400 d) mesophilic laboratory reactor trials. Nine biosludge batches collected evenly over a period of one year from a pulp and paper industry wastewater treatment plant had different solid and nutrient (nitrogen, phosphorus, trace elements) characteristics. Nutrient characteristics may vary by a factor of 2-11, while biomethane potentials (BMPs) ranged from 89 to 102 NL CH<inf>4</inf> kg⁻¹ VS between batches. The BMPs were enhanced by 39-88% with thermal pretreatments at 105-134 °C. Despite varying biosludge properties, stable operation was achieved in reactor trials with a hydraulic retention time (HRT) of 14 d. Hydrolysis was the process limiting step, ceasing gas production when the HRT was shortened to 10 days. However, digestion with an HRT of 10 days was feasible after thermal pretreatment of the biosludge (20 min at 121 °C) due to enhanced hydrolysis. The methane yield was 78 NL CH<inf>4</inf> kg⁻¹ VS for untreated biosludge and was increased by 77% (138 NL CH<inf>4</inf> kg⁻¹ VS) after pretreatment.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio)
Contributors: Kinnunen, V., Ylä-Outinen, A., Rintala, J.
Number of pages: 7
Pages: 105-111
Publication date: 15 Dec 2015
Peer-reviewed: Yes
Early online date: 5 Sep 2015

Publication information
Journal: Water Research
Volume: 87
Article number: 11500
ISSN (Print): 0043-1354
Ratings:

Scopus rating (2015): CiteScore 10.5 SJR 2.665 SNIP 2.49
Original language: English
ASJC Scopus subject areas: Water Science and Technology, Waste Management and Disposal, Pollution, Ecological Modelling
Keywords: Biogas, Hydrothermal pretreatment, Lignin, Methane production, Secondary sludge, Waste activated sludge
DOIs:

10.1016/j.watres.2015.08.053
URLs:

http://www.scopus.com/inward/record.url?scp=84941946419&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note
AUX=keb,"Ylä-Outinen, A."
Source: Scopus
Source ID: 84941946419
Research output: Contribution to journal › Article › Scientific › peer-review

Methane production from 30-100 year old sedimented fibre from pulp and paper industry

General information
Publication status: Published
Organisations: Chemistry and Bioengineering
Contributors: Kokko, M., Koskue, V., Rintala, J.
Publication date: 2017
Peer-reviewed: Unknown
Event: Paper presented at the 15th IWA World Conference on Anaerobic Digestion, .
Research output: Other conference contribution › Paper, poster or abstract › Scientific

A recombinant Escherichia coli sensor strain for the detection of tetracyclines
A bioluminescent Escherichia coli K-12 strain for the specific detection of the tetracycline group of antibiotics is described, A sensor plasmid, containing five genes from bacterial luciferase operon of Photorhabdus luminescens inserted under the control of tetracycline-responsive elements of the transposon Tn10, was constructed. Usage of the full-length luciferase operon in the sensor resulted in tetracycline-dependent light production without additions, i.e., self-luminescent phenotype, since all the substrates were intrinsically produced by the recombinant organism, The time needed for optimal induction of light emission was 90 min. Maximal induction of similar to 100-fold over uninduced levels by using 20 ng of tetracycline, and picomole sensitivities for the seven different tetracyclines tested, were obtained without added Mg2+ ions. The higher the pH and the magnesium ion concentration in the assay medium the higher was the amount of membrane-impermeable tetracycline-Mg2+ chelate complex. In consequence, by adjusting the pH and the Mg2+ ion concentration, the sensitivity of the assay can be modified for different analytical purposes. Different non-tetracycline antibiotics did not cause induction of light emission.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Univ Turku, University of Turku, Dept Biotechnol, University of Turku
Contributors: Korpela, M. T., Kurittu, J. S., Karvinen, J. T., Karp, M. T.
Number of pages: 6
Pages: 4457-4462
Publication date: 1 Nov 1998
Peer-reviewed: Yes

Publication information
Journal: Analytical Chemistry
Volume: 70
Issue number: 21
ISSN (Print): 0003-2700
Original language: English
Keywords: XENORHABDUS-LUMINESCENS, EXPRESSION, ANTIMONITE, PROMOTER, ARSENITE, BACTERIA, BINDING, CLONING, GENES
DOIs:
10.1021/ac980740e
Source: WOS
Source ID: 000076839000011
Research output: Contribution to journal › Article › Scientific › peer-review

Modeling of the catalytic effects of potassium and calcium on spruce wood gasification in CO_2

Using previously reported thermogravimetric analysis measurements, the effects of calcium and potassium on the char gasification rate of spruce wood were modeled. Spruce wood was leached of inorganic ash elements and doped with measured amounts of potassium and calcium. The wood was gasified in an isothermal thermogravimetric analysis device in CO_2 where the devolatilization of the wood, char formation and char gasification all occurred inside the preheated reactor. A new method for separating the effects of devolatilization and char gasification is presented. Kinetic models were evaluated for their ability to describe the observed catalytic effects of potassium and calcium on the gasification rate. Two modified versions of the random pore model were able to accurately describe the measured conversion rates and the parameters of the kinetic models were found to be dependent on the calcium and potassium concentrations. Empirical correlations were developed to predict the char conversion rate from only the potassium and calcium concentration of the sample.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Johan Gadolin Process Chemistry Centre, Abo Akademi University, VTT Technical Research Centre of Finland
Contributors: Kramb, J., DeMartini, N., Perander, M., Moilanen, A., Konttinen, J.
Number of pages: 10
Pages: 50-59
Publication date: 1 Jul 2016
Peer-reviewed: Yes

Publication information
Journal: Fuel Processing Technology
Volume: 148
ISSN (Print): 0378-3820
Ratings:
Scopus rating (2016): CiteScore 6.8 SJR 1.397 SNIP 1.769
Original language: English
ASJC Scopus subject areas: Fuel Technology, Energy Engineering and Power Technology, Chemical Engineering(all)
Keywords: Biomass, Gasification, Modeling, Reaction kinetics
DOIs:
10.1016/j.fuproc.2016.01.031

Bibliographical note
EXT=”Moilanen, Antero"
Source: Scopus
Source ID: 84959431503
Research output: Contribution to journal › Article › Scientific › peer-review

Clashing coalitions: A discourse analysis of an artificial groundwater recharge project in Finland

The purpose of this paper is to increase understanding of the dynamics of knowledge production in the context of large-scale environmental projects causing local conflict. In particular, the paper analyses the discourse coalitions that formed around an artificial groundwater recharge project for the Turku Region in Finland. The material for this study consists of over 400 articles and opinion pieces which were collected from local and regional newspapers between 1999 and 2010. The articles were analysed by using Hajer's [1995. The politics of environmental discourse. Ecological modernisation and the policy process. Oxford, UK: Clarendon] discursive framework, and the analysis was complemented with the concept of knowledge coalition by Van Buuren and Edelenbos [2004. Conflicting knowledge. Why is joint knowledge production such a problem? Science and Public Policy, 31 (4), 289–299]. Results of the study indicate that knowledge coalitions were

formed among the researchers, lay residents, and policy-makers, and they all utilised similar expertise-based factual arguments to support their cause. Thus, the paper participates in the academic discussion on the use and interpretation of expert knowledge in environmental policy-making by reshaping the division between experts and lay residents.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Turun Kauppakorkeakoulu
Contributors: Kurki, V., Takala, A., Vinnari, E.
Pages: 1317-1331
Publication date: 2016
Peer-reviewed: Yes

Publication information

Journal: Local Environment
Volume: 21
Issue number: 11
ISSN (Print): 1354-9839
Ratings:

Scopus rating (2016): CiteScore 3.2 SJR 0.852 SNIP 0.941
Original language: English
ASJC Scopus subject areas: Geography, Planning and Development, Management, Monitoring, Policy and Law
Keywords: civil society, Environmental conflict, infrastructure projects, knowledge production, local government
DOIs:

10.1080/13549839.2015.1113516
URLs:

http://www.scopus.com/inward/record.url?scp=84946605654&partnerID=8YFLogxK (Link to publication in Scopus)

Bibliographical note

EXT="Vinnari, Eija"
Source: Scopus
Source ID: 84946605654
Research output: Contribution to journal › Article › Scientific › peer-review

Biomass Resource Allocation for Bioenergy Production on Cutaway Peatlands with Geographical Information (GI) Analyses

In recent years, technical and economic challenges in combustion of spring harvested dry reed canary grass (RCG, Phalaris arundinacea) has led into a situation where a significant amount of cutaway peatlands were out of intensive RCG growing in Finland. At the same time, thousands of hectares of cutaway peatlands were released annually from peat extraction, which still would allow energy crop growing without competition with food production. The objective of this work was to assess alternative uses for the cutaway peatlands for fresh RCG growing for bioenergy production. It was studied where are the most favourable areas for such practices at national and regional level and finally location optimization of bioenergy plants was made in a local scale inside a Finnish study area. In this work, fresh harvested RCG was shown to be a feasible energy crop on the cutaway peatlands if the cultivation is optimized. Compared to the traditional RCG combustion, fresh harvested RCG can have higher biomass yields, lower lignin content and better digestibility in biogas process. Land suitability assessment showed that, theoretically, ca. 300 km2 of future cutaway peatlands are suitable for biogas energy crop production by 2045 in Finland. It could be possible to grow energy crops, over 100 Gg total solids (TS) a year and having biogas potential of ca. 300 GWh. Especially, North and South Ostrobothnia regions are potential locations for this practice due to high peat extraction intensity in national level. Consequently, the precise local potential of cutaway peatlands was studied also with a questionnaire in a case study area in South Ostrobothnia. It was found that landowners of the cutaway peatlands are interested in bioenergy production, and they usually prefer forestry as an after-use method. In the final part of the thesis, bioenergy plant location optimization was done with multiple feedstocks including a biogas plant scenario and a wood terminal scenario. The R and ArcGIS software programs were used to identify potential locations for 13 farm-scale biogas plants (>100 kW) and 8 centralized biogas plants (>300 kW), and two potential wood terminals. These tools could be applied for different biomass resources and used in relevant decision makings to plan the locations of bioenergy plants in other countries as well.

General information

Publication status: Published
MoE publication type: G5 Doctoral dissertation (article)
Organisations: Materials Science and Environmental Engineering
Contributors: Laasasenaho, K.
Number of pages: 105
Publication date: 19 Dec 2019

Publication information
Publisher: Tampere University
Volume: 191
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ISBN (Electronic): 978-952-03-1389-0
Original language: English

Publication series
Name: Tampere University Dissertations
Volume: 191
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ISSN (Electronic): 2490-0028
URLs:
http://urn.fi/URN:ISBN:978-952-03-1389-0
Research output: Book/Report › Doctoral thesis › Collection of Articles

Biogas and combustion potential of fresh reed canary grass grown on cutover peatland

(1) In Finland, in recent years, the combustion of dry reed canary grass (RCG, Phalaris arundinacea) grown intensively on cutover peatlands, has decreased markedly. We therefore made experiments in two areas to assess the alternative of using freshly harvested RCG grown for biogas production on cutover peatland. We measured both biogas production and combustion energy release. (2) The experiments show that the RCG biomass yields in total solids (TS) in both areas, with two cuts a year, were surprisingly small (yields of 2.7 and 4.2 Mg ha^{-1} [1 Mg ha^{-1} = 100 g m^{-2}]); having biogas and combustion potentials, on the two areas, of 277–348 dm^3 kg^{-1} VS (volatile solids) and 14.8–16.3 MJ kg^{-1} TS, and 11.8–21.9 MWh ha^{-1} in combustion. (3) Fresh RCG may produce larger biomass yields if cut several times a year, together with lower lignin proportion, and better suitability for biogas production compared with spring harvested dry RCG. (4) For cutover peatlands there are several after-use possibilities, however, with different benefits and challenges. For example, peat soil emissions may be affected during the after-use period, and this should be considered when planning the use of cutover peatlands.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, University of Jyvaskyla, Griffith University
Contributors: Laasasenaho, K., Renzi, F., Karjalainen, H., Kaparaju, P., Konttinen, J., Rintala, J.
Number of pages: 9
Publication date: 2020
Peer-reviewed: Yes

Publication information
Journal: Mires and Peat
Volume: 26
Article number: 10
ISSN (Print): 1819-754X
Original language: English
ASJC Scopus subject areas: Ecology, Evolution, Behavior and Systematics, Aquatic Science, Ecology, Soil Science, Nature and Landscape Conservation
Keywords: Bioenergy, Biomass, Energy crop, Marginal land, Phalaris arundinacea
Electronic versions:
Biogas and combustion potential of fresh reed 2020
DOIs:
10.19189/MaP.2019.OMB.StA.1786
URLs:
http://urn.fi/URN:NBN:fi:tuni-202008136469
Source: Scopus
Source ID: 85085659384
Research output: Contribution to journal › Article › Scientific › peer-review

Light induced cytosolic drug delivery from liposomes with gold nanoparticles

Externally triggered drug release at defined targets allows site- and time-controlled drug treatment regimens. We have developed liposomal drug carriers with encapsulated gold nanoparticles for triggered drug release. Light energy is converted to heat in the gold nanoparticles and released to the lipid bilayers. Localized temperature increase renders liposomal bilayers to be leaky and triggers drug release. The aim of this study was to develop a drug releasing system capable of releasing its cargo to cell cytosol upon triggering with visible and near infrared light signals. The liposomes were formulated using either heat-sensitive or heat- and pH-sensitive lipid compositions with star or rod shaped gold

nanoparticles. Encapsulated fluorescent probe, calcein, was released from the liposomes after exposure to the light. In addition, the pH-sensitive formulations showed a faster drug release in acidic conditions than in neutral conditions. The liposomes were internalized into human retinal pigment epithelial cells (ARPE-19) and human umbilical vein endothelial cells (HUVECs) and did not show any cellular toxicity. The light induced cytosolic delivery of calcein from the gold nanoparticle containing liposomes was shown, whereas no cytosolic release was seen without light induction or without gold nanoparticles in the liposomes. The light activated liposome formulations showed a controlled content release to the cellular cytosol at a specific location and time. Triggering with visual and near infrared light allows good tissue penetration and safety, and the pH-sensitive liposomes may enable selective drug release in the intracellular acidic compartments (endosomes, lysosomes). Thus, light activated liposomes with gold nanoparticles are an attractive option for time- and site-specific drug delivery into the target cells.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Frontier Photonics, Aalto Univ, Aalto University, Sch Chem Technol, Dept Forest Prod Technol, Univ Helsinki, University of Helsinki, Ctr Drug Res, Div Pharmaceut Biosci, Andalusian Ctr Nanomed & Biotechnol, Univ Eastern Finland, University of Eastern Finland, Sch Pharm, University of Helsinki
Contributors: Lajunen, T., Viitala, L., Kontturi, L., Laaksonen, T., Liang, H., Vuorimaa-Laukkanen, E., Viitala, T., Le Guevel, X., Yliperttula, M., Murtomaki, L., Urtti, A.
Number of pages: 14
Pages: 85-98
Publication date: 10 Apr 2015
Peer-reviewed: Yes

Publication information
Journal: Journal of Controlled Release
Volume: 203
ISSN (Print): 0168-3659
Ratings:

Scopus rating (2015): CiteScore 13.8 SJR 2.738 SNIP 2.066
Original language: English
Keywords: Light activation, Liposome, Gold nanoparticle, Intracellular delivery, Triggered release, Retinal pigment epithelium, RETINAL-PIGMENT EPITHELIUM, NEAR-INFRARED LIGHT, PH-SENSITIVE LIPOSOMES, GENE DELIVERY, THERMOSENSITIVE LIPOSOMES, TRIGGERED DRUG, MULTIFOCAL CHOROIDITIS, UNILAMELLAR LIPOSOMES, MACULAR DEGENERATION, CONTENTS RELEASE
DOIs:

10.1016/j.jconrel.2015.02.028

Bibliographical note
EXT="Laaksonen, Timo"
Source: WOS
Source ID: 000351696600010
Research output: Contribution to journal › Article › Scientific › peer-review

Production of Electricity and Butanol from Microalgal Biomass in Microbial Fuel Cells

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Contributors: Lakaniemi, A., Tuovinen, O. H., Puhakka, J. A.
Pages: 481-491
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: BioEnergy Research
Volume: 5
Issue number: 2
ISSN (Print): 1939-1234
Ratings:

Scopus rating (2012): CiteScore 4.5 SJR 1.349 SNIP 1.668
Original language: English
DOIs:

10.1007/s12155-012-9186-2

Bibliographical note
Contribution: organisation=keb bio,FACT1=1
Publisher name: Springer New York LLC
Source: researchoutputwizard
Source ID: 4645
Research output: Contribution to journal › Article › Scientific › peer-review

Mine wastewater treatment using Phalaris arundinacea plant material hydrolyzate as substrate for sulfate-reducing bioreactor

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering
Contributors: Lakaniemi, A., Nevatalo, L. M., Kaksonen, A. H., Puhakka, J. A.
Pages: 3931-3939
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Bioresource Technology
Volume: 101
Issue number: 11
ISSN (Print): 0960-8524
Ratings:

Scopus rating (2010): SJR 2.089 SNIP 2.348
Original language: English
DOIs:

10.1016/j.biortech.2010.01.020

Bibliographical note
Contribution: organisation=keb bio,FACT1=1
Source: researchoutputwizard
Source ID: 8565
Research output: Contribution to journal › Article › Scientific › peer-review

Growth of Dunaliella tertiolecta and associated bacteria in photobioreactors

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Contributors: Lakaniemi, A., Intihar, V. M., Tuovinen, O. H., Puhakka, J. A.
Pages: 1357-1365
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: Journal of Industrial Microbiology and Biotechnology
Volume: 39
Issue number: 9
ISSN (Print): 1367-5435
Ratings:

Scopus rating (2012): CiteScore 4.5 SJR 1.094 SNIP 1.52
Original language: English
DOIs:

10.1007/s10295-012-1133-x

Bibliographical note
Contribution: organisation=keb bio,FACT1=1
Publisher name: Springer-Verlag
Source: researchoutputwizard
Source ID: 4644
Research output: Contribution to journal › Article › Scientific › peer-review

Growth of Chlorella vulgaris and associated bacteria in photobioreactors

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Contributors: Lakaniemi, A., Intihar, V. M., Tuovinen, O. H., Puhakka, J. A.
Pages: 69-78
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: Microbial Biotechnology
Volume: 5
Issue number: 1
ISSN (Print): 0964-7562
Ratings:

Scopus rating (2012): CiteScore 5.4 SJR 1.142 SNIP 0.957
Original language: English
DOIs:

10.1111/j.1751-7915.2011.00298.x

Bibliographical note
Contribution: organisation=keb bio,FACT1=1
Publisher name: Wiley-Blackwell Publishing Ltd
Source: researchoutputwizard
Source ID: 4643
Research output: Contribution to journal › Article › Scientific › peer-review

Hydrolysed cellulose material as sulfate reduction electron donor to treat metal- and sulfate containing waste water

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Former organisation of the author
Contributors: Lakaniemi, A., Nevatalo, L., Kaksonen, A., Puhakka, J.
Pages: 326-326
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Advanced Materials Research
Volume: 20-21
ISSN (Print): 1022-6680
Ratings:

Scopus rating (2007): SJR 0.18 SNIP 0.753
Original language: English
DOIs:

10.4028/www.scientific.net/AMR.20-21.326

Bibliographical note
Contribution: organisation=bio,FACT1=1
Source: researchoutputwizard
Source ID: 14835
Research output: Contribution to journal › Article › Scientific › peer-review

Biogenic hydrogen and methane production from reed canary grass

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Contributors: Lakaniemi, A., Koskinen, P. E., Nevatalo, L. M., Kaksonen, A. H., Puhakka, J. A.

Pages: 773-780
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Biomass & Bioenergy
Volume: 35
Issue number: 2
ISSN (Print): 0961-9534
Ratings:

Scopus rating (2011): CiteScore 4.9 SJR 1.759 SNIP 2.306
Original language: English
DOIs:

10.1016/j.biombioe.2010.10.032

Bibliographical note
Contribution: organisation=keb bio,FACT1=1
Source: researchoutputwizard
Source ID: 6541
Research output: Contribution to journal › Article › Scientific › peer-review

Biogenic hydrogen and methane production from Chlorella vulgaris and Dunaliella tertiolecta biomass

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Contributors: Lakaniemi, A., Hulatt, C. J., Thomas, D. N., Tuovinen, O. H., Puhakka, J. A.
Number of pages: 12
Pages: 1-12
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Biotechnology for Biofuels
Volume: 4
Issue number: 1
Article number: 34
ISSN (Print): 1754-6834
Ratings:

Scopus rating (2011): CiteScore 6.3 SJR 2.239 SNIP 2.221
Original language: English
DOIs:

10.1186/1754-6834-4-34

Bibliographical note
Contribution: organisation=keb bio,FACT1=1
Source: researchoutputwizard
Source ID: 6540
Research output: Contribution to journal › Article › Scientific › peer-review

Comparison of the total mercury content in sediment samples with a mercury sensor bacteria test and Vibrio fischeri toxicity test

The suitability of a luminescent bacterial sensor strain Escherichia coli MC1061(pTOO11) [Virta, M.; Lampinen, J.; Karp, M. Anal Chem 1995, 67, 667-669] for the measuring of mercury from sediment samples was evaluated. The sensor strain is based on the control of expression of a reporter gene, firefly luciferase, by a mercury sensitive regulation unit. The sensor responds to mercury by increased luminescence as a consequence of increased production of the reporter protein luciferase. The method is simple to perform since the luminescence is recorded with a portable luminometer and the sensor bacteria are freeze-dried. The results obtained from river sediment samples were compared with the total mercury content of the samples, which was measured by atomic absorption spectrometry and Leco(R) Mercury analyzer and the modified photobacteria luminescence inhibition test (Lappalainen, J.; Juvonen, R.; Vaajasaari, K.; Karp, M. Chemosphere 1999, 38, 1069-1083). The correlation between the bacterial sensor results with the total mercury content, ranging from 0.01 mg/kg to 16 mg/kg, was significant with 32 samples tested (R-2 UP to 0.8115). There was no correlation between the total mercury content and toxicity measured with Vibrio fischeri in this sample panel, (C) 2000 by John Wiley & Sons, Inc.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: University of Turku
Contributors: Lappalainen, J. O., Karp, M. T., Juvonen, R., Virta, M. P. J., Nurmi, J.
Number of pages: 6
Pages: 443-448
Publication date: Dec 2000
Peer-reviewed: Yes

Publication information
Journal: Environmental Toxicology
Volume: 15
Issue number: 5
ISSN (Print): 1520-4081
Ratings:

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10.1002/1522-7278(2000)15:5<443::AID-TOX12>3.0.CO;2-L
Source: WOS
Source ID: 000165446600012
Research output: Contribution to journal › Article › Scientific › peer-review

Sub- and Supercritical Water Liquefaction of Kraft Lignin and Black Liquor Derived Lignin
To mitigate global warming, humankind has been forced to develop new efficient energy solutions based on renewable energy sources. Hydrothermal liquefaction (HTL) is a promising technology that can efficiently produce bio-oil from several biomass sources. The HTL process uses sub- or supercritical water for producing bio-oil, water-soluble organics, gaseous products and char.
Black liquor mainly contains cooking chemicals (mainly alkali salts) lignin and the hemicellulose parts of the wood chips used for cellulose digestion. This review explores the effects of different process parameters, solvents and catalysts for the HTL of black liquor or black liquor-derived lignin. Using short residence times under near- or supercritical water conditions may improve both the
quality and the quantity of the bio-oil yield. The quality and yield of bio-oil can be further improved by using solvents (e.g., phenol) and catalysts (e.g., alkali salts, zirconia). However, the solubility of alkali salts present in black liquor can lead to clogging problem in the HTL reactor and process tubes when approaching supercritical water conditions.

General information
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MoE publication type: A2 Review article in a scientific journal
Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, Paul Scherrer Institut, Karlsruhe Institute of Technology, VTT Technical Research Centre of Finland
Contributors: Lappalainen, J., Baudouin, D., Hornung, U., Schuler, J., Melin, K., Bjelić, S., Vogel, F., Konttinen, J., Joronen, T.
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Research output: Contribution to journal › Review Article › Scientific › peer-review

Recovering Nitrogen as a Solid without Chemical Dosing: Bio-Electroconcentration for Recovery of Nutrients from Urine

This letter presents the proof of concept of a novel bio-electroconcentration system (BEC), a hybrid microbial electrolysis/electrodialysis cell specifically designed to recover nitrogen (as ammonia NH_4-N), phosphorus (as phosphate PO_4-P), and potassium (as K^+) from urine. Using a synthetic urine medium, the BECs could reach high current densities of up to 37.6 A m^{-2} at E_{we} values of 0.0 versus the standard hydrogen electrode (SHE) and 50 A m^{-2} at 0.2 V versus SHE, which in turn drove the removal and recovery of N, P, and K at rates of 7.18 kg of NH_4-N m^{-3} day^{-1}, 0.52 kg of PO_4-P m^{-3} day^{-1}, and 1.62 kg of K^+ m^{-3} day^{-1} into a concentrate stream (containing 1.87 M NH_4-N, 0.29 M PO_4-P, and 0.18 M K^+). Finally, this communication demonstrates the recovery of a nitrogen-rich solid from the synthetic urine (in the form of pure NH_4HCO_3 crystals with 17% N content) without any chemical additions via the flash-cooling of the produced nutrient-rich concentrate to 4 °C. These two new products may help facilitate the reuse of urine nutrients in the fertilizer or protein production industries of the future.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, University of Queensland
Contributors: Ledezma, P., Jermakka, J., Keller, J., Freguia, S.
Number of pages: 6
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Publication date: 14 Mar 2017
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DOIs:

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Research output: Contribution to journal › Article › Scientific › peer-review

Methane oxidation potential of boreal landfill cover materials: The governing factors and enhancement by nutrient manipulation

Methanotrophs inhabiting landfill covers are in a crucial role in mitigating CH_4 emissions, but the characteristics of the cover material or ambient temperature do not always enable the maximal CH_4 oxidation potential (MOP). This study aimed at identifying the factors governing MOPs of different materials used for constructing biocovers and other cover structures. We also tested whether the activity of methanotrophs could be enhanced at cold temperature (4 and 12 °C) by improving the nutrient content (NO_3^-, PO_4^{3-}, trace elements) of the cover material. Compost samples from biocovers designed to support CH_4 oxidation were exhibiting the highest MOPs (4.16 μmol CH_4 g_{dw}^{-1} h^{-1}), but also the soil samples collected from other cover structures were oxidising CH_4 (0.41 μmol CH_4 g_{dw}^{-1} h^{-1}). The best predictors for the MOPs were the NO_3^- content and activity of heterotrophic bacteria at 72.8 %, which were higher in the compost samples than in the soil samples. The depletion of NO_3^- from the landfill cover material limiting the activity of methanotrophs could not be confirmed by the nutrient manipulation assay at 4 °C as the addition of nitrogen decreased the MOPs from 0.090 μmol CH_4 g_{dw}^{-1} h^{-1} to < 0.085 μmol CH_4 g_{dw}^{-1} h^{-1}. At 12 °C, all nutrient additions reduced the MOPs. The inhibition was believed to result from high ionic concentration caused by nutrient addition. At 4 °C, the addition of trace elements increased the MOPs (> 0.096 μmol CH_4 g_{dw}^{-1} h^{-1}) suggesting that this was attributable to stimulation of the enzymatic activity of the psychrotolerant methanotrophs.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio)
Contributors: Maanoja, S. T., Rintala, J. A.
Number of pages: 9
Pages: 399-407

Publication date: 2015
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ISSN (Print): 0956-053X
Ratings:
Scopus rating (2015): CiteScore 6.3 SJR 1.732 SNIP 2.268
Original language: English
Keywords: Greenhouse gases, Landfill, Cover material, Methane oxidation, Nutrients
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10.1016/j.wasman.2015.08.011
Research output: Contribution to journal › Article › Scientific › peer-review

Factors affecting the elimination capacity of a passive methane biofilter

Passive biofilters are used for controlling CH_4 emissions from different sources with the help of methanotrophic bacteria. The CH_4 elimination capacity of a biofilter can be affected by different factors, such as the structure and composition of the filter material and formation of bacterial exopolymeric saccharides (EPS). Recognising these factors and resolving their effect on the elimination capacity is important for efficient greenhouse gas emission control. Hence, we studied the evolution of the elimination capacity of a passive CH_4 biofilter containing soil as low-cost filter material. We aimed at identifying the factors affecting the elimination capacity and tested the effectiveness of a mechanical regeneration method for improving the operation efficiency. A laboratory-scale biofilter containing landfill soil was operated for 148 days. The CH_4 removal efficiency reached 70 % in the beginning of the operation (0–7 days), but stabilised at 25 % after 50 days. The filter bed was mixed and loosened twice during the operation. As a result, the glucose content of the soil representing the clogging agent secreted by bacteria (EPS) remained stable throughout the experiment (23 mg g_{dw}^{-1}) and O_2 penetrated deeper in the filter bed indicating improved gas diffusion. However, the CH_4 removal efficiency did not increase from 25–30 %. The reason for this remained unknown, but the results indicated that soil as filter material was able to maintain its elimination capacity despite the formation of EPS. Mixing was shown to be an effective and necessary method for improving the gas diffusion properties of the filter bed.

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MoE publication type: D3 Professional conference proceedings
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Maanoja, S., Rintala, J.
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Ei ole, HO.
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

Compacted bentonite as a source of substrates for sulfate-reducing microorganisms in a simulated excavation-damaged zone of a spent nuclear fuel repository

Sulfide formed by sulfate-reducing microorganisms (SRM) is a potential safety risk in the geological disposal of spent nuclear fuel (SNF) enclosed in copper canisters because it can corrode copper. The canisters will be isolated from the environment by surrounding them with compacted bentonite. This study shows experimentally that the organic matter naturally present in compacted bentonites can become dissolved and sustain biological sulfate reduction. The experiment was conducted in cell systems consisting of an interface of compacted bentonite (at dry density of 1314–1368 kg m^{-3}) and a low-porosity sand layer representing an excavation-damaged zone of the host rock. Some cells were inoculated with SRM and groundwater microorganisms and some were not. Varying concentrations of organic matter and sulfate in the sand layer solution resulted from partial dissolution of the studied bentonites (Wyoming, Indian, and Bulgarian). The dissolved organic matter promoted biological sulfate reduction, as demonstrated by the decrease in sulfate concentration in the sand layer solution and the formation of sulfide iron precipitates in the inoculated cells relative to the uninoculated cells. Other anaerobic microorganisms (e.g., methanogens) also became active in the cells and they along with the SRM were found to grow within the sand and/or bentonite layers of the cells. The findings of this study show that bentonites can

sustain biological sulfate reduction in areas with lower density and immobilize possibly formed sulfides. However, the extent of these capabilities seems to be affected by the mineralogy of bentonites in the studied density range.

General information

Publication status: Published
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Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, Posiva Oy , Tampere University, Posiva Oy
Contributors: Maanoja, S., Lakaniemi, A. M., Lehtinen, L., Salminen, L., Auvinen, H., Kokko, M., Palmroth, M., Muuri, E., Rintala, J.
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int=MSEE,"Lehtinen, Leena"
int=MSEE,"Salminen, Linda"
Source: Scopus
Source ID: 85087490126
Research output: Contribution to journal › Article › Scientific › peer-review

Biohydrogen Production: A Protein to Community Level Perspective Study

Excessive usage of traditional energy reserves leading to increased environmental pollution and global warming have strongly urged for alternative sustainable energy sources. Due to non-polluting nature and high energy yields, hydrogen (H_2) gas is considered as an ideal candidate for alternative fuel. Biohydrogen ($bioH_2$) production from organic wastes is a sustainable approach, addressing energy production through organic waste disposal. Organic wastes such as lignocellulosic biomass and industrial glycerol, a by-product of biodiesel manufacturing process, have been recently investigated for their bioconversion potential. However, bioconversion of such organic wastes is a challenge due to the presence of impurities, toxic degradation products and complex nature. In comparison to pure bacterial strains, natural microflora could be an ideal inoculum choice offering better adaptability, substrate utilization efficiency and bioconversion rates. Another challenge to ensure efficient fermentation is to optimize various physico-chemical factors such as pH, temperature, substrate selection and concentration, medium compounds, and H_2 removal and collection due to individual and interactive effects on microbial growth, metabolism and hydrogenase enzyme. Hydrogenases are metalloenzymes that reversibly catalyzes proton reduction to H_2, and are divided into three classes based on the metal cofactor at the active site, [Fe-Fe], [Ni-Fe] and [Fe] hydrogenase. Among the hydrogenase classes, [Fe-Fe] hydrogenases exhibit highest catalytic activity involving mostly in H_2 production. Apart from their pivotal role in fermentative H_2 production, [Fe-Fe] hydrogenases promise an alternative catalyst choice in fuel cells. However, in spite of their preference towards H_2 production, [Fe-Fe] hydrogenases are extremely prone to catalytic inactivation upon oxygen exposure. This is the major challenge, at the protein level, that hinders a cost-effective approach for biotechnological applications and suggests the requirement of targeted tools to investigate the inactivation process at the molecular level. The purpose of the present study was to investigate $bioH_2$ production in protein to community level perspective. More specifically the aims were to (1) establish an anaerobic biopanning procedure to enrich antibody binders specific against clostridial [Fe-Fe] hydrogenase protein, (2) develop and standardize a novel enrichment system, (3) implement the enrichment technique to enrich functional inoculum capable of degrading complex substrates, (4) enrich crude glycerol fermenting microbial community and finally, (5) optimize the physico-chemical factors influencing fermentative H_2 production for efficient bioprocess. In the present study, biopanning with synthetic ‘mixed’ single chain variable fragment (scFv) libraries against active and inactive clostridial [Fe-Fe] hydrogenases aided the enrichment of anti-hydrogenase antibodies. Out of ninety four (from inactive hydrogenase) and ninety two (from active hydrogenase) random clones screened, nine potential antibody clones with recognition specificity towards Clostridium acetobutylicum [Fe-Fe] hydrogenase were selected. The enriched binders also recognized [Fe-Fe] hydrogenase from C. butyricum. Based on the results from this study, it could be reasoned that the binders with generic specificity against closely related clostridial [Fe-Fe] hydrogenases can be used as novel molecular tools for quantitative monitoring [Fe-Fe] hydrogenases at the protein level. Another of-note observation was the specificity of the antibody binders towards active and inactive hydrogenases. Preliminary experiments indicated 7Ac binder (enriched against active hydrogenase) specificity towards the catalytically active [Fe-Fe] hydrogenase rather to the inactive state and 48In (enriched against inactive hydrogenase) recognized both catalytic states. These findings indicate the possibility to

apply the isolated antibody clones for functional detection of clostridial [Fe-Fe] hydrogenases. The study progresses in investigating bioH_2 production in perspective of microbial community. The novel microbial enrichment system was developed and the proof-of-principle experiments conducted using artificial mixed microbial community and varied selection criteria allowed the enrichment of the best H_2 producer. The system was implemented in enriching cellobiose degrading H_2 producer from an environmental sample. The bacterial strain isolated by spread plate technique on agar plates containing CMC was affiliated with Citrobacter sp. and named as Citrobacter sp. CMC-1. Citrobacter sp. CMC-1 utilized glucose, cellobiose and CMC and followed mixed-acid fermentation profile producing H_2 and carbon dioxide (CO_2) as gaseous metabolites and acetate, formate, lactate and ethanol as liquid metabolites. At optimized values of cultivation conditions (pH 6.0 and 34 ˚C) the H_2 yield was 1.82 mol-H_2/mol-glucose. The isolate efficiently fermented monomeric hemi-cellulose sugars to H_2 (mol-H_2/mol-substrate): Galactose, 1.18; Mannose, 1.23; Xylose, 1.22; Arabinose, 0.94 and Rhamnose, 1.01). Except for arabinose, an increase in cultivation period improved the biomass and H_2 yield (mol-H_2/mol-substrate): Galactose, 1.68; Mannose, 1.93 and Xylose, 1.63) followed with observations of reduced formate accumulation in the medium, indicating that Citrobacter sp. CMC-1 produced H_2 from formate breakdown via the FHL complex. Microbial community pre-dominated with Clostridium spp. enriched from activated sludge fermented crude glycerol mainly to H_2, CO_2, acetate, butyrate and ethanol. Optimal bioprocess conditions for the enriched inoculum were experimentally observed to be pH 6.5, 40˚C and 1g/L crude glycerol. The H_2 yield from raw glycerol at optimal cultivation conditions was 1.1 mol-H_2/mol-glycerol consumed . At elevated crude glycerol concentrations, substrate utilization and H_2 production were limited due to the presence of impurities in the crude glycerol fraction. The bioconversion of crude glycerol to H_2 was further improved by statistical optimization of the growth medium composition. Initial screening with Plackett – Burman design identified NH_4Cl, K_2HPO and KH_2PO_4 with individual and interactive effects on H_2 yield. Among the three identified media components, NH_4Cl and KH_2PO_4 imparted the maximal significance and were optimized in scrutiny. A series of statistical models identified the optimal media composition for improved H_2 production from crude glycerol fermentations and were successful in improving the H_2 yield by 29% (1.42 mol-H_2/mol-glycerol consumed) in comparison to previously reported value (1.1 mol-H_2/mol-glycerol consumed).

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Contributors: Mangayil, R.
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Source: researchoutputwizard
Source ID: 123456789/22912
Research output: Book/Report › Doctoral thesis › Collection of Articles

Improved bioconversion of crude glycerol to hydrogen by statistical optimization of media components

Bioconversion of crude glycerol to hydrogen has gained importance as it addresses both sustainable energy production and waste disposal issues. Until recently, statistical optimizations of crude glycerol bioconversion to hydrogen have been greatly focused on pure strains. In this study, biohydrogen production from crude glycerol by an enriched microbial culture (predominated with Clostridium species) was improved by statistical optimization of media components. Plackett-Burman design identified $MgCl_2.6H_2O$ and KCl with negative effect on hydrogen production and selected NH_4Cl, K_2HPO_4 and KH_2PO_4 as significant variables. Box-Behnken design indicated the optimal region beyond design area and studies were continued by ridge analysis. Central composite face centered design envisaged a maximal hydrogen yield of 1.41mol-H_2/mol-$glycerol_{consumed}$ at concentrations 4.40g/L and 2.27g/L for NH_4Cl and KH_2PO_4 respectively. Confirmation experiment with the optimized media (NH_4Cl, 4.40g/L; K_2HPO_4, 1.6g/L; KH_2PO_4, 2.27g/L; $MgCl_2.6H_2O$, 1.0g/L; KCl, 1.0g/L; Na-acetate.$3H_2O$, 1.0g/L and tryptone, 2.0g/L) revealed an excellent correlation between predicted and experimental hydrogen yield. Optimization of media components by design of experiments enhanced hydrogen yield by 29%.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Tampere University of Technology, Department of Signal Processing, Urban circular bioeconomy (UrCirBio)
Contributors: Mangayil, R., Aho, T., Karp, M., Santala, V.
Number of pages: 7
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Publication date: 1 Mar 2015
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ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment
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Portfolio EDEND: 2014-12-12
Publisher name: Pergamon; The World Renewable Energy Network
Source: researchoutputwizard
Source ID: 1020
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Recombinant antibodies for specific detection of clostridial [Fe-Fe] hydrogenases

Biological hydrogen production is based on activity of specific enzymes called hydrogenases. Hydrogenases are oxygen sensitive metalloenzymes containing Ni and/or Fe atoms at the active site, catalyzing reversible reduction of protons. Generally, [Fe-Fe] hydrogenases prefer proton reduction to molecular hydrogen, a potential energy carrier molecule that can be produced by bioprocesses in sustainable manner. Thus, monitoring tools have been developed to study the relationship between [Fe-Fe] hydrogenases and biohydrogen production in bioreactors at DNA and RNA levels. In the present study, novel molecular tools are introduced for quantitative monitoring of clostridial [Fe-Fe] hydrogenases at the protein level. Aerobic and anaerobic biopanning (for inactive and active [Fe-Fe] hydrogenase, respectively) of phage displayed single-chain variable fragment (scFv) antibody libraries aided in isolating nine potential scFvs. The enriched antibodies demonstrated high specificity towards Clostridium spp. [Fe-Fe] hydrogenases allowing detection from pure and mixed cultures. Additionally, the antibodies showed different binding characteristics towards hydrogenase catalytic states, providing a possible means for functional detection of clostridial [Fe-Fe] hydrogenases. From hydrogenase-antibody interaction studies we observed that though antibody binding reduced the enzyme catalytic activity, it facilitated to retain hydrogen evolution from oxygen exposed hydrogenases.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Univ Turku, University of Turku, Dept Biotechnol
Contributors: Mangayil, R., Karp, M., Lamminmäki, U., Santala, V.
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Ratings:

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Research output: Contribution to journal › Article › Scientific › peer-review

Co-production of 1,3 propanediol and long-chain alkyl esters from crude glycerol
Crude glycerol is an excellent carbon source for bacterial production systems. Bacterial fermentation often generates by-products that can offer an additional carbon pool to improve the product profile for optimal valorization. In this study, the properties of two phylogenetically distinct bacteria, Acinetobacter baylyi ADP1 and Clostridium butyricum, were coupled in a one-pot batch process to co-produce 1,3 propanediol (PDO) and long-chain alkyl esters (wax esters, WEs) from crude glycerol. In the process, A. baylyi deoxidized the growth medium allowing glycerol fermentation and PDO production by C. butyricum. Reaeration of the co-cultivations enabled A. baylyi to metabolize the fermentation by-products, acetate and butyrate, and synthesize intracellular WEs. To improve PDO production and A. baylyi growth, carbon and macronutrients in the growth medium were screened and optimized using Plackett-Burman and Box-Behnken models. The validation experiment revealed a good correlation between the observed and predicted values. The salting-out method recovered 89.5% PDO from the fermentation broth and in vacuo extraction resulted in a PDO content of 5.3 g L-1. Nuclear magnetic resonance revealed a WE content and yield of 34.4 ± 1.4 mg L-1 and 34.2 ± 3.2 mg WE g-1 dry cell weight, respectively. A molar yield of 0.65 mol PDO mol-1 and 0.62 µmol WE mol-1 crude glycerol was achieved with the synthetic consortium. This work emphasizes the strength of response surface methodology in improving production processes from the mutualistic association of divergent bacterial species in consortium. The co-production of PDO and WEs from crude glycerol is demonstrated for the first time in this study.

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Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy
Contributors: Mangayil, R., Efimova, E., Konttinen, J., Santala, V.
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Publication date: 11 Jul 2019
Peer-reviewed: Yes

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Bibliographical note

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Source ID: 31302257
Research output: Contribution to journal › Article › Scientific › peer-review

Lipid production by eukaryotic microorganisms isolated from palm oil mill effluent

Microbial oil production combined with wastewater management is one option for a more sustainable future. Micrographs of microbial cultures enriched from palm oil mill effluent (POME) showed lipid inclusion in the eukaryotic cells, indicating the cells can accumulate lipids. However, enriching the culture did not increase the total lipids. Therefore, eukaryotic microorganisms were isolated from POME to investigate whether these microorganisms are potential lipid producers. Four strains were isolated, and their lipid synthesis capabilities were compared with known oleaginous yeasts in a synthetic oil-free medium. Two strains (identified as Galactomyces geotrichum and Graphium penicillioides) had the potential to accumulate lipid accumulation based on the increase in triacylglycerol content. G. penicillioides was the most promising strain for lipid production as this strain accumulated more lipids than the well-known oleaginous yeast Cryptococcus curvatus (29.1 ± 3.0. wt% vs. 20.2 ± 2.9. wt%). To our knowledge, oil synthesis and accumulation by G. penicillioides have not previously been reported.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), National Cheng Kung University, Center of Bioscience and Biotechnology, Research Center for Energy Technology and Strategy, Neste Oil Oyj
Contributors: Marjakangas, J. M., Lakaniemi, A. M., Koskinen, P. E. P., Chang, J. S., Puhakka, J. A.
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Source: Scopus
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Research output: Contribution to journal › Article › Scientific › peer-review

Simultaneous nutrient removal and lipid production with Chlorella vulgaris on sterilized and non-sterilized anaerobically pretreated piggery wastewater

Piggery wastewater is a potent nutrient source for microalgal lipid production. Wastewater has been usually sterilized when used for microalgal cultivation. This is uneconomical in large-scale applications. Therefore, lipid productivity of Chlorella vulgaris CY5 using sterilized and non-sterilized diluted anaerobically pretreated piggery wastewater was studied in batch reactors. The maximum average lipid productivity was obtained after 12 days of incubation and it was higher with the sterilized wastewater than with the non-sterilized one (117g/L/d vs. 91.3g/L/d), due to the higher biomass concentration. Because of the unexpected increase of dissolved organic carbon (DOC) in the cultures, second experiment was conducted to characterize the composition of produced DOC in non-sterilized wastewater. Carbohydrate content increased in the liquid phase but decreased in the biomass after nitrogen had been exhausted. After 12 days of incubation, soluble chemical oxygen demand (COD<inf>s</inf>) was 414±56mg/L, biomass production was 2.8±0.15g/L, and lipid content was 30.3±1.2wt%. Average lipid productivity from day zero to day 12 was 70.5±1.1g/L/d. C. vulgaris removed nutrients from the non-sterilized wastewater and produced oleaginous biomass, although the lipid productivity was higher with sterilized wastewater.

General information

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Selecting an indigenous microalgal strain for lipid production in anaerobically treated piggery wastewater
The aim of this study was to select a potential microalgal strain for lipid production and to examine the suitability of anaerobically treated piggery wastewater as a nutrient source for production of lipid-rich biomass with the selected microalga. Biomass and lipid productivity of three microalgal strains (Chlorella sorokiniana CY1, Chlorella vulgaris CY5 and Chlamydomonas sp. JSC-04) were compared by using different media, nitrogen sources, and nitrogen concentrations. The highest lipid content and productivity (62.5 wt%, 162 mg/L/d) were obtained with C. vulgaris with BG-11 with 62 mg N/L. Secondly, C. vulgaris was cultivated in sterilized, diluted (1–20×), anaerobically treated piggery wastewater. Biomass production decreased and lipid content increased, when wastewater was more diluted. The highest lipid content of 54.7 wt% was obtained with 20× dilution, while the highest lipid productivity of 100.7 mg/L/d with 5× dilution. Piggery wastewater is a promising resource for mass production of oleaginous microalgal biomass.

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Production of Oleaginous Microbial Biomass by Reusing Wastewaters

Global energy demand continues to increase, which raises the question regarding how to solve the energy crisis caused by diminishing fossil fuels. There is no single alternative energy source that could substitute the fossil fuels, but microbial single cell oils (SCO) could be part of the solution. SCOs can be produced by cultivating microorganisms in wastewater in which nutrients and carbon from the wastewater are used for biomass production. In optimized conditions, microorganisms begin to accumulate lipids, and these lipids can be further refined for the production of biodiesel or renewable diesel. The lipid accumulation of the microorganisms may be enhanced by culturing the microorganisms under stressful conditions. The most commonly used strategy for enhancing lipid accumulation is nitrogen starvation, but it is even more effective when combined with another stress factor, such as moderately increased salinity. In microbial lipid production, the major cost factor is often the substrate needed for the microorganisms. Therefore, utilizing inexpensive substrates and waste materials for the cultivation of oleaginous microorganisms is very desirable. Various wastewaters from municipalities, agriculture, and industrial sources have been studied, and many of these wastewaters have shown the potential for lipid-rich biomass production. Unfortunately, most of the studies have been conducted using sterilized wastewater. In large-scale applications, the sterilization of the wastewater is not cost-effective; therefore, lipid-accumulating microorganisms able to compete with the indigenous microorganisms of the wastewater need to be further studied. The aim of this work was to sustainably produce oleaginous biomass by reusing the carbon and nutrients from wastewaters. This work included an evaluation of the suitability of various wastewaters for lipid-lipid rich biomass production (Paper I), the isolation of yeasts and fungi, which could possibly accumulate lipids by utilizing wastewater as substrate (Paper II), and the determination of the ability of the isolated microorganisms to accumulate lipids by comparing them with known lipid accumulating yeasts (Paper II). Unlike yeasts and fungi, microalgae are able to use an inorganic carbon source for their growth. This feature enables the combination of wastewater and flue gas treatment. Therefore, the growth and lipid accumulation of three microalgal species were compared (Paper III), and the suitability of the most potential microalgal species for accumulating lipids in sterilized and non-sterilized wastewater was studied (Paper III & IV). Based on the results of this study, palm oil mill effluent (POME) has more potential for lipid production than chemithermomechanical pulp mill effluent (CTMP) or municipal wastewate r (MWW) (Paper I). The residual lipids and solids of POME obstructed the analyses of the microbial SCOs. Eukaryotes isolated from POME with agar plates were genetically identified as Candida silvae NRRL Y-6725 (with 100% similarity), Galactomyces geotrichum LMA-20 (with 99.8% similarity), Lecythophora hoffmannii CBS245.38T (with 96.7% similarity), and Graphium penicillioides JCM9300 (with 99.3% similarity) (Paper II). The fungus Graphium penicillioides had a great potential for lipid accumulation based on the comparison study with well-known oleaginous yeast strains (Yarrowia lipolytica DSMZ8212, Cryptococcus curvatus DSMZ70022, & Cryptococcus albidus DSMZ701097) in a synthetic medium (Paper II). The lipid content per dry weight was higher with G. penicillioides compared to C. curvatus after 15 days of incubation (29.1±3.0 wt% vs 20.2±2.9 wt%, Paper II). Unfortunately, the overall lipid concentration was lower due to a lower biomass concentration. G. penicillioides contained more than 20% lipids, so it can be called oleaginous. From the three microalgae isolated from a Taiwanese freshwater area (Chlorella sorokiniana CY1, Chlorella vulgaris CY5, & Chlamydomonas sp. JSC-04), C. vulgaris accumulated more lipids when various media, nitrogen sources, and nitrogen concentrations were studied (Paper III). The C. vulgaris in the BG-11 medium, initially containing 0.38 g $NaNO_3$/L, produced 3.8 g/L biomass and 57.5 wt% lipids after 12 days of incubation. The most suitable wastewater dilution for the lipid accumulation of C. vulgaris on sterilized anaerobically treated piggery wastewater was 5x dilution, which resulted in initial chemical oxygen demand and total Kjeldahl nitrogen of 75.4 mg/L and 57.4 mg/L, respectively. C. vulgaris was suitable for accumulating lipids on both sterilized and non-sterilized anaerobically treated piggery wastewater (PW) (Paper IV). The highest lipid content and productivity with the non-sterilized wastewater were rather promising (32.5±3.2 wt%, 71.2±2.2 g/L/d). However, under the conditions of these experiments, C. vulgaris excreted dissolved organic carbon (Paper III & IV), and the aim in wastewater treatment is the removal of organic carbon. In summary, this work demonstrates the potential of indigenous eukaryotic microorganisms for lipid-rich biomass production. G. penicillioides isolated from POME has the potential for lipid-rich biomass production in a synthetic medium, which has not been previously reported. Similarly, C. vulgaris has the potential for lipid-rich biomass production in non-sterilized piggery wastewater, while most of the studies in the literature on C. vulgaris and wastewater have been conducted using sterilized wastewater. To enable simultaneous accumulation of lipids and efficient treatment of wastewater, special attention should be focused on the growth conditions.

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Cultivation and safety aspects of Arthrospira platensis (Spirulina) grown with struvite recovered from anaerobic digestion plant as phosphorus source

In this study, the cyanobacterium Arthrospira platensis, commonly known as Spirulina, was cultivated utilizing phosphorus in the form of struvite recovered from effluents of a biogas plant treating municipal and agro-industrial wastes. Under the specific experimental conditions, providing sterilized struvite at about 120mg/L (or 15 mg-P/L) gave the same results in terms of biomass production and biochemical composition as the control cultures (with KH2PO4 as a P source). Struvite sterilization was found to be an important step because its original microbial load had a negative effect on the biomass production and resulted in biomass with lower value (lower protein and phycocyanin content). P from struvite was almost complete released upon adding it in the cultivation medium after 90min, where parameters, such as medium pH, struvite particle size and medium reusing cycles had no effect on the kinetics of P release, indicating that P is almost immediately available for cell uptake. Since struvite was generated from effluents of a biogas plant treating municipal and agro-industrial wastes, the potential of its contamination with hazardous compounds was examined in order to assess the safety of the produced biomass. Unwanted compounds like heavy metals, bisphenol A (BPA), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) were calculated to be at levels significantly lower than those of the maximum levels allowed in the European Union regulation for feedstuff safety, while neither veterinary drugs nor Escherichia coli were detected in the struvite. Results suggest that struvite recovered from biogas plants could be used as P source for the cultivation of A. platensis for feed or food quality.

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Impact of film thickness of ultra-thin dip-coated compact TiO2 layers on the performance of mesoscopic perovskite solar cells

Uniform and pinhole-free electron selective TiO_2 layers are of utmost importance for efficient perovskite solar cells. Here we used a scalable and low-cost dip coating method to prepare uniform and ultra-thin (5−50 nm) compact TiO_2 films on fluorine doped tin oxide (FTO) glass substrates. The thickness of the film was tuned by changing the $TiCl_4$ precursor concentration. The formed TiO_2 follows the texture of the underlying FTO substrates, but at higher $TiCl_4$ concentrations, the surface roughness is substantially decreased. This change occurs at a film thickness close to 20–30 nm. A similar $TiCl_4$ concentration is needed to produce crystalline TiO_2 films. Furthermore, below this film thickness, the underlying FTO might be exposed resulting in pinholes in the compact TiO_2 layer. When integrated into mesoscopic perovskite solar cells, there appears to be a similar critical compact TiO_2 layer thickness above which the devices perform more optimally. The power conversion efficiency was improved by more than 50% (from 5.5% to ~8.6%) when inserting a compact TiO_2 layer. Devices without or with very thin compact TiO_2 layers display J-V curves with an “s-shaped” feature in the negative voltage range, which could be attributed to immobilized negative ions at the electron-extracting interface. A strong

correlation between the magnitude of the s-shape feature and the exposed FTO seen in the x-ray photoelectron spectroscopy measurements indicates that the s-shape is related to pinholes in the compact TiO_2 layer when it is too thin.

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Gene expression profiles of Vibrio parahaemolyticus in viable but non-culturable state
Viable but non-culturable (VBNC) state is referred to as a dormant state of non-sporulating bacteria enhancing the survival in adverse environments. To our knowledge, only few studies have been conducted on whole genomic expression of Vibrio parahaemolyticus VBNC state. Since a degradation of nucleic acids in V. vulnificus non-culturable state has been detected, we hypothesize that gene regulation of VBNC cells is highly reduced, downregulation of gene expression is dominant and only metabolic functions crucial for survival are kept on a sustained basis. Hence, we performed the whole transcriptomic profiles of V. parahaemolyticus in three phases (exponential, early stationary phase and VBNC state). Compared with exponential and early stationary phase, in V. parahaemolyticus VBNC cells we found 509 induced genes and 309 repressed by more than 4-fold among 4820 investigated genes. Upregulation was dominant in most of non-metabolism functional categories, while five metabolism-related functional categories revealed downregulation in VBNC state. To our knowledge, this is the first study of comprehensive transcriptomic analyses of three phases of V. parahaemolyticus RIMD2210633. Although the mechanism of VBNC state is not yet clear, massive regulation of gene expression occurs in VBNC state compared with expression in other two phases, indicating VBNC cells are active.

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Characterization of fine fraction mined from two Finnish landfills

A fine fraction (FF) was mined from two Finnish municipal solid waste (MSW) landfills in Kuopio (1- to 10-year-old, referred as new landfill) and Lohja (24- to 40-year-old, referred as old landfill) in order to characterize FF. In Kuopio the FF (<20mm) was on average 45±7% of the content of landfill and in Lohja 58±11%. Sieving showed that 86.5±5.7% of the FF was smaller than 11.2mm and the fraction resembled soil. The total solids (TS) content was 46-82%, being lower in the bottom layers compared to the middle layers. The organic matter content (measured as volatile solids, VS) and the biochemical methane potential (BMP) of FF were lower in the old landfill (VS/TS 12.8±7.1% and BMP 5.8±3.4m^3 CH_4/t TS) than in the new landfill (VS/TS 21.3±4.3% and BMP 14.4±9.9m^3 CH_4/t TS), and both were lower compared with fresh MSW. In the Kuopio landfill materials were also mechanically sieved in the full scale plant in two size fraction <30mm (VS/TS 31.1% and 32.9m^3 CH_4/t TS) and 30-70mm (VS/TS 50.8% and BMP 78.5m^3 CH_4/t TS). The nitrogen (3.5±2.0g/kg TS), phosphorus (<1.0-1.5g/kg TS) and soluble chemical oxygen demand (COD) (2.77±1.77kg/t TS) contents were low in all samples. Since FF is major fraction of the content of landfill, the characterization of FF is important to find possible methods for using or disposing FF mined from landfills.

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Stabilization of fine fraction from landfill mining in anaerobic and aerobic laboratory leach bed reactors

Fine fraction (FF, <20mm) from mined landfill was stabilized in four laboratory-scale leach bed reactors (LBR) over 180days. The aim was to study feasibility of biotechnological methods to treat FF and if further stabilization of FF is possible. Four different stabilization methods were compared and their effects upon quality of FF were evaluated. Also during the stabilization experiment, leachate quality as well as gas composition and quantity were analyzed. The methods studied included three anaerobic LBRs (one without water addition, one with water addition, and one with leachate recirculation) and one aerobic LBR (with water addition). During the experiment, the most methane was produced in anaerobic LBR without water addition (18.0LCH<inf>4</inf>/kgVS), while water addition and leachate recirculation depressed methane production slightly, to 16.1 and 16.4LCH<inf>4</inf>/kgVS, respectively. Organic matter was also removed via the leachate and was measured as chemical oxygen demand (COD). Calculated removal of organic matter in gas and leachate was highest in LBR with water addition (59gCOD/kgVS), compared with LBR without water addition or with leachate recirculation (51gCOD/kgVS). Concentrations of COD, ammonium nitrogen and anions in leachate decreased during the experiment, indicating washout mechanism caused by water additions. Aeration increased sulfate and nitrate concentrations in leachate due to oxidized sulfide and ammonium. Molecular weight distributions of leachates showed that all the size categories decreased, especially low molecular weight compounds, which were reduced the most. Aerobic stabilization resulted in the lowest final VS/TS (13.1%), lowest respiration activity (0.9-1.2mgO<inf>2</inf>/gTS), and lowest methane production after treatment (0.0-0.8LCH<inf>4</inf>/kgVS), with 29% of VS being removed from FF.

Anaerobic stabilization methods also reduced organic matter by 9-20% compared with the initial amount. Stabilization reduced the quantity of soluble nitrogen in FF and did not alter concentration of soluble and insoluble phosphorus, and insoluble nitrogen. All four stabilization methods decreased organic matter and thus are possible stabilization methods for FF, but aerobic treatment was the most efficient in this study.

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Screening biological methods for laboratory scale stabilization of fine fraction from landfill mining

Abstract Increasing interest for the landfill mining and the amount of fine fraction (FF) in landfills (40–70% (w/w) of landfill content) mean that sustainable treatment and utilization methods for FF are needed. For this study FF (<20 mm) was mined from a municipal solid waste (MSW) landfill operated from 1967 to 1989. FF, which resembles soil, was stabilized in laboratory scale reactors in two phases: first, anaerobically for 101 days and second, for 72 days using four different methods: anaerobic with the addition of moisture (water) or inoculum (sewage sludge) and aerobic with continuous water washing, with, or without, bulking material. The aim was to evaluate the effect on the stability of mined FF, which has been rarely reported, and to study the quality and quantity of gas and leachate produced during the stabilization experiment. The study showed that aerobic treatment reduced respiration activity (final values 0.9–1.1 mg O2/g TS) and residual methane potential (1.1 L CH4/kg TS) better than anaerobic methods (1.8–2.3 mg O2/g TS and 1.3–2.4 L CH4/kg TS, respectively). Bulking material mixed in FF in one aerobic reactor had no effect on the stability of FF. The benefit of anaerobic treatment was the production of methane, which could be utilized as energy. Even though the inoculum addition increased methane production from FF about 30%, but the methane production was still relatively low (in total 1.5–1.7 L CH4/kg TS). Continuous water washing was essential to remove leachable organic matter and soluble nutrients from FF, while increasing the volume of leachate collected. In the aerobic treatment, nitrogen was oxidized into nitrite and nitrate and then washed out in the leachate. Both anaerobic and aerobic methods could be used for FF stabilization. The use of FF, in landscaping for example, is possible because its nutrient content (4 g N/kg TS and 1 g P/kg TS) can increase the nutrient content of soil, but this may have limitations due to the possible presence of heavy metal and other contaminants.

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Characterization and biological stabilization of fine fraction from landfill mining

Landfilling has been the major method to dispose waste for the decades, thus there are thousands of landfills around the world. Landfills contain large amount of resources, which could be used as material or energy. There is an increasing interest for landfill mining which means excavation and processing of waste materials mined from landfills. While previous landfill composition studies have focused especially on metal recovery and combustible materials, they have shown that landfills contain significant amounts of soil type material with small particle size, referred as fine fraction (FF). As redisposal of FF after landfill mining is expensive and causes emissions for decades, FF should be treated to increase value for reuse. The aim of this thesis was to assess in details the characteristics of the FF and to evaluate the effects of different biological treatment methods on stability and characteristics of FF. In this study, FF was sampled from two landfills representing different eras of material consumption and waste management practices: Kuopio, landfilled 2001–2011, and Lohja, landfilled 1967–1989.

The Kuopio landfill was found to contain 38–54 % of FF (< 20 mm) and the Lohja landfill 40–74%. FF contains in various amounts of organic matter (VS 6–27% of TS), nutrients (1.4–8 kg N/t TS, 1–1.5 kg P/t TS) and soluble organic compounds (e.g. 0.5–4.6 kg COD/t TS). The organic matter content, biomethane potential (0.4–27 L CH4/kg TS) and respiration activity (1.4–2.4 g O2/kg TS) were detected to be higher in top layer of new landfill (1–5 years old) while bottom layer of new landfill (6–10 years old) was similar to old landfill (24–46 years old). Biological activity may limit the utilization of FF after landfill mining, thus FF needs to be stabilized to reduce biological activity. Furthermore, FF may also contain hazardous compounds, which needs to be assessed when evaluating the use of FF.

To reduce biological activity of FF, the anaerobic and aerobic stabilization of FF were studied in two laboratory experiments employing simultaneous four leach bed reactors operated for 173–180 days. In anaerobic stabilization, methane production was found to range from 9 to 18 m3 CH4/t VS for FFs from both landfills. Irrigation of FF was necessary for efficient methane production while sludge addition providing both moisture and inoculum deteriorated the characteristics of FF.

Aerobic stabilization reduced more efficiently organic matter content and biological activity from FF compared with anaerobic treatment. Ammonium nitrogen in the leachate was removed rapidly in aerobic treatment due to nitrification. Organic matter and soluble compounds were efficiently removed with continuous water adding, regardless of anaerobic and aerobic conditions, while leachate recirculation introduced those back to the reactor. The scaling up of the anaerobic and aerobic stabilization methods of FF showed that applied technology, for example aeration or irrigation method, and size of treatment area have major effects on the costs of FF treatment. However, anaerobic stabilization and aerobic stabilization with passive aeration without continuous irrigation would have similar costs in similar sites.

In conclusion, FF may need stabilization due to organic matter content and biological activity before utilization. Both anaerobic and aerobic stabilization improved the quality of FF by reducing organic matter content and biological activity. Both treatment methods can be used in full scale stabilization of FF. The treatment of FF has potential to increase the value and usability of FF. Treatment concept and technology should be further optimized in pilot and full scales.

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Selenium biomineralization for biotechnological applications

Selenium (Se) is not only a strategic element in high-tech electronics and an essential trace element in living organisms, but also a potential toxin with low threshold concentrations. Environmental biotechnological applications using bacterial biomineralization have the potential not only to remove selenium from contaminated waters, but also to sequester it in a reusable form. Selenium biomineralization has been observed in phylogenetically diverse microorganisms isolated from pristine and contaminated environments, yet it is one of the most poorly understood biogeochemical processes. Microbial respiration of selenium is unique because the microbial cells are presented with both soluble (SeO42- and SeO32- and insoluble (Se) forms of selenium as terminal electron acceptor. Here, we highlight selenium biomineralization and the potential biotechnological uses for it in bioremediation and wastewater treatment.

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Research output: Contribution to journal › Literature review › Scientific › peer-review

Metals removal and recovery in bioelectrochemical systems: A review

Metal laden wastes and contamination pose a threat to ecosystem well being and human health. Metal containing waste streams are also a valuable resource for recovery of precious and scarce elements. Although biological methods are inexpensive and effective for treating metal wastewaters and in situ bioremediation of metal(loid) contamination, little progress has been made towards metal(loid) recovery. Bioelectrochemical systems are emerging as a new technology platform for removal and recovery of metal ions from metallurgical wastes, process streams and wastewaters. Biodegradation of organic matter by electroactive biofilms at the anode has been successfully coupled to cathodic reduction of metal ions. Until now, leaching of Co(II) from LiCoO<inf>2</inf> particles, and removal of metal ions i.e.

Co(III/II), Cr(VI), Cu(II), Hg(II), Ag(I), Se(IV), and Cd(II) from aqueous solutions has been demonstrated. This article reviews the state of art research of bioelectrochemical systems for removal and recovery of metal(loid) ions and pertaining removal mechanisms.

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MoE publication type: A2 Review article in a scientific journal
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), CSIR-Indian Institute of Chemical Technology, Bhabha Atomic Research Centre
Contributors: Nancharaiah, Y. V., Venkata Mohan, S., Lens, P.
Number of pages: 13
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Scopus rating (2015): CiteScore 9.2 SJR 2.243 SNIP 1.899
Original language: English
ASJC Scopus subject areas: Bioengineering, Environmental Engineering, Waste Management and Disposal
Keywords: Bioelectrochemical treatment (BET), Biorecovery, Heavy metals, Microbial fuel cells, Wastewater treatment
DOIs:

10.1016/j.biortech.2015.06.058
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Source: Scopus
Source ID: 84945442633
Research output: Contribution to journal › Review Article › Scientific › peer-review

FAIMS analysis of urine gaseous headspace is capable of differentiating ovarian cancer
Aim: We hypothesized that field asymmetric waveform ion mobility spectrometry (FAIMS) as a novel artificial olfactory technology could differentiate urine of women with malignant ovarian tumors from controls and women with benign tumors, based on previous findings on the ability of canine olfactory system to “smell” cancer. Patients and methods: Preoperative urine samples from 51 women with ovarian tumors, both benign and malignant, and from 18 women with genital prolapse, as controls, were collected. The samples were analyzed by FAIMS device. Data analysis was processed by quadratic data analysis (QDA) and linear discriminant analysis (LDA), and cross-validated using 10-fold cross-validation. Results: Thirty-three women had malignant ovarian tumors, of which 18 were high-grade cancers. FAIMS distinguished controls from malignancies with the accuracy of 81.3% (sensitivity 91.2% and specificity 63.1%), and benign tumors from malignancies with the accuracy of 77.3% (sensitivity 91.5% and specificity 51.4%). Moreover, low grade tumors were also separated from high grade cancers and benign ovarian tumors with accuracies of 88.7% (sensitivity 87.8% and specificity 89.6%) and 83.9% (sensitivity 73.1% and specificity 92.9%), respectively. Conclusions: This proof of concept-study indicates that the FAIMS from urine has potential to discriminate malignant ovarian tumors from no tumor-bearing controls and benign tumors.

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Measurement Technology and Process Control, Tampere University Hospital, University of Tampere
Contributors: Niemi, R. J., Roine, A. N., Eräviita, E., Kumpulainen, P. S., Mäenpää, J. U., Oksala, N.
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Keywords: FAIMS, Ovarian cancer, Ovarian neoplasm, Owlstone Lonestar, Urine, VOC
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Stable carbon isotopic composition of peat columns, subsoil and vegetation on natural and forestry-drained boreal peatlands

We studied natural and forestry-drained peatlands to examine the effect of over 34 years lowered water table on the $\delta^{13}C$ values of vegetation, bulk peat and subsoil. In the seven studied sites, $\delta^{13}C$ in the basal peat layer was 1.1 and 1.2 ‰ lower than that of the middle-layer and surface layer, respectively. Furthermore, there was a positive correlation between the $\delta^{13}C$ values of the basal and surface peat layers, possibly due to carbon (C) recycling within the peat column. In the same mire complex, natural fen peat $\delta^{13}C$ values were lower than those of the nearby bog, possibly due to the dominance of vascular plants on fen and the generally larger share of recycled C in the fens than in the bogs. Furthermore, natural and 51 years previously drained fen and bog, on the opposite sides of a ditch on the same mire complex, showed no significant differences in $\delta^{13}C$ values. Plant $\delta^{13}C$ values were lower, while $\delta^{13}C$ values of subsoil were higher in the drained than in the natural site of the fen.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, University of Eastern Finland, University of Jyväskylä
Contributors: Nykänen, H., Mpamah, P. A., Rissanen, A. J.
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ASJC Scopus subject areas: Environmental Chemistry, Environmental Science(all), Inorganic Chemistry
Keywords: Biogeochemistry, bog, carbon cycle, carbon dioxide, carbon-13, diagenesis, drainage, fen, isotope ecology, Sphagnum, Suess effect
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Source ID: 85053893057
Research output: Contribution to journal › Article › Scientific › peer-review

Carbon storage change and δ13C transitions of peat columns in a partially forestry-drained boreal bog

Background and aims

In forestry-drained peatlands, drying leads to changes in C cycling which could affect peat δ13C. Furthermore, the δ13C profile of the entire peat column may reveal effects of earlier climatic periods.

Methods

We measured peat δ13C and C inventories in adjacent peat profiles, two collected from undrained and two from the

drained side of a bog that was partially ditch-drained 37 years earlier. The cores were sliced into 10-cm subsamples for analyses; matching of the profiles based on surface levelling, peat stratigraphic correlation and a horizontal ash layer found in both profiles.

Results

Surface subsidence of 30 cm was observed in the dried site and the uppermost 160 cm in the undrained site contained an excess of 5.9 kg m−2 of C compared with the corresponding strata of the ditch-drained site. The δ13C values increased but markedly only in the thin surface layer of the drained site, indicating low δ13C of the missing C (ca. –30‰). In the deeper strata, dating to Mid-Holocene, high dry bulk density, C%, N%, humification index and low C/N ratio were connected to low δ13C of peat.

Conclusions

Drainage of 37 years increased δ13C values in the upper peat profile of the drained bog and led to the selective loss of 13C depleted C. Results indicate that C balance studies can be aided by C isotope analyses. Low δ13C values in the peat profile indicate the existence of a wet fen stage during the moist and warm period during Mid-Holocene.

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Organisations: Research group: Bio- and Circular Economy, Materials Science and Environmental Engineering, University of Eastern Finland, Geological Survey of Finland
Contributors: Nykänen, H., Rissanen, A. J., Turunen, J., Tahvanainen, T., Simola, H.
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Bioaugmentation enhances dark fermentative hydrogen production in cultures exposed to short-term temperature fluctuations
Hydrogen-producing mixed cultures were subjected to a 48-h downward or upward temperature fluctuation from 55 to 35 or 75 °C. Hydrogen production was monitored during the fluctuations and for three consecutive batch cultivations at 55 °C to evaluate the impact of temperature fluctuations and bioaugmentation with synthetic mixed culture of known H2 producers either during or after the fluctuation. Without augmentation, H2 production was significantly reduced during the downward temperature fluctuation and no H2 was produced during the upward fluctuation. H2 production improved significantly during temperature fluctuation when bioaugmentation was applied to cultures exposed to downward or upward temperatures. However, when bioaugmentation was applied after the fluctuation, i.e., when the cultures were returned to 55 °C, the H2 yields obtained were between 1.6 and 5% higher than when bioaugmentation was applied during the fluctuation. Thus, the results indicate the usefulness of bioaugmentation in process recovery, especially if bioaugmentation time is optimised.

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Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, INRA
Contributors: Okonkwo, O., Escudié, R., Bernet, N., Mangayil, R., Lakaniemi, A., Trably, E.
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EXT="Okonkwo, Onyinye"
Research output: Contribution to journal › Article › Scientific › peer-review

Ecological Sanitation - A Logical Choice? The Development of the Sanitation Institution in a World Society
Sustainability, encompassing ecological, economic as well as sociocultural aspects, has become a driving force for many political and administrational decisions. It is no longer enough to follow old practices or rely on profit margins – it is necessary to consider the needs of society and nature in a more holistic way as a larger whole. Sustainability is the key word also in terms of sanitation; ecological sanitation, or ecosan for short, has come to mark the sustainable approach to handling human excreta.

In 2014, there are still approximately 2.5 billion people in the world without access to adequate sanitation; 1.1 billion practice open defecation. Lack of sanitation is often – but not necessarily – linked to lack of clean drinking water and poor hygiene. However, poor wastewater treatment also occurs in more developed countries as well as in times of crisis. In the case of natural disasters, even waterborne sanitation, which is often considered the norm, does not prevent the risk of contamination from pathogens. Ecological sanitation aims at a closed cycle of nutrients and absence of water; dry toilets, composting and urine diversion help to return nutrients back into the soil.

Based on these challenges, it is necessary to examine alternatives to the current toilet institution that considers waterborne sanitation as the norm. This dissertation explores the feasibility of ecological sanitation as a potential alternative to the mainstream option and the aim is to discover which issues affect the development and change of the current waterborne toilet institution. From a multi- and interdisciplinary point of view, the dissertation determines the various aspects affected by ecosan, such as water and environment, health, culture, education, agriculture, business and technology, and from these points of view develops futures scenarios for sustainable sanitation practices. Technology is here defined beyond artefacts and processes encompassing also knowhow as well as the sociotechnical systems of use, including legislation, culture and practices.

The data collected for this research includes expert interviews (n=11), case studies from Ethiopia, Finland, New Zealand and Zambia, and literature review including various policy documents and legislation of the aforementioned case countries to shed light to the current state of ecological sanitation and how it is taken into account from a legal perspective. In addition, a two-round consensus-Delphi survey (n1=44, n2=22) together with theme seminars was conducted among Finnish experts to determine the future potential of ecological sanitation.

Through qualitative data analyses, the potential futures and desirable outcomes are mapped with the help of futures research and environmental scanning. The overall challenge of potentially changing the waterborne toilet institution is discussed in the light of the World Polity Theory – with the understanding that global norms are valid everywhere and that change eventually must start from intergovernmental actors rather than political decision makers.

This research brings more insight to the relatively unknown and overlooked subject of ecological sanitation. The integrated approach offers new insight into sustainable sanitation practices and closed loop approach from view points of the various sectors of society, including social, economic and ecological aspects. The undisputed challenges of inadequate sanitation facilities faced by 2.5 billion people worldwide are generally not recognized in scientific literature, although several invaluable studies have contributed to the field. Still, concrete results for improvement are still required.

The results of this study find that ecological sanitation must be approached from a multidisciplinary point of view in order to understand the variety of sectors impacted by these sustainable practices. As a conclusion it can be stated that the traditional norms in waterborne sanitation are difficult to change but the pressure of limited phosphorus resources and deteriorating or non-existing infrastructure require alternative solutions to the norm. As yet, legislation has generally not allowed or considered the use of human excreta as fertiliser, but practices are slowly changing along with attitudes. Institutions do not change easily but can do so while attitudes, policies and practices all start adopting new ways of operating.

It is possible that in the future ecological sanitation will indeed be accepted as a feasible option along with other sanitation

methods. This is supported also by the increasing need for sustainable practices in societies. However, in more daunting futures the lack of closed cycles will lead to shortages in resources as well as the lack of wellbeing in communities without access to sanitation. Thus, the research of sustainable sanitation solution is significant and necessary – also in the future.

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Organisations: Department of Chemistry and Bioengineering
Contributors: O'Neill, M.
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o'neill_1284.pdf: 3364317 bytes, checksum: 78eac8bfe0a42d2087dd7e78192f6216 (MD5)
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Research output: Book/Report › Doctoral thesis › Monograph

Fungal treatment of landfill mining fine fraction to increase its stability and end-use potential
Landfill mining, i.e. extraction, processing, treatment and recovery of landfilled materials, is conducted to prevent pollution and to recover materials and energy from waste (Krook et al., 2012). On average, half of landfilled waste is material resembling soil, i.e. its fine fraction (FF, < 20 mm) (Kaartinen et al., 2013). The end-use potential of the FF is limited due to its organic matter content, a possible presence of harmful contaminants as well as its stability. The aim of this study was to evaluate if fungal treatment stabilises FF and removes organic contaminants thus allowing an end-use of FF as soil-like material. Basidiomycetous fungi were obtained and maintained according to Valentin et al. (2008) prior to experiments and were screened for their potential to grow in FF originally landfilled between 1967 – 1989. Screening experiments and previous experiences with contaminated soil (Valentin et al. 2008) led to the selection of Phanerochaete velutina for fungal treatment experiments, which were carried out at room temperature for 58 days. Two acryl columns (height 600 mm, radius 75 mm) were filled with 1 – 2 cm layer of gravel at the bottom and 5.8 kg of FF on the top as well as 500 mL of tap water. The fungal column was amended with fungal bark inoculum to the middle of the column. Two ports at the bottom of the columns were used to collect leachate and aerate columns with humidified air at 0.1 L/min, respectively. Carbon dioxide (CO_2) production was followed during the experiment with gas chromatography. The columns were covered with aluminium foil to stop germination of seeds present in FF. Total solids and volatile solids (VS) were analysed from FF according to standard SFS 3008. Organic contaminants mentioned in criteria for landfilling were analysed from FF in an accredited laboratory. Aerobic stability of FF was determined by the Oxitop method and anaerobic stability of FF was determined as biochemical methane potential. In less than one month, fungal mycelium was observed throughout the FF in the column inoculated with Phanerochaete velutina while no mycelium was observed in the control column. At this stage the experiment was continued in order to allow fungal mycelium to degrade and produce CO_2. Concentrations of mineral oils (C10-C40) and organic matter, measured as VS, were higher in FF than in waste that can be placed to landfills. Mineral oil concentrations exceeded Finnish criteria set for contaminated soil. The aerobic stability of FF was high even initially and it did not increase in control or fungal treatments. Fungal treatment reduced organic matter content of FF and

reduced mineral oil concentrations, although the criteria set in legislation could not be met in these experiments.

General information
Publication status: Published
MoE publication type: A4 Article in a conference publication
Organisations: Research group: Industrial Bioengineering and Applied Organic Chemistry, Department of Chemistry and Bioengineering, University of Helsinki, Department of Food and Environmental Sciences
Contributors: Palmroth, M. R. T., Mönkäre, T. J., Steffen, K. T.
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ASJC Scopus subject areas: Bioengineering, Geotechnical Engineering and Engineering Geology, Environmental Engineering
Keywords: bioremediation

Bibliographical note
xabstract
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

Mitigation of propylene glycol emissions to groundwater and soil
Background
Propylene glycol based deicing agents are used at airports to remove ice and prevent ice accumulation into airplanes. Propylene glycol is readily biodegradable both aerobically and anaerobically but it has been noticed to migrate into groundwater (Greco et al., 2012). Currently propylene glycol emissions are collected and treated at municipal treatment plants. More information is needed about mitigation measures to prevent propylene glycol emissions into ground water and soil.
Aim
The objective of current study was to study whether low cost materials can improve propylene glycol degradation in soil and decrease its migration into groundwater and soil at low temperatures. The low cost materials were chosen based on literature survey and small scale laboratory experiments as well as technical parameters and current use at Finnish airport structures. Experiments were carried out in two pilot-scale temperature controlled lysimeters (height 3 m, radius 50 cm) operated at -5 to 20° C, i.e. simulating winter, spring and summer conditions to compare control lysimeter and amended lysimeter. Deicing agent was mixed with flake ice in order to simulate snow and added on top of the soil and/or amendments. The purpose was to find out whether addition of peat and blast furnace sand can mitigate propylene glycol emissions.
Conclusion
Lysimeter leachate formation and migration of propylene glycol into lysimeter leachate were minimal when the soil was frozen. Biodegradation of propylene glycol was detected as formation of its degradation products in both lysimeters after the soil temperature had increased above 0 ºC. However, comparison of results from control lysimeter and lysimeter amended with peat and blast furnace sand revealed that the amendments did not improve biodegradation of propylene glycol nor decrease its migration into lysimeter leachate.

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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Tampere University of Technology, Finavia Oy
Contributors: Palmroth, M. R. T., Pispa, L., Kettunen, R. H., Hänninen, T., Rintala, J. A.
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ASJC Scopus subject areas: Environmental Engineering
URLs:

http://nordrocs.org/ (Conference website)
Research output: Other conference contribution › Paper, poster or abstract › Scientific

Semi-continuous mono-digestion of OFMSW and Co-digestion of OFMSW with beech sawdust: Assessment of the maximum operational total solid content
In this study, mono-digestion of the organic fraction of municipal solid waste (OFMSW) and co-digestion of OFMSW with beech sawdust, simulating green waste, were used to investigate the maximum operational total solid (TS) content in

semi-continuous high-solids anaerobic digestion (HS-AD). To alleviate substrate overloading in HS-AD, the effluent mass was relatively reduced compared to the influent mass, extending the mass retention time. To this aim, the reactor mass was daily evaluated, permitting to assess the reactor content removal by biogas production. During mono-digestion of OFMSW, the NH_3 inhibition and the rapid TS removal prevented to maintain HS-AD conditions (i.e. TS ≥ 10%), without exacerbating the risk of reactor acidification. In contrast, the inclusion of sawdust in OFMSW permitted to operate HS-AD up to 30% TS, before acidification occurred. Therefore, including a lignocellulosic substrate in OFMSW can prevent acidification and stabilize HS-AD at very high TS contents (i.e. 20–30%).

General information
Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, University of Cassino and Southern Lazio, ENEA/CREATE/Università Degli Studi Napoli Federico II, University of Montpellier, University of Montpellier
Contributors: Pastor-Poquet, V., Papirio, S., Trably, E., Rintala, J., Escudié, R., Esposito, G.
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Keywords: Acidification, Ammonia inhibition, High-solids anaerobic digestion, Influent/effluent uncoupling, Substrate overloading
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EXT="Papirio, Stefano"
Source: Scopus
Source ID: 85054370336
Research output: Contribution to journal › Article › Scientific › peer-review

Catalytic effect of Ca and K on CO2 gasification of spruce wood char

Gasification is one route to produce chemicals and liquid fuels from biomass. The gasification of the char is catalyzed by alkali and alkaline earth metals in the biomass. In this work the catalytic effect of calcium (Ca) and potassium (K) on CO_2 gasification of spruce wood was studied using a thermo gravimetric analyzer (TGA). The ash-forming elements were first removed from the wood using an acid leaching method. Then, various concentrations of K and Ca were absorbed to the wood by ion-exchange to carboxylic and phenolic groups, impregnation of K_2CO_3 or physically mixing of CaC_2O_4. The prepared spruce samples were placed in a mesh holder and gasified in the TGA at 850°C in 100% CO_2. The results demonstrate that the gasification rate of the char increased linearly with an increase in the concentration of Ca or K. Crystalline CaC_2O_4 distributed only at the surface of the wood particles resulted in low catalytic activity. The catalytic activity of Ca was higher than K in the beginning of char gasification but the catalytic effect of Ca decreased earlier than the catalytic effect of potassium. Further, the char structure was investigated by SEM-EDX. The SEM analysis from interrupted gasification experiments showed the formation of $CaCO_3$ and K_2CO_3 layer on the char surface. By adding corresponding levels of Ca and K as the original spruce to the acid washed sample, a similar gasification reactivity was obtained at 850 °C.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Abo Akademi University, Åbo Akademi University, University of Jyväskylä, Process Chemistry Center, VTT Technical Research Centre of Finland
Contributors: Perander, M., DeMartini, N., Brink, A., Kramb, J., Karlström, O., Hemming, J., Moilanen, A., Konttinen, J., Hupa, M.
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Keywords: Biomass, Calcium, Char reactivity, CO, Gasification, Potassium
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http://www.scopus.com/inward/record.url?scp=84924100908&partnerID=8YFLogxK (Link to publication in Scopus)

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EXT="Kramb, J."
Source: Scopus
Source ID: 84924100908
Research output: Contribution to journal › Article › Scientific › peer-review

How and why does willow biochar increase a clay soil water retention capacity?
Addition of biochar into a soil changes its water retention properties by modifying soil textural and structural properties. In addition, internal micrometer-scale porosity that is able to directly store readily plant available water affects soil water retention properties. This study shows how precise knowledge of the internal micrometer-scale pore size distribution of biochar can deepen the understanding of the biochar-water interactions in soils. The micrometer-scale porosity of willow biochar was quantitatively and qualitatively characterized using X-ray tomography, 3D image analysis and Helium ion microscopy. The effect of biochar application on clay soil water retention was studied by conventional water retention curve approach. The results indicate that the internal pores of biochar, with sizes of at 50 and 10 μm (equivalent pore diameter), increased soil porosity and the amount of readily plant available water. After biochar addition, changes in soil porosity were detected at pore size regimes 5–10 and 25 μm, i.e. biochar pore sizes multiplied by factor 0.5. The detected pore size distribution of biochar does not predict directly (1:1 compatibility) the changes observed in the soil moisture characteristics. It is likely that biochar chemistry and pore morphology affect biochar-water interactions via e.g. surface roughness and contact angle. In addition, biochar induced changes in soil structure and texture affected soil moisture characteristics. However, the approach presented is an attractive pathway to more generalized understanding on how and why biochar internal porosity affects soil moisture characteristics.

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Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Biophysics and Imaging Group, Natural Resources Institute Finland (Luke), Jyväskylän yliopisto
Contributors: Rasa, K., Heikkinen, J., Hannula, M., Arstila, K., Kulju, S., Hyväluoma, J.
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ASJC Scopus subject areas: Forestry, Renewable Energy, Sustainability and the Environment, Agronomy and Crop Science, Waste Management and Disposal
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CH4 oxidation in a boreal lake during the development of hypolimnetic hypoxia
Freshwater ecosystems represent a significant natural source of methane (CH4). CH4 produced through anaerobic decomposition of organic matter (OM) in lake sediment and water column can be either oxidized to carbon dioxide (CO2) by methanotrophic microbes or emitted to the atmosphere. While the role of CH4 oxidation as a CH4 sink is widely accepted, neither the magnitude nor the drivers behind CH4 oxidation are well constrained. In this study, we aimed to gain more specific insight into CH4 oxidation in the water column of a seasonally stratified, typical boreal lake, particularly under hypoxic conditions. We used 13CH4 incubations to determine the active CH4 oxidation sites and the potential CH4 oxidation rates in the water column, and we measured environmental variables that could explain CH4 oxidation in the water column. During hypolimnetic hypoxia, 91% of available CH4 was oxidized in the active CH4 oxidation zone, where the potential CH4 oxidation rates gradually increased from the oxycline to the hypolimnion. Our results showed that in warm springs, which become more frequent, early thermal stratification with cold well-oxygenated hypolimnion delays the period of hypolimnetic hypoxia and limits CH4 production. Thus, the delayed development of hypolimnetic hypoxia may partially counteract the expected increase in the lacustrine CH4 emissions caused by the increasing organic carbon load from forested catchments.

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Contributors: Saarela, T., Rissanen, A. J., Ojala, A., Pumpanen, J., Aalto, S. L., Tiirola, M., Vesala, T., Jäntti, H.
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Research output: Contribution to journal › Article › Scientific › peer-review

Microbial community response on wastewater discharge in boreal lake sediments
Despite high performance, municipal wastewater treatment plants (WWTPs) still discharge significant amounts of organic material and nitrogen and even microbes into the receiving water bodies, altering physico-chemical conditions and microbial functions. In this study, we examined how nitrified wastewater affects the microbiology of boreal lake sediments. Microbial community compositions were assessed with next generation sequencing of the 16S rRNA gene, and a more detailed view on nitrogen transformation processes was gained with qPCR targeting on functional genes (nirS, nirK, nosZI, nosZII, amoAarchaea, and amoAbacteria). In both of the two studied lake sites, the microbial community composition differed significantly between control point and wastewater discharge point, and a gradual shift toward natural community composition was seen downstream following the wastewater gradient. SourceTracker analysis predicted that ~2% of

sediment microbes were of WWTP-origin on the study site where wastewater was freely mixed with the lake water, while when wastewater was specially discharged to the sediment surface, ~6% of microbes originated from WWTP, but the wastewater-influenced area was more limited. In nitrogen transformation processes, the ratio between nitrifying archaea (AOA) and bacteria (AOB) was affected by wastewater effluent, as the AOA abundance decreased from the control point (AOA:AOB 28:1 in Keuruu, 11:1 in Petäjävesi) to the wastewater-influenced sampling points, where AOB dominated (AOA:AOB 1:2–1:15 in Keuruu, 1:3–1:19 in Petäjävesi). The study showed that wastewater can affect sediment microbial community through importing nutrients and organic material and altering habitat characteristics, but also through bringing wastewater-originated microbes to the sediment, and may thus have significant impact on the freshwater biogeochemistry, especially in the nutrient-poor boreal ecosystems.

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Organisations: Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, University of Jyväskylä, Univ Jyvaskyla, University of Jyvaskyla, Dept Biol & Environm Sci, Nanosci Ctr, Univ Jyvaskyla, Dept Biomed & Environm Sci
Contributors: Saarenheimo, J., Aalto, S. L., Rissanen, A. J., Tiirola, M.
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Research output: Contribution to journal › Article › Scientific › peer-review

Fluorination of pyrene-based organic semiconductors enhances the performance of light emitting diodes and halide perovskite solar cells
In this work, a fluorinated pyrene-based organic semiconductor (L-F) has been designed and synthesized starting from a low-cost pyrene core functionalized with triphenilamine substituents at 1,3,6,8 positions (L-H), obtained via Suzuki coupling reactions. Its performance when used as green emitter in organic light emitting diodes (OLEDs) or as dopant-free hole-transporting material (HTM) in halide perovskite solar cells (PSCs) is higher than that of the L-H counterpart, in spite of its lower bulk hole-mobility (7.0×10−6cm2/V) to L-H (1.9×10−4cm2/V). In fact, the OLED devices based on a L-F active layer showed excellent green emission (brightness and current efficiency were 1759.8cd/m2 and 3.7cd/A, respectively) at a 4.5V turn-on voltage. When the molecules were employed as a dopant-free HTM in PSCs, L-F led to a power conversion efficiency (PCE) and open circuit voltage (Voc) of 5.9% and 1.07V, respectively, thus outperforming those of corresponding devices based on L-H (PCE=5.0% and Voc=0.87V) under similar experimental conditions (AM 1.5G and 100mWcm2). We attribute the enhancements of L-F-based optoelectronic devices (OLEDs and PSCs) to the observed better quality of the L-F films. The promising performance of L-F indicates that fluorination of small molecules can be an effective strategy to achieve low-cost and high-performing materials for energy harvesting and display-based organic electronic devices.

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Organisations: Research group: Chemistry & Advanced Materials, Materials Science and Environmental Engineering, Åbo Akademi
Contributors: Salunke, J., Singh, A., He, D., Duc Pham, H., Bai, Y., Wang, L., Dahlström, S., Nyman, M., Manzhos, S., Feron, K., Österbacka, R., Priimägi, A., Vivo, P., Sonar, P.
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Developing Synthetic Biology Tools and Model Chassis: Production of Bioenergy and High-Value Molecules

One of the aims of synthetic biology is the sustainable production of high-value compounds and bioenergy molecules. Synthetic biologists exploit fundamental engineering principles, such as DNA component standardization, modular genetic circuits, and de novo design, to create novel production pathways and products. A well-characterized host cell serves as the chassis for the system construction; generally, the model bacterium Escherichia coli is applied. However, the metabolism and characteristics of E. coli are not ideal for all applications. Furthermore, many E. coli based systems are patent protected which restricts the use in forthcoming application. Acinetobacter baylyi ADP1 is a potential alternative host for synthetic biology. The metabolism and genetics of the strain are well-understood, and the engineering of its genome is technically straight-forward. The versatile and unusual metabolic pathways, including those producing long chain hydrocarbons, can be rerouted, modified, and integrated into novel ones. I exploited A. baylyi ADP1 as a model host for the production of high-value hydrocarbons, triacylglycerols and wax esters. I employed metabolic engineering, novel molecular monitoring tools, and synthetic pathway design to improve the production, and to demonstrate the utility of ADP1 as a synthetic biology host. In particular, the production of triacylglycerols was improved over 5-folds by targeted gene deletions which resulted in redirected carbon flux towards the product and elimination of competitive pathways. The long-chain hydrocarbon metabolism, including alcohol and wax ester biosynthesis, is not yet fully understood. These pathways are regulated through several mechanisms sensitive to specific environmental conditions and the cellular states. However, the lack of robust and straight-forward analysis tools has restricted the studies of lipid metabolism and production kinetics. I developed a simple in vivo tool for the investigation of the long chain hydrocarbon metabolism in real-time. The tool is based on a light-producing reporter enzyme, bacterial luciferase. The enzyme utilizes a specific intermediate of the hydrocarbon synthesis pathway as a substrate for bioluminescence production. Initially, the tool was applied for monitoring the wax ester metabolism of A. baylyi ADP1. Subsequently, I modified the monitoring tool for studying the degradation of alkanes. The studies suggest that the tool can be applied for production optimization in different hosts and for a variety of products. I also reconstructed the wax ester synthesis pathway of A. baylyi ADP1 by replacing a natural key enzyme with an alternative well-characterized component, enabling a regulated production of unnatural wax esters. Bioprocess control and scale-up of production systems are challenging. Multispecies cultures are suggested to improve the robustness and performance of bacterial production processes. I exploited the metabolic versatility of A. baylyi ADP1 to construct a rationally engineered synthetic coculture with E. coli. The designed coculture exhibited improved biomass and recombinant protein production compared to the pure culture of E. coli. To conclude, I have shown that the strain ADP1 is a suitable host for synthetic biology applications, especially for long-chain hydrocarbon production, the development of novel tools for metabolic studies, and for exploiting the existing unusual metabolic networks of the cell. Thus, further studies of the remaining challenges related to ADP1 bioprocess and as-of-yet uncharacterized cell mechanisms, are warranted.

General information

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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Santala, S.
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Research output: Book/Report › Doctoral thesis › Collection of Articles

Rewiring the wax ester production pathway of acinetobacter baylyi ADP1
Wax esters are industrially relevant high-value molecules. For sustainable production of wax esters, bacterial cell factories are suggested to replace the chemical processes exploiting expensive starting materials. However, it is well recognized that new sophisticated solutions employing synthetic biology toolbox are required to improve and tune the cellular production platform to meet the product requirements. For example, saturated wax esters with alkanol chain lengths C12 or C14 that are convenient for industrial uses are rare among bacteria. Acinetobacter baylyi ADP1, a natural producer of wax esters, is a convenient model organism for studying the potentiality and modifiability of wax esters in a natural host by means of synthetic biology. In order to establish a controllable production platform exploiting well-characterized biocomponents, and to modify the wax ester synthesis pathway of A. baylyi ADP1 in terms product quality, a fatty acid reductase complex LuxCDE with an inducible arabinose promoter was employed to replace the natural fatty acyl-CoA reductase acr1 in ADP1. The engineered strain was able to produce wax esters by the introduced synthetic pathway. Moreover, the fatty alkanol chain length profile of wax esters was found to shift toward shorter and more saturated carbon chains, C16:0 accounting for most of the alkanols. The study demonstrates the potentiality of recircuiting a biosynthesis pathway in a natural producer, enabling a regulated production of a customized bioproduct. Furthermore, the LuxCDE complex can be potentially used as a well-characterized biopart in a variety of synthetic biology applications involving the production of long-chain hydrocarbons. © 2014 American Chemical Society.

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Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Research area: Design, Development and LCM, Urban circular bioeconomy (UrCirBio), Neste Oil Oyj
Contributors: Santala, S., Efimova, E., Koskinen, P., Karp, M. T., Santala, V.
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Organic Chromophores in Self-Assembled Monolayers and Supramolecular Arrays

Large aromatic chromophores, e.g. phthalocyanines or perylene derivatives are widely used in modern photonic applications. For these systems, well-organized films of the chromophores are very important. One of the ways to ensure the order on molecular level is to bind the organic dyes covalently to a solid substrate with a suitable anchor group. Expanding the concept, multilayered supramolecular assemblies can be built on surfaces as well.

In the present Thesis various chromophores with a capability to anchor onto a solid surface were prepared. Synthesized molecules were porphyrins, phthalocyanines, and perylene mono- and diimides with different substituents. The anchor-surface pairs were of several types, and the chromophores were attached to a surface by one- or two-step methods.

Two of the perylene monoimide derivatives were found to be a perfect basement for construction of multilayered films. Using a metal-ligand interaction it was possible to prepare stable double layers, as well ten molecules thick stable deeply colored multilayer films. The developed approach is versatile and will allow in future to expand the capabilities of molecular film architecture.

General information

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MoE publication type: G5 Doctoral dissertation (article)
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Contributors: Sariola-Leikas, E.
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Start-up of anaerobic digester treating LCFA containing wastewater at low temperature

General information

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Contributors: Singh, S., Kokko, M., Rintala, J.
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Research output: Other conference contribution › Paper, poster or abstract › Scientific

Study of LCFA mediated granular disintegration in EGSB at low temperature using Static Image Analysis

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Contributors: Singh, S., Tolvanen, H., Kokko, M., Rintala, J.
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Research output: Other conference contribution › Paper, poster or abstract › Scientific

Carbazole-based small molecule electron donors: Syntheses, characterization, and material properties

Efficient synthetic methods for carbazole-based small molecule electron donors with donor–acceptor (D–A) and A–D–A type structures were developed. In order to study the relation between chemical structures and material properties, the prepared compounds were characterized in detail using absorption spectroscopy, differential pulse voltammetry, and computational methods. In addition, symmetrical A–D–A type compounds were tested as an active layer component in bulk heterojunction based organic solar cell (OSC) devices with conventional structure. The results show that the two compound types have many similar properties. However, the extended molecular structure of A–D–A type compounds offer better film forming properties and higher molar absorption coefficients compared with the D–A type materials. Furthermore, the attachment of fluoro substituents in the A units has a positive effect on all solar cell device parameters. Moreover, the computational studies revealed that the molecular structures are twisted between the central carbazole D unit and π-bridge which may result in inefficient intramolecular charge transfer and, also, relatively limited short-circuit currents in OSC devices.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Supramolecular photochemistry, Research group: Chemistry & Advanced Materials, Research Unit of Sustainable Chemistry, IMEC PV Department
Contributors: Sippola, R. J., Hadipour, A., Kastinen, T., Vivo, P., Hukka, T. I., Aernouts, T., Heiskanen, J. P.
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Pages: 79-88
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Early online date: 8 Nov 2017

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Research output: Contribution to journal › Article › Scientific › peer-review

Interdisciplinary water research network building within Nordic and Baltic countries.

General information

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MoE publication type: A2 Review article in a scientific journal
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Department of Civil Engineering
Contributors: Sörensen, J., Kurki, V., Sidaraviciute, R., Ngari Kibocha, S., Retike, I., Ikobe, G., Tichonovas, M., Elijosiute, E., Rajala, R.
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Research output: Contribution to journal › Review Article › Scientific › peer-review

Biomimetic collagen I and IV double layer Langmuir-Schaefer films asmicroenvironment for human pluripotent stem cell derived retinal pigment epithelial cells

The environmental cues received by the cells from synthetic substrates invitro are very different from those they receive invivo. In this study, we applied the Langmuir-Schaefer (LS) deposition, a variant of Langmuir-Blodgett technique, to fabricate a biomimetic microenvironment mimicking the structure and organization of native Bruch's membrane for the production of the functional human embryonic stem cell derived retinal pigment epithelial (hESC-RPE) cells. Surface pressure-area isotherms were measured simultaneously with Brewster angle microscopy to investigate the self-assembly of human collagens type I and IV on air-subphase interface. Furthermore, the structure of the prepared collagen LS films was characterized with scanning electron microscopy, atomic force microscopy, surface plasmon resonance measurements and immunofluorescent staining. The integrity of hESC-RPE on double layer LS films was investigated by measuring transepithelial resistance and permeability of small molecular weight substance. Maturation and functionality of hESC-RPE cells on double layer collagen LS films was further assessed by RPE-specific gene and protein expression, growth factor secretion, and phagocytic activity. Here, we demonstrated that the prepared collagen LS films have layered structure with oriented fibers corresponding to architecture of the uppermost layers of Bruch's membrane and result in increased barrier properties and functionality of hESC-RPE cells as compared to the commonly used dip-coated controls.

General information

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Contributors: Sorkio, A. E., Vuorimaa-Laukkanen, E. P., Hakola, H. M., Liang, H., Ujula, T. A., Valle-Delgado, J. J., Österberg, M., Yliperttula, M. L., Skottman, H.
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Source ID: 000351796700025
Research output: Contribution to journal › Article › Scientific › peer-review

Photoresponsive Polymer Hydrogel Coatings that Change Topography

This chapter provides a brief overview of the principles as well as the potential applications of photoresponsive hydrogel films, which change surface topography. It discusses the operating mechanisms that lead to topographical changes. Changes in topography can affect the wettability of a surface, which is an interesting characteristic for making self-cleaning coatings. The chapter also discusses polymer films that are useful for the development of self-cleaning films. It then discusses responsive materials, for cell culturing and microfluidics applications. The chapter further shows that appealing photoresponsive polymer hydrogel coatings that change topography can be fabricated, which holds great promise in a variety of fields ranging from microfluidic devices to biomedical applications. When the structures of the topography are in the micrometer size regime, they influence the wettability of the surface. Two types of wetting can be defined: Wenzel and Cassie-Baxter.

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Organisations: Chemistry and Bioengineering, Research group: Chemistry & Advanced Materials
Contributors: Stumpel, J. E., ter Schiphorst, J., Schenning, A. P. H. J.
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Reduced Inorganic Sulfur Compounds of Simulated Mining Waters Support Bioelectrochemical and Electrochemical Current Generation

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Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy
Contributors: Sulonen, M., Lakaniemi, A., Kokko, M., Puhakka, J.
Publication date: 2017
Peer-reviewed: Unknown
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Bioelectrochemical removal of inorganic sulfur compounds and copper from simulated acidic mining water

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Research output: Other conference contribution › Paper, poster or abstract › Scientific

Struvite precipitation in raw and co-digested swine slurries for nutrients recovery in batch reactors
The release of nitrogen (N) and phosphorus (P) from agro-industrial sources is a major environmental concern. Furthermore, the scarcity of mineable P and the growing demand for food worldwide necessitate that we find an alternative P source. This study applied struvite precipitation for N-P recovery to slurries with high levels of organics and ammonia to achieve environmental protection from excessive nutrients diffusion and to generate a sustainable P source. Batch tests were carried out on raw and co-digested swine slurries to study the feasibility of struvite precipitation and the effect of several parameters, including pH, reaction time, competing ions (Ca²⁺, K⁺), total solids (TS), and alkalinity. The batch assays with raw swine slurries showed high N-P removals (up to 80%), while the anaerobic liquor returned lower recovery efficiency due to the high solids and alkali content. Struvite crystallization was detected at pH values as low as 6, and the characteristics of the recovered struvite matched those of the theoretical. Slight co-precipitation of calcium-phosphates occurred and was dependent on the Ca²⁺/Mg²⁺ ratio rather than on varying pH values. Struvite precipitation was shown to be feasible in complex matrices as agro-industrial effluents, characterized by high NH<inf>4</inf>⁺, alkalinity, solids and organic content, and interfering ions such as Ca²⁺ and K⁺.

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Contributors: Taddeo, R., Lepistö, R.
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Source: Scopus
Source ID: 84929000113
Research output: Contribution to journal › Article › Scientific › peer-review

Characteristics and agronomic usability of digestates from laboratory digesters treating food waste and autoclaved food waste
Digestate characteristics such as organic and nutrient content, hygienic quality and stability are valuable measures when evaluating the use of food waste (FW) digestate as organic fertiliser. This study compared the characteristics of FW and autoclaved (160 °C, 6.2 bar) FW and their digestates from laboratory-scale reactors. Decreased ammonification and low ammonium nitrogen content were observed in the digestate from an autoclaved FW reactor due to autoclave treatment of FW, which affected the nitrogen-containing molecules by formation of Maillard compounds. The methane potential of autoclaved FW and its digestate was decreased by 40% due to reduced microbial activity as microbes were not able to adapt to the conditions within a reactor fed with autoclaved FW. Both studied materials were suitable for agricultural use in terms of their nutrient content, hygienic quality and stability, and thus the decrease in ammonium nitrogen in digestate from an autoclaved FW reactor supported the use of digestate as soil amendment rather than fertiliser.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), Natural Resources Institute Finland (Luke)
Contributors: Tampio, E., Ervasti, S., Rintala, J.
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ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Renewable Energy, Sustainability and the Environment, Environmental Science(all), Strategy and Management
Keywords: Ammonium nitrogen, Autoclave treatment, Characterisation, Digestate, Fertiliser, Food waste
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Bibliographical note
EXT="Tampio, Elina"
Source: Scopus
Source ID: 84928768890
Research output: Contribution to journal › Article › Scientific › peer-review

Use of laboratory anaerobic digesters to simulate the increase of treatment rate in full-scale high nitrogen content sewage sludge and co-digestion biogas plants

The aim of this study was to assess the effect of increasing feedstock treatment rate on the performance of full-scale anaerobic digestion using laboratory-scale reactors with digestate and feedstock from full-scale digesters. The studied nitrogen-containing feedstocks were i) a mixture of industrial by-products and pig slurry, and ii) municipal sewage sludge, which digestion was studied at 41 and 52 degrees C, respectively. This study showed the successful reduction of hydraulic retention times from 25 and 20 days to around 15 days, which increased organic loading rates from 2 to 3.5 kg volatile solids (VS)/m(3) d and 4 to 6 kg VS/m(3) d. As a result, the optimum retention time in terms of methane production and VS removal was 10-15% lower than the initial in the full-scale digesters. Accumulation of acids during start-up of the co-digestion reactor was suggested to be connected to the high ammonium nitrogen concentration and intermediate temperature of 41 degrees C.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Gasum Biovakka Ltd, Natural Resources Institute Finland (Luke)
Contributors: Tampio, E., Ervasti, S., Paavola, T., Rintala, J.
Number of pages: 8
Pages: 47-54
Publication date: 2016
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Publication information

Journal: Bioresource Technology
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ISSN (Print): 0960-8524
Ratings:

Scopus rating (2016): CiteScore 9.9 SJR 2.215 SNIP 1.945
Original language: English
Keywords: Anaerobic digestion, Nitrogen, Co-digestion, Sewage sludge, Hydraulic retention time, MICROBIAL COMMUNITY STRUCTURE, FOOD WASTE, SUBSTRATE RATIO, AMMONIA, INOCULUM, TEMPERATURE, PERFORMANCE, MANURE
DOIs:

10.1016/j.biortech.2016.08.058

Bibliographical note

EXT="Tampio, Elina"
Source: WOS
Source ID: 000384712900007
Research output: Contribution to journal › Article › Scientific › peer-review

Biological treatment of selenium-laden wastewater containing nitrate and sulfate in an upflow anaerobic sludge bed reactor at pH 5.0

This study investigated the removal of selenate (SeO_4^{2-}), sulfate (SO_4^{2-}) and nitrate (NO_3^-) at different influent pH values ranging from 7.0 to 5.0 and 20 °C in an upflow anaerobic sludge blanket (UASB) reactor using lactate as an electron donor. At pH 5.0, the UASB reactor showed a 20–30% decrease in reactor performance compared to operation at pH 5.5 to 7.0, reaching removal efficiencies of 79%, 15%, 43% and 61% for NO_3^-, SO_4^{2-}, Se_{total} and Se_{diss}, respectively. However, the reactor stability was an issue upon lowering the pH to 5.0 and further experiments are recommended. The sludge formed during low pH operation had a fluffy, floc-like appearance with filamentous structure, possibly due to the low polysaccharide (PS) to protein (PN) ratio (0.01 PS/PN) in the soluble extracellular polymeric substances (EPS) matrix of the biomass. Scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX) analysis of the sludge confirmed Se oxyanion reduction and deposition of Se^0 particles inside the biomass. Microbial community analysis using Illumina MiSeq sequencing revealed that the families of Campylobacteraceae and Desulfomicrobiaceae were the dominant phylotypes throughout the reactor operation at approximately 23% and 10% relative abundance, respectively. Furthermore, approximately 10% relative abundance of both Geobacteraceae and Spirochaetaceae was observed in the granular sludge during the pH 5.0 operation. Overall, this study demonstrated the feasibility of UASB operation at pH values ranging from 7.0 to 5.0 for removing Se and other oxyanions from wastewaters.

General information

Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Bhabha Atomic Research Centre, Montana State University (MSU), Hydraulic and Environmental Engineering (IHE) Inst. for Water Education

Contributors: Tan, L. C., Nancharaiah, Y. V., Lu, S., van Hullebusch, E. D., Gerlach, R., Lens, P. N.
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Journal: Chemosphere
Volume: 211
ISSN (Print): 0045-6535
Ratings:

Scopus rating (2018): CiteScore 7.4 SJR 1.448 SNIP 1.57
Original language: English
ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Chemistry(all), Pollution, Health, Toxicology and Mutagenesis
Keywords: Acid mine drainage, Anaerobic granular sludge, Microbial diversity, Selenate bioreduction, UASB reactor
DOIs:

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Source: Scopus
Source ID: 85053212365
Research output: Contribution to journal › Article › Scientific › peer-review

Detecting bioavailable toxic metals and metalloids from natural water samples using luminescent sensor bacteria
We have generated microbial sensors for analyzing the presence of various metals or metalloids by recombinant DNA technology. The strains are based on strictly regulated promoters controlling the expression of the firefly luciferase gene in microbial cells. The regulator-reporter constructs are located in shuttle plasmids capable of replicating in gram-negative or -positive microbial organisms. The sensors developed are real-time indicators of metal responsive gene expression giving results in approximately 30 min, with optimal induction times ranging from 60 to 240 min. We describe here the performance of these metal sensing bacteria for the assessment of different water samples spiked with lead, arsenic, mercury or cadmium. We show that these bacteria are sensitive detectors of metal bioavailability, which is difficult or even impossible to measure by traditional analytical chemistry methods. All measurements were done using freeze-dried bacteria, which makes these sensors reagent-like and also easy to use in field conditions.

General information
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Organisations: Univ Turku, University of Turku, Dept Biotechnol
Contributors: Tauriainen, S. M., Virta, M. P. J., Karp, M. T.
Number of pages: 6
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Publication date: Jul 2000
Peer-reviewed: Yes

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Journal: Water Research
Volume: 34
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ISSN (Print): 0043-1354
Ratings:

Scopus rating (2000): SJR 1.308 SNIP 1.639
Original language: English
Keywords: luciferase, luc-gene, environment, cadmium, mercury, arsenite, ESCHERICHIA-COLI, ARSENITE, LUCIFERASE, ANTIMONITE, MERCURY, LEAD, EXPRESSION, BIOSENSOR, CADMIUM, GENES
DOIs:

10.1016/S0043-1354(00)00005-1
Source: WOS
Source ID: 000087436600004
Research output: Contribution to journal › Article › Scientific › peer-review

Method with high-throughput screening potential for antioxidative substances using Escherichia coli biosensor katG'::lux
A new method is described for the rapid real-time screening of antioxidative properties using a recombinant Escherichia coli DPD2511 biosensor. This microplate technique, without time-consuming pre-incubations and handling, has potential for a high-throughput search of bioactive compounds. Special emphasis was given to obtaining highly reliable and repeatable results.

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MoE publication type: A1 Journal article-refereed
Organisations: Research group: Industrial Bioengineering and Applied Organic Chemistry, Department of Chemistry and Bioengineering, Tampere University of Technology, Urban circular bioeconomy (UrCirBio), Natural Resources Institute Finland (Luke), Parkano Research Unit
Contributors: Tienaho, J., Sarjala, T., Franzén, R., Karp, M.
Number of pages: 3
Pages: 78-80
Publication date: 2015
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Journal: Journal of Microbiological Methods
Volume: 118
Article number: 4723
ISSN (Print): 0167-7012
Ratings:

Scopus rating (2015): CiteScore 3.5 SJR 0.819 SNIP 0.86
Original language: English
ASJC Scopus subject areas: Microbiology, Molecular Biology, Microbiology (medical)
Keywords: Antioxidative activity, Bacterial biosensor, Bioscreening, Microplate technique
DOIs:

10.1016/j.mimet.2015.08.018
Source: Scopus
Source ID: 84941101607
Research output: Contribution to journal › Article › Scientific › peer-review

Quantifying the pore structure of different biochars and their impacts on the water retention properties of Sphagnum moss growing media

Amending growing media with biochar has the potential to sequester carbon and enhance the properties of the receiving substance. However, knowledge of the mechanisms of how biochar amends the physical properties of the material is incomplete. By combining 3D image analysis and more conventional methods, this study aimed to (1) characterise the pore structure properties of three different plant-based biochars and (2) quantify their impact on Sphagnum moss growing media physical properties. The 3D imaging showed that irrespective of the feedstock, the majority (0.80–0.94 m^3 m^{-3}) of the biochar pore volume resided in pores with diameters 2–11 μm. Biochar pore properties shared similarities due to the structure of plant tissue. The application of biochar increased the water retention of the growing media by a maximum increase of 0.06 m^3 m^{-3} in the pore diameter range 1–8 μm. This is relevant for plant-available water and microbiological activity, which indicates the usability of the biochar amendments. From methodological point of view, the benefits of combining 3D imaging with conventional measurements and impacts of the water table continuum discontinuity between the biochar and the surrounding growing media were demonstrated. The design of biochar for optimal water retention would benefit from further studies quantifying pore structure characteristics of biochar produced from a wide range of feedstocks.

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Publication status: Published
MoE publication type: A1 Journal article-refereed
Organisations: Research group: Computational Biophysics and Imaging Group, BioMediTech, Natural Resources Institute Finland (Luke), Häme University of Applied Sciences
Contributors: Turunen, M., Hyväluoma, J., Heikkinen, J., Keskinen, R., Kaseva, J., Hannula, M., Rasa, K.
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Publication date: 2020
Peer-reviewed: Yes

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Journal: Biosystems Engineering
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ISSN (Print): 1537-5110
Original language: English
ASJC Scopus subject areas: Control and Systems Engineering, Food Science, Animal Science and Zoology, Agronomy and Crop Science, Soil Science
Keywords: 3D imaging, Biochar, Connectivity, Substrate, Tomography
DOIs:

10.1016/j.biosystemseng.2020.01.006

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Source ID: 85078080862
Research output: Contribution to journal › Article › Scientific › peer-review

High Nitrogen Removal in a Constructed Wetland Receiving Treated Wastewater in a Cold Climate

Constructed wetlands provide cost-efficient nutrient removal, with minimal input of human labor and energy, and their number is globally increasing. However, in northern latitudes, wetlands are rarely utilized, because their nutrient removal efficiency has been questioned due to the cold climate. Here, we studied nutrient retention and nitrogen removal in a boreal constructed wetland (4-ha) receiving treated nitrogen-rich wastewater. On a yearly basis, most of the inorganic nutrients were retained by the wetland. The highest retention efficiency was found during the ice-free period, being 79% for ammonium-nitrogen (NH4+-N), 71% for nitrate-nitrogen (NO3--N), and 88% for phosphate-phosphorus (PO43--P). Wetland also acted as a buffer zone during the disturbed nitrification process of the wastewater treatment plant. Denitrification varied between 106 and 252 mg N m-2 d-1 during the ice-free period. During the ice-cover period, total gaseous nitrogen removal was 147 mg N m-2 d-1, from which 66% was removed as N2, 28.5% as N2O through denitrification, and 5.5% as N2 through anammox. Nearly 2600 kg N y-1 was estimated to be removed through microbial gaseous N-production which equaled 72% of NO3--N and 60% of TN yearly retention in the wetland. The wetland retained nutrients even in winter, when good oxygen conditions prevailed under ice. The results suggest that constructed wetlands are an efficient option for wastewater nitrogen removal and nutrient retention also in cold climates.

General information

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MoE publication type: A1 Journal article-refereed
Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, University of Helsinki, Jyväskylän yliopisto, University of Eastern Finland
Contributors: Uusheimo, S., Huotari, J., Tulonen, T., Aalto, S. L., Rissanen, A. J., Arvola, L.
Number of pages: 8
Pages: 13343-13350
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Journal: Environmental science & technology
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Original language: English
ASJC Scopus subject areas: Chemistry(all), Environmental Chemistry
Electronic versions:

high_nitrogen_removal_in_a_constructed_2018. Embargo ended: 28/10/19
DOIs:

10.1021/acs.est.8b03032
URLs:

http://urn.fi/URN:NBN:fi:tuni-201910234051. Embargo ended: 28/10/19
Source: Scopus
Source ID: 85056728368
Research output: Contribution to journal › Article › Scientific › peer-review

Resilient performance of an anoxic biotrickling filter for hydrogen sulphide removal from a biogas mimic: Steady, transient state and neural network evaluation

Biological hydrogen sulphide (H2S) removal from a biogas mimic (pH=~7.0) was tested for 189 days in an anoxic biotrickling filter (BTF) inoculated with a pure culture of Paracoccus versutus strain MAL 1HM19. The BTF was packed with polyurethane foam cubes and operated in both fed-batch and continuous modes. The H2S inlet concentration to the BTF was varied between ~100 and ~500 ppmv during steady-state tests, and thereafter to ~1000, ~2000, ~3000 and ~4000 ppmv during shock-load (i.e. transient state) tests. The H2S removal efficiency (RE) ranged between 17 and 100% depending on the operational mode of the BTF and the presence of acetate as a carbon source. The maximum elimination capacity (ECmax) of the BTF reached 113.5 (±6.4) g S/m3 h with 97% RE during H2S shock-load experiments at ~4000 ppmv which showed the robustness and resilient capacity of BTF for the large fluctuations of H2S concentrations. The results from polymerase chain reaction denaturing gradient gel electrophoresis (PCR–DGGE) revealed that P. versutus remained dominant throughout the 189 days of BTF operation which can imply the crucial role of this bacterium to remove H2S and upgrade to clean biogas. The analysis using artificial neural networks (ANNs) predicted the H2S and NO3−-N REs and SO42− production in the anoxic BTF. Consequently, this study revealed that a BTF can be used to treat H2S contamination of biogas under anoxic conditions.

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Contributors: Watsuntorn, W., Khanongnuch, R., Chulalaksananukul, W., Rene, E. R., Lens, P. N.
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Peer-reviewed: Yes

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Journal: Journal of Cleaner Production
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Ratings:

Scopus rating (2019): CiteScore 10.9 SJR 1.886 SNIP 2.394
Original language: English
Keywords: Pollution reduction, Anoxic biotrickling filter, Biogas, strain MAL 1HM19, Hydrogen sulphide removal
DOIs:

10.1016/j.jclepro.2019.119351
Source: Bibtex
Source ID: WATSUNTORN2019119351
Research output: Contribution to journal › Article › Scientific › peer-review

Impact of heavy metals on denitrification of simulated mining wastewaters

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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio)
Contributors: Zou, G., Ylinen, A., Di Capua, F., Papirio, S., Lakaniemi, A., Puhakka, J.
Number of pages: 4
Pages: 500-503
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Advanced Materials Research
Volume: 825
ISSN (Print): 1022-6680
Ratings:

Scopus rating (2013): CiteScore 0.11 SJR 0.142 SNIP 0.197
Original language: English
DOIs:

10.4028/www.scientific.net/AMR.825.500

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Contribution: organisation=keb,FACT1=1
Portfolio EDEND: 2013-11-29
Publisher name: Trans Tech Publications Ltd.
Source: researchoutputwizard
Source ID: 3792
Research output: Contribution to journal › Article › Scientific › peer-review

Fluidized-bed denitrification of mining water tolerates high nickel concentrations
This study revealed that fluidized-bed denitrifying cultures tolerated soluble Ni concentrations up to 500mg/L at 7-8 and 22°C. From 10 to 40mg/L of feed Ni, denitrification resulted in complete nitrate and nitrite removal. The concomitant reduction of 30mg/L of sulfate produced 10mg/L of sulfide that precipitated nickel, resulting in soluble effluent Ni below 22mg/L. At this stage, Dechloromonas species were the dominant denitrifying bacteria. From 60 to 500mg/L of feed Ni, nickel remained in solution due to the inhibition of sulfate reduction. At soluble 60mg/L of Ni, denitrification was partially inhibited prior to recover after 34days of enrichment by other Ni-tolerant species (including Delftia, Zoogloea and Azospira) that supported Dechloromonas. Subsequently, the FBR cultures completely removed nitrate even at 500mg/L of Ni. Visual Minteq speciation model predicted the formation of NiS, $NiCO_3$ and $Ni_3(PO_4)_2$, whilst only $Ni_3(PO_4)_2$ was detected by XRD.

General information
Publication status: Published

MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Urban circular bioeconomy (UrCirBio), Université Paris-Est, Laboratoire Géomatériaux et Environnement (EA 4508), UPEM
Contributors: Zou, G., Papirio, S., van Hullebusch, E. D., Puhakka, J. A.
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Peer-reviewed: Yes

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Journal: Bioresource Technology
Volume: 179
ISSN (Print): 0960-8524
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Original language: English
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Keywords: Denitrification, Denitrifying communities, Fluidized-bed reactor, Nickel, X-ray diffraction
DOIs:

10.1016/j.biortech.2014.12.044
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Source: Scopus
Source ID: 84919934975
Research output: Contribution to journal › Article › Scientific › peer-review

High rate autotrophic denitrification in fluidized-bed biofilm reactors
High rate, high efficiency thiosulfate-driven autotrophic denitrification and denitritation with Thiobacillus denitrificans dominated biofilms were achieved in fluidized-bed reactors (FBRs) operated at 20.0 ± 2.0 and 30.0 ± 0.2 °C. Complete nitrate removal was obtained even at nitrate loading rate and hydraulic retention time (HRT) of 600 mg L−1 h−1 and 10 min, respectively. Further decrease of HRT to 5 min resulted in 50% of nitrate removal efficiency. Nitrite did not accumulate when nitrate was used as electron acceptor unless HRT was decreased to 5 min. Effluent pH remained at 5.8 during denitrification. When nitrite was supplemented as the electron acceptor, denitritation effectively proceeded with the highest nitrite loading rate of 228 mg L−1 h−1. Similar denitrification and denitritation performances were obtained at 20.0 ± 2.0 and 30.0 ± 0.2 °C. Batch assays conducted at temperature range from 1 to 46 °C, however, showed a significant impact of temperature on autotrophic denitrification. Ratkowsky model was used to estimate the minimum, optimal and maximum growth temperatures of T. denitrificans dominated culture that were below 1, 26.6 and 50.8 °C, respectively.

General information
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MoE publication type: A1 Journal article-refereed
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Zou, G., Papirio, S., Lakaniemi, A., Ahoranta, S., Puhakka, J.
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Publication date: 2016
Peer-reviewed: Yes
Early online date: 28 Sep 2015

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Journal: Chemical Engineering Journal
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ISSN (Print): 1385-8947
Ratings:

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Original language: English
DOIs:

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Research output: Contribution to journal › Article › Scientific › peer-review

Biological Nitrogen Removal from Acidic, Heavy-metal Containing Waters

General information
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MoE publication type: G5 Doctoral dissertation (article)
Organisations: Department of Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry
Contributors: Zou, G.
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Publication date: 2015

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ISBN (Print): 978-952-15-3558-1
Original language: English

Publication series
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Volume: 1314
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Research output: Book/Report › Doctoral thesis › Collection of Articles