

### Transparent Yb<sup>3+</sup> doped phosphate glass-ceramics

Yb<sup>3+</sup> doped oxyfluorophosphate glasses with the composition (98.75) [90NaPO<sub>3</sub>-(10-x) Na<sub>2</sub>O-xNaF] - 1.25Yb<sub>2</sub>O<sub>3</sub> (in mol%) with x = 0, 2.5, 5, 7.5 and 10 were prepared using a standard melting process. The progressive replacement of Na<sub>2</sub>O by NaF leads to an increase in the number of Q<sup>2</sup> units at the expense of the Q<sup>1</sup> units. This increase in the polymerization of the glass network leads to a shift of the optical band gap to lower wavelength, to a slight increase in the intensity of the emission at 1000 nm and more importantly to a change in the glass crystallization process. Indeed, both surface and bulk crystallization were observed in the glass with x = 0 while surface crystallization only occurs when NaF is added in the phosphate network. The heat treatment leads to the precipitation of at least three crystalline phases: as x increases, the NaPO<sub>3</sub> phase grows at the expense of Na<sub>5</sub>P<sub>3</sub>O<sub>10</sub>. All glasses precipitate the Yb containing crystal, NaYbP<sub>2</sub>O<sub>7</sub> which leads to an increase in the intensity of the emission at 1000 nm compared to the emission at 975 nm. We show for the first time to the best of our knowledge that transparent Yb<sup>3+</sup> doped phosphate glass-ceramics can be obtained within this glass system when free of NaF.

#### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Fondazione LINKS – Leading Innovation & Knowledge for Society, CNRS, Université de Bordeaux, ICMCB

Contributors: Hongisto, M., Veber, A., Boetti, N. G., Danto, S., Jubera, V., Petit, L.

Publication date: 1 Jan 2020

Peer-reviewed: Yes

#### Publication information

Journal: Ceramics International

ISSN (Print): 0272-8842

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry

Keywords: Glass-ceramic, Luminescence, Phosphate glass, XRD, Yb

DOIs:

10.1016/j.ceramint.2020.01.121

Source: Scopus

Source ID: 85077933290

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

### In-flight wind field identification and prediction of parafoil systems

The wind field is an essential factor that affects accurate homing and flare landing of parafoil systems. In order to obtain the ambient wind field during the descent of a parafoil system, a combination method of in-flight wind field identification and prediction is proposed. First, a wind identification method only using global position system information is derived based on the flight dynamics of parafoil systems. Then a wind field prediction model is constructed using the atmospheric dynamics, and the low-altitude wind field is predicted based on the identified wind field of high-altitude. Finally, simulations of wind field identification and prediction are conducted. The results demonstrate that the proposed method can identify the wind fields precisely and also predict the wind fields reasonably. This method can potentially be applied in practical parafoil systems to provide wind field information for homing tasks.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Predictive Society and Data Analytics (PSDA), Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), Anhui Science and Technology University, Aalto University, Peking University, University of Applied Sciences Upper Austria, School of Management, Nankai University

Contributors: Gao, H., Tao, J., Dehmer, M., Emmert-Streib, F., Sun, Q., Chen, Z., Xie, G., Zhou, Q.

Number of pages: 15

Publication date: 2020

Peer-reviewed: Yes

#### Publication information

Journal: Applied Sciences (Switzerland)

Volume: 10

Issue number: 6

Article number: 1958

ISSN (Print): 2076-3417

Original language: English

ASJC Scopus subject areas: Materials Science(all), Instrumentation, Engineering(all), Process Chemistry and Technology, Computer Science Applications, Fluid Flow and Transfer Processes

Keywords: Autonomous homing, Identification, Parafoil system, Prediction, Wind field

Electronic versions:

In-flight wind field identification 2020

DOIs:

10.3390/app10061958

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008266688>

Source: Scopus

Source ID: 85082646563

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Mining tailings as raw materials for reaction-sintered aluminosilicate ceramics: Effect of mineralogical composition on microstructure and properties**

This paper presents studies on the utilization of aluminosilicate-based mining tailings as raw materials for mullite-based ceramics. Based on the 3:2 stoichiometric composition, mullite was synthesised by reactive sintering with a series of powder mixtures with alumina additions. X-ray diffractometry and scanning electron microscopy analyses revealed that, at the specific mineralogical composition, mullite structure formed surrounded by an amorphous glass phase in reaction-sintered powder mixtures. Results demonstrated that the chemical and mineralogical composition of mining tailings do have an effect on mullite formation possibilities and, only with the particular mineralogical composition, the mullite formation is possible regardless of the correct Al:Si ratio in tailings. Physical and mechanical properties of the formed ceramics were defined, showing comparable values to 3:2 mullite reference. Mullite structure formation enables a better thermal resistance up to above 1450 °C of the formed tailings-based ceramics compared to other aluminosilicates, reflecting their utilization potential for refractory ceramic applications.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland, Geologian tutkimuskeskus

Contributors: Karhu, M., Lagerbom, J., Solismaa, S., Honkanen, M., Ismailov, A., Räisänen, M. L., Huttunen-Saarivirta, E., Levänen, E., Kivikytö-Reponen, P.

Pages: 4840-4848

Publication date: Mar 2019

Peer-reviewed: Yes

Early online date: 2018

#### **Publication information**

Journal: Ceramics International

Volume: 45

Issue number: 4

ISSN (Print): 0272-8842

Ratings:

Scopus rating (2019): CiteScore 6.1 SJR 0.891 SNIP 1.31

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry

Keywords: Mining tailings, Mullite, Reaction sintering, Refractory ceramics, Utilization

DOIs:

10.1016/j.ceramint.2018.11.180

#### **Bibliographical note**

EXT="Lagerbom, Juha"

Source: Scopus

Source ID: 85057276435

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Cost-optimal energy performance measures in a new daycare building in cold climate**

New municipal service buildings must be energy effective, and cost-optimality is one of the criteria for selecting the suitable energy performance improvement measures. A daycare building in a cold climate was studied by means of simulation-based, multi-objective optimisation. Using a genetic algorithm, both target energy use and life-cycle cost of the selected measures were minimised. It was found that extensive insulation of the building envelope is not a cost-optimal method to reduce the daycare building energy use. Improving energy efficiency of the ventilation system, utilising solar energy on-site and employing a light control strategy are preferable ways of improving the building energy performance. Ground-source heat pump is a more cost-optimal heating system for the daycare building than district heating. The cost-optimal sizing of the heat pump is small, only 28% of the required maximum heating power. Abbreviations: AHU: air

handling unit; CAV: constant air volume; COMBI: comprehensive development of nearly zero-energy municipal service buildings; COP: coefficient of performance; DH: district heating; DHW: domestic hot water; EPBD: energy performance of buildings directive; EU: European Union; FINVAC: Finnish Association of HVAC Societies; GSHP: ground-source heat pump; HRU: heat recovery unit; IDA ICE: IDA Indoor Climate and Energy; LED: light-emitting diode; MOBO: multi-objective building optimisation tool; NSGA-II: Non-dominated Sorting Genetic Algorithm II; nZEB: nearly zero-energy building; PV: photovoltaic; TRY: test reference year; VAV: variable air volume; ZEB: zero-energy building

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Equa Simulation Finland Oy, Aalto University, Sweco Finland Oy

Contributors: Sankelo, P., Jokisalo, J., Nyman, J., Vinha, J., Sirén, K.

Number of pages: 19

Pages: 104-122

Publication date: 2019

Peer-reviewed: Yes

Early online date: 15 Mar 2018

### Publication information

Journal: International Journal of Sustainable Energy

Volume: 38

Issue number: 2

ISSN (Print): 1478-6451

Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.427 SNIP 0.595

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes

Keywords: Building simulation, daycare building, life-cycle cost, multi-objective optimisation, simulation-based optimisation, target energy use

Electronic versions:

Jokisalo - Cost-optimal energy performance measures in a new daycare building in cold climate. Embargo ended:

14/03/19

DOIs:

10.1080/14786451.2018.1448398

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911186054>. Embargo ended: 14/03/19

Source: Scopus

Source ID: 85043677926

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

### Effect of apartment building energy renovation on hourly power demand

Optimal energy renovations of apartment buildings in Finland have a great impact on annual energy demand. However, reduction of energy demand does not necessarily translate into similar changes in peak power demand. Four different types of apartment buildings, representing the Finnish apartment building stock, were examined after optimal energy retrofits to see the influence of retrofitting on hourly power demand. Switching from district heating to ground-source heat pumps reduced emissions significantly under current energy mix. However, the use of ground-source heat pumps increased hourly peak electricity demand by 46–153%, compared to district heated apartment buildings. The corresponding increase in electrical energy demand was 30–108% in the peak month of January. This could increase the use of high emission peak power plants and negate some of the emission benefits. Solar thermal collectors and heat recovery systems could reduce purchased heating energy to zero in summer. Solar electricity could reduce median power demand in summer, but had only a little effect on peak power demand. The reduction in peak power demand after energy retrofits was less than the reduction in energy demand.

### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Aalto University, Nanjing Tech University

Contributors: Hirvonen, J., Jokisalo, J., Heljo, J., Kosonen, R.

Publication date: 2019

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Sustainable Energy

ISSN (Print): 1478-6451

Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.427 SNIP 0.595

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes

Keywords: apartment building, district heating, energy performance, Energy retrofits, greenhouse gas emissions, power demand

DOIs:

10.1080/14786451.2019.1613992

Source: Scopus

Source ID: 85065643393

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

### **Towards the EU emissions targets of 2050: optimal energy renovation measures of Finnish apartment buildings**

Member countries of the European Union have released targets to reduce carbon dioxide emissions by 80% by the year 2050. Energy use in buildings is a major source of these emissions, which is why this study focused on the cost-optimal renovation of Finnish apartment buildings. Apartment buildings from four different construction years (pre-1976, 1976–2002, 2003–2009 and post-2010) were modelled, using three different heating systems: district heating, ground-source heat pump and exhaust air heat pump. Multi-objective optimisation was utilised to find the most cost-effective energy renovation measures. Most cost-effective renovation measures were ground-source heat pumps, demand-based ventilation and solar electricity. Additional thermal insulation of walls was usually too expensive. By performing only the cost-effective renovations, the emissions could be reduced by 80%, 82%, 69% and 68%, from the oldest to the newest buildings, respectively. This could be done with the initial investment cost of 296, 235, 115 and 104 €/m<sup>2</sup>, respectively.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Aalto University, Nanjing Tech University

Contributors: Hirvonen, J., Jokisalo, J., Heljo, J., Kosonen, R.

Publication date: 2019

Peer-reviewed: Yes

Early online date: 2018

#### **Publication information**

Journal: International Journal of Sustainable Energy

Volume: 38

Issue number: 7

ISSN (Print): 1478-6451

Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.427 SNIP 0.595

Original language: English

ASJC Scopus subject areas: Renewable Energy, Sustainability and the Environment, Fuel Technology, Energy(all), Process Chemistry and Technology, Fluid Flow and Transfer Processes

Keywords: apartment building, Cost-optimal renovation, energy performance, greenhouse gas emissions, multi-objective optimisation

DOIs:

10.1080/14786451.2018.1559164

Source: Scopus

Source ID: 85058681434

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

### **Volatile fatty acid adsorption on anion exchange resins: kinetics and selective recovery of acetic acid**

The removal of volatile fatty acids was examined through adsorption on anion exchange resins in batch systems. During the initial screening step, granular activated carbon and 11 anion exchange resins were tested and the resins Amberlite IRA-67 and Dowex optipore L-493 were chosen for further investigation. The adsorption kinetics and diffusion mechanism and adsorption isotherms of the two resins for VFA were evaluated. Based on the selective adsorption capacity of the resins, a sequential batch process was tested to achieve separation of acetic acid from the VFA mixture and selective recoveries > 85% acetic acid and ~ 75% propionic acid was achieved.

#### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science and Environmental Engineering, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Institute for Water Education

Contributors: Eregowda, T., Rene, E. R., Rintala, J., Lens, P. N.  
Publication date: 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Separation Science and Technology (Philadelphia)

ISSN (Print): 0149-6395

Ratings:

Scopus rating (2019): CiteScore 2.6 SJR 0.374 SNIP 0.66

Original language: English

ASJC Scopus subject areas: Chemistry(all), Chemical Engineering(all), Process Chemistry and Technology, Filtration and Separation

Keywords: anion-exchange resins, Brunauer-Emmett-Teller model, selective recovery, Volatile fatty acids

DOIs:

10.1080/01496395.2019.1600553

Source: Scopus

Source ID: 85065190589

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

#### The effect of carbon and nickel additions on the precursor synthesis of Cr<sub>3</sub>C<sub>2</sub>-Ni nanopowder

Decreasing crystal size to nanoscale is a proven method to enhance material properties. In this study, nanosize Cr<sub>3</sub>C<sub>2</sub> and Cr<sub>3</sub>C<sub>2</sub>-Ni were synthesized and the reaction sequence was studied. Aqueous precursors using only water-soluble raw materials with varying carbon contents and a nickel addition were spray-dried. Glycine was used as a carbon source and chromium acetate hydroxide as a chromium source in the precursor solutions. Nickel nitrate hexahydrate was introduced as a nickel source to yield a metallic binder into the carbide nanopowder. Resulting powders were heat-treated to identify an applicable precursor composition producing the targeted Cr<sub>3</sub>C<sub>2</sub> phase with crystal size of tens of nanometers. Thermal synthesis tests of the precursor powders to yield Cr<sub>3</sub>C<sub>2</sub> took place at a temperature between 900 and 1300 °C under an Argon atmosphere. The synthesis of nanosize Cr<sub>3</sub>C<sub>2</sub>-Ni powder was successful at 1000 °C in 30 min, in a case of the best precursor. In order to produce the carbide phase with no residual oxide traces, relative carbon load has to be 48 wt%, while the stoichiometric amount of carbon in Cr<sub>3</sub>C<sub>2</sub> is 13 wt%. When also introducing the nickel source into the precursor, an even higher carbon load was required. The carbon surplus needed to enable the Cr<sub>3</sub>C<sub>2</sub> synthesis attributes to the non-homogeneity of the precursor composition. The chemical synthesis starting from water-soluble raw materials is a promising way of preparing nanosize Cr<sub>3</sub>C<sub>2</sub>-Ni with the targeted phase configuration.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Research group: Materials Characterization, VTT Technical Research Centre of Finland

Contributors: Kaunisto, K., Kotilainen, M., Karhu, M., Lagerbom, J., Vuorinen, T., Honkanen, M., Vippola, M., Turunen, E.

Pages: 9338-9346

Publication date: 1 Jun 2018

Peer-reviewed: Yes

Early online date: 2018

#### Publication information

Journal: Ceramics International

Volume: 44

Issue number: 8

ISSN (Print): 0272-8842

Ratings:

Scopus rating (2018): CiteScore 5.2 SJR 0.888 SNIP 1.297

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry

Keywords: A. Nanosize CrC synthesis, A. Powders: chemical preparation, B. Grain size, D. Carbides, E. Wear parts

DOIs:

10.1016/j.ceramint.2018.02.146

#### Bibliographical note

EXT="Vuorinen, Tommi"

EXT="Lagerbom, Juha"

EXT="Kaunisto, Kimmo"

Source: Scopus

Source ID: 85042300396

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

## **Influence of the phosphate glass melt on the corrosion of functional particles occurring during the preparation of glass-ceramics**

We report our findings on the impact of the glass composition on the corrosion of microparticles occurring during the preparation of glass-ceramics using the direct doping method. Microparticles (MPs) with the composition  $\text{Sr}_4\text{Al}_{14}\text{O}_{25}:\text{Eu}^{2+},\text{Dy}^{3+}$  with blue-green persistent luminescence were chosen as the changes in their spectroscopic properties can be related to the MPs' corrosion. The MPs were added in phosphate-based glasses with different compositions. When using the same doping parameters, the glass system with the composition  $90\text{NaPO}_3\text{-}10\text{Na}_2\text{O}$  (mol%) was found to be the least corrosive on the MPs whereas the glass system with the composition  $90\text{NaPO}_3\text{-}10\text{NaF}$  (mol%) is the most corrosive on the MPs probably due to their different viscosity at  $575\text{ }^\circ\text{C}$ , the temperature at which the MPs are added in the glass melts.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Research group: Nanophotonics, Turun Yliopisto/Turun Biomateriaalikeskus, Laboratory of Photonics

Contributors: Ojha, N., Laihininen, T., Salminen, T., Lastusaari, M., Petit, L.

Pages: 11807-11811

Publication date: Jun 2018

Peer-reviewed: Yes

Early online date: 1 Jan 2018

### **Publication information**

Journal: Ceramics International

Volume: 44

Issue number: 10

ISSN (Print): 0272-8842

Ratings:

Scopus rating (2018): CiteScore 5.2 SJR 0.888 SNIP 1.297

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry

Keywords: Corrosion, Direct doping method, Glass melt, Phosphate glass-ceramics, SrAlO:Eu, Dy microparticles

DOIs:

10.1016/j.ceramint.2018.03.267

Source: Scopus

Source ID: 85044921933

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

## **The effects of laser patterning $10\text{CeTzP-Al}_2\text{O}_3$ nanocomposite disc surfaces: Osseous differentiation and cellular arrangement in vitro**

Customized square grid arrangements of different groove depths (1.0, 1.5 and 3.0  $\mu\text{m}$ ) and separations (10 and 30  $\mu\text{m}$ ) were successfully laser patterned, using a nanosecond pulsed fibre laser, on the surface of 10 mol% ceria-stabilized zirconia and alumina ( $10\text{CeTzP-Al}_2\text{O}_3$ ) nanocomposite discs (diameter: 10 mm; thickness: 1.5 mm). The patterned surfaces and the in vitro biological response of osteoblasts (SAOS-2) towards them were thoroughly analysed. In terms of composition, the laser treatment was found to cause superficial monoclinic-tetragonal zirconia phase transformation and alumina evaporation. In vitro, the most effective grid configuration for osseous differentiation was found to be 1.5  $\mu\text{m}$  groove depth and 10  $\mu\text{m}$  groove separation, and confocal microscopy revealed that the cells show a tendency to be sorted as groove depth increases. It is thought that custom-made patterns could be produced to guide cell attachment in vivo, which could favour implant integration and reduce healing time.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Mechanical Engineering and Industrial Systems, Nanoker Research, Universidad de Oviedo

Contributors: Goyos-Ball, L., Prado, C., Díaz, R., Fernández, E., Ismailov, A., Kumpulainen, T., Levänen, E., Torrecillas, R., Fernández, A.

Pages: 9472-9478

Publication date: Jun 2018

Peer-reviewed: Yes

Early online date: 2018

### **Publication information**

Journal: Ceramics International

Volume: 44

Issue number: 8

ISSN (Print): 0272-8842

Ratings:

Scopus rating (2018): CiteScore 5.2 SJR 0.888 SNIP 1.297

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Ceramics and Composites, Process Chemistry and Technology, Surfaces, Coatings and Films, Materials Chemistry

Keywords: Alumina, Cellular arrangement, Ceramic nanocomposite, Laser patterning, Osseous differentiation, Zirconia  
DOIs:

10.1016/j.ceramint.2018.02.164

Source: Scopus

Source ID: 85042621677

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

### **Aqueous synthesis of Z-scheme photocatalyst powders and thin-film photoanodes from earth abundant elements**

Solid-state narrow band gap semiconductor heterostructures with a Z-scheme charge-transfer mechanism are the most promising photocatalytic systems for water splitting and environmental remediation under visible light. Herein, we construct all-solid Z-scheme photocatalytic systems from earth abundant elements (Ca and Fe) using an aqueous synthesis procedure. A novel Z-scheme two-component  $\text{Fe}_2\text{O}_3/\text{Ca}_2\text{Fe}_2\text{O}_5$  heterostructure is obtained in a straightforward manner by soaking various iron-containing nanoparticles (amorphous and crystalline) with  $\text{Ca}(\text{NO}_3)_2$  and performing short (20min) thermal treatments at  $820^\circ\text{C}$ . The obtained powder materials show high photocatalytic performances for methylene blue dye degradation under visible light ( $45 \text{ mW}/\text{cm}^2$ ), exhibiting a rate constant up to  $0.015 \text{ min}^{-1}$ . The heterostructure exhibits a five-fold higher activity compared to that of pristine hematite. The experiments show that amorphous iron-containing substrate nanoparticles trigger the  $\text{Fe}_2\text{O}_3/\text{Ca}_2\text{Fe}_2\text{O}_5$  heterostructure formation. We extended our study to produce  $\text{Fe}_2\text{O}_3/\text{Ca}_2\text{Fe}_2\text{O}_5$  nanoheterostructure photoanodes via the electrochemical deposition of amorphous iron-containing sediment were used. The visible-light ( $15 \text{ mW}/\text{cm}^2$ ) photocurrent increases from  $183 \mu\text{A}/\text{cm}^2$  to  $306 \mu\text{A}/\text{cm}^2$  after coupling hematite and  $\text{Ca}_2\text{Fe}_2\text{O}_5$ . Notably, the powders and photoanodes exhibit distinct charge-transfer mechanisms evidenced by the different stabilities of the heterostructures under different working conditions.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Photonics, Riga Technical University, Institute of Physics, University of Tartu, Institute of Solid State Physics University of Latvia, Riga Technical University

Contributors: Šutka, A., Vanags, M., Joost, U., Šmits, K., Ruža, J., Ločs, J., Kleperis, J., Juhna, T.

Number of pages: 10

Pages: 2606-2615

Publication date: 1 Apr 2018

Peer-reviewed: Yes

### **Publication information**

Journal: Journal of Environmental Chemical Engineering

Volume: 6

Issue number: 2

ISSN (Print): 2213-3437

Ratings:

Scopus rating (2018): CiteScore 5.3 SJR 0.876 SNIP 1.219

Original language: English

ASJC Scopus subject areas: Chemical Engineering (miscellaneous), Waste Management and Disposal, Pollution, Process Chemistry and Technology

Keywords: Hematite, Photoanode, Photocatalyst, Photoelectrochemical properties, Z-scheme

DOIs:

10.1016/j.jece.2018.04.003

### **Bibliographical note**

INT=fot, "Joost, U."

Source: Scopus

Source ID: 85045209610

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

### **Deactivation of Pt/SiO<sub>2</sub>-ZrO<sub>2</sub> diesel oxidation catalysts by sulphur, phosphorus and their combinations**

The impact of sulphur, phosphorus and water and their co-exposure on a monolith-type Pt/SiO<sub>2</sub>-ZrO<sub>2</sub> diesel oxidation catalyst was investigated. The accelerated laboratory-scale sulphur treatments for Pt/SiO<sub>2</sub>-ZrO<sub>2</sub> were done with and

without water (S- and SW-treatments, respectively) at 400 °C. Similarly, the phosphorus treatment with water (PW-treatment) as well as the co-exposure of phosphorus, sulphur and water (PSW-treatment) were also done to find out the interactions between the impurities. The studied catalysts were characterized by using several techniques and the activity of the catalyst was tested in lean diesel exhaust gas conditions. Based on the XPS and the elemental analysis, more phosphorus was adsorbed on the Pt/SiO<sub>2</sub>-ZrO<sub>2</sub> catalyst than sulphur. Sulphur, in the presence and absence of water, was found to have a negligible effect on the CO and C<sub>3</sub>H<sub>6</sub> light-off temperatures (T<sub>90</sub>) over the fresh Pt/SiO<sub>2</sub>-ZrO<sub>2</sub>, whereas the T<sub>90</sub> values of CO and C<sub>3</sub>H<sub>6</sub> increased by 30–45 °C as a result of the PW-treatment and by 15–35 °C after the PSW-treatment. Based on the Transmission electron microscope (TEM) analyses, no morphological changes on the Pt/SiO<sub>2</sub>-ZrO<sub>2</sub> surfaces were observed due to the phosphorus treatment. Therefore, the reason for the lower activity after the PW-treatment could be the formation of phosphates that are decreasing the specific surface area of the catalyst, blocking the accessibility of the reactants to the catalyst pores and active sites. However, it is worth noting that sulphur decreased the amount of adsorbed phosphorus and thus, inhibited the poisoning effect of phosphorus.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Research group: Materials Characterization, Dinex Ecocat Oy, Univ of Oulu, Aalto University

Contributors: Väliheikki, A., Kärkkäinen, M., Honkanen, M., Heikkinen, O., Kolli, T., Kallinen, K., Huuhtanen, M., Vippola, M., Lahtinen, J., Keiski, R. L.

Number of pages: 11

Pages: 409-419

Publication date: 5 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Applied Catalysis B-Environmental

Volume: 218

ISSN (Print): 0926-3373

Ratings:

Scopus rating (2017): CiteScore 17.3 SJR 3.152 SNIP 2.367

Original language: English

ASJC Scopus subject areas: Catalysis, Environmental Science(all), Process Chemistry and Technology

Keywords: DOC, Phosphorus, Platinum, Silicon-zirconium oxide, Sulphur dioxide

DOIs:

10.1016/j.apcatb.2017.06.068

Source: Scopus

Source ID: 85021933594

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

### Photodynamic self-disinfecting surface using pyridinium phthalocyanine

We have synthesized novel phthalocyanine with four pyridyl substituents connected to  $\alpha$ -phthalo-positions via direct C-C bond. The Zn complex and tetracationic derivatives of phthalocyanine were also synthesized and the dyes were impregnated into filter paper to prepare photoactive antimicrobial surface. The photodynamic antimicrobial efficacy of the dyed paper samples was evaluated by a simple and fast setup using bioluminescent microbes. *Escherichia coli* and *Acinetobacter baylyi* ADP1 strains carrying bacterial luciferase genes were used in the screening experiment. The most efficient compound, tetracationic zinc derivative 8, was investigated further. The compound was highly water soluble, had high molar absorptivity and exhibited good adhesion to the filter paper without leaching into the solution. The singlet oxygen quantum yield of tetracationic zinc derivative 8 in water was found out to be  $30 \pm 20\%$ . According to the cell viability assay test performed on *E. coli* wild type in solution, the molecule had similar or better photo toxicity as the reference photosensitizer, tetrakis (1-methyl-pyridinium-4-yl)porphyrin (TMPyP). Antimicrobial efficacy of the dye 8 on photoactive surface was studied by live cell assessment through colony forming unit (CFU) counting. The colored surface demonstrated 3 log reduction in CFU against *E. coli* and *A. baylyi* ADP1 just after 1 h of illumination with the white light of low intensity.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, Institut für Physik

Contributors: George, L., Müller, A., Röder, B., Santala, V., Efimov, A.

Number of pages: 9

Pages: 334-342

Publication date: 1 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Dyes and Pigments

Volume: 147

ISSN (Print): 0143-7208

Ratings:

Scopus rating (2017): CiteScore 5.6 SJR 0.819 SNIP 1.009

Original language: English

ASJC Scopus subject areas: Chemical Engineering(all), Process Chemistry and Technology

Keywords: Antimicrobial, Photodynamic antimicrobial chemotherapy, Pyridinium phthalocyanine, Self-disinfecting surface, Singlet oxygen

DOIs:

10.1016/j.dyepig.2017.08.021

Source: Scopus

Source ID: 85027896139

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

### New Evidence for the Mechanism of Action of a Type-2 Diabetes Drug Using a Magnetic Bead-Based Automated Biosensing Platform

The mechanism of action (MOA) of the first line type-2 diabetes drug metformin remains unclear despite its widespread usage. However, recent evidence suggests that the mitochondrial copper (Cu)-binding action of metformin may contribute toward the drug's MOA. Here, we present a novel biosensing platform for investigating the MOA of metformin using a magnetic microbead-based agglutination assay which has allowed us to demonstrate for the first time the interaction between Cu and metformin at clinically relevant low micromolar concentrations of the drug, thus suggesting a potential pathway of metformin's blood-glucose lowering action. In this assay, cysteine-functionalized magnetic beads were agglutinated in the presence of Cu due to cysteine's Cu-chelation property. Addition of clinically relevant doses of metformin resulted in disaggregation of Cu-bridged bead-clusters, whereas the effect of adding a closely related but blood-glucose neutral drug propanediimidamide (PDI) showed completely different responses to the clusters. The entire assay was integrated in an automated microfluidics platform with an advanced optical imaging unit by which we investigated these aggregation-disaggregation phenomena in a reliable, automated, and user-friendly fashion with total assay time of 17 min requiring a sample (metformin/PDI) volume of 30  $\mu$ L. The marked difference of Cu-binding action between the blood-glucose lowering drug metformin and its inactive analogue PDI thus suggests that metformin's distinctive Cu-binding properties may be required for its effect on glucose homeostasis. The novel automated platform demonstrating this novel investigation thus holds the potential to be utilized for investigating significant and sensitive molecular interactions via magnetic bead-based agglutination assay.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Danmarks Tekniske Universitet, DTU Informatik, University of Dundee, Academia Sinica Taiwan

Contributors: Uddin, R., Nur-E-Habiba, N., Rena, G., Hwu, E. T., Boisen, A.

Number of pages: 8

Pages: 1329-1336

Publication date: 22 Sep 2017

Peer-reviewed: Yes

### Publication information

Journal: ACS Sensors

Volume: 2

Issue number: 9

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2017): CiteScore 4.3 SJR 0.584 SNIP 1.593

Original language: English

ASJC Scopus subject areas: Bioengineering, Fluid Flow and Transfer Processes, Process Chemistry and Technology, Instrumentation

Keywords: agglutination assay, biosensor, magnetic beads, metformin, molecular interactions, optical imaging, type-2 diabetes

DOIs:

10.1021/acssensors.7b00384

### Bibliographical note

INT=keb,"Nur-E-Habiba, N."

Source: Scopus

Source ID: 85029817525

### Accelerated deactivation studies of the natural-gas oxidation catalyst-Verifying the role of sulfur and elevated temperature in catalyst aging

Accelerated deactivation, caused by thermal aging (TA) and/or sulfur+water poisoning (SW), of the PtPd/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> natural-gas oxidation catalyst was studied. Thermal aging and poisoning treatments were performed separately and with varied combinations and comprehensive characterization of the catalyst was carried out after each step. The fresh catalyst has small, oxidized PtPd particles (<5nm) uniformly distributed in the  $\gamma$ -alumina washcoat. After the SW-treatment, a small amount of bulk aluminum sulfate was observed near the slightly grown noble metal particles. During the thermal aging,  $\gamma$ -alumina changed to  $\delta$ - $\theta$ - and  $\alpha$ -alumina. In addition, total decomposition of oxidized Pt and partly decomposition of oxidized Pd occurred resulting in the formation of the grown noble metal particles with a bimetallic PtPd core and a polycrystalline PdO shell. Also few, small (~5nm) bimetallic PtPd particles were still detected. In the TA+SW-treated catalyst with grown noble metal particles, a small amount of bulk aluminum sulfate was detected and it was randomly distributed over the noble metal particles and washcoat. The activity in the terms of methane conversion over the TA-, SW-, and SW+TA-treated catalysts was similar but it was decreased compared to the fresh catalyst. The activity of the TA+SW-treated catalyst was drastically decreased compared to the fresh catalyst due to significant morphological changes and aluminum sulfate formation.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Materials Characterization, University of Oulu, Aalto University, Chalmers University of Technology, Dinex Ecocat Oy

Contributors: Honkanen, M., Kärkkäinen, M., Kolli, T., Heikkinen, O., Viitanen, V., Zeng, L., Jiang, H., Kallinen, K., Huhtanen, M., Keiski, R. L., Lahtinen, J., Olsson, E., Vippola, M.

Number of pages: 10

Pages: 439-448

Publication date: 2016

Peer-reviewed: Yes

Early online date: 1 Oct 2015

#### Publication information

Journal: Applied Catalysis B-Environmental

ISSN (Print): 0926-3373

Ratings:

Scopus rating (2016): CiteScore 14.9 SJR 2.693 SNIP 2.208

Original language: English

ASJC Scopus subject areas: Catalysis, Process Chemistry and Technology, Environmental Science(all)

Keywords: Deactivation, Palladium, Platinum, Sulfur poisoning, Thermal aging

Electronic versions:

Honkanen et al\_revised manuscript. Embargo ended: 1/10/17

DOIs:

10.1016/j.apcatb.2015.09.054

URLs:

<http://urn.fi/URN:NBN:fi:tty-201606134232> . Embargo ended: 1/10/17

Source: Scopus

Source ID: 84943638016

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

### Metrics for polyphonic sound event detection

This paper presents and discusses various metrics proposed for evaluation of polyphonic sound event detection systems used in realistic situations where there are typically multiple sound sources active simultaneously. The system output in this case contains overlapping events, marked as multiple sounds detected as being active at the same time. The polyphonic system output requires a suitable procedure for evaluation against a reference. Metrics from neighboring fields such as speech recognition and speaker diarization can be used, but they need to be partially redefined to deal with the overlapping events. We present a review of the most common metrics in the field and the way they are adapted and interpreted in the polyphonic case. We discuss segment-based and event-based definitions of each metric and explain the consequences of instance-based and class-based averaging using a case study. In parallel, we provide a toolbox containing implementations of presented metrics.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Audio research group

Contributors: Mesaros, A., Heittola, T., Virtanen, T.  
Publication date: 2016  
Peer-reviewed: Yes

#### Publication information

Journal: Applied Sciences

Volume: 6

Issue number: 6

Article number: 162

ISSN (Print): 2076-3417

Ratings:

Scopus rating (2016): SJR 0.315 SNIP 0.791

Original language: English

ASJC Scopus subject areas: Fluid Flow and Transfer Processes, Process Chemistry and Technology, Computer Science Applications, Engineering(all), Materials Science(all), Instrumentation

Keywords: Audio content analysis, Audio signal processing, Computational auditory scene analysis, Evaluation of sound event detection, Everyday sounds, Pattern recognition, Polyphonic sound event detection, Sound events

Electronic versions:

Metrics for Polyphonic Sound Event Detection

DOIs:

10.3390/app6060162

URLs:

<http://urn.fi/URN:NBN:fi:tty-201607294341>

Source: Scopus

Source ID: 84973574836

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

#### Enhanced photoactive and photoelectrochemical properties of TiO<sub>2</sub> sol-gel coated steel by the application of SiO<sub>2</sub> intermediate layer

Photocatalysis is a promising solution for purifying air and water from pollutants, yet more efficient photocatalytic materials are needed. A new approach is proposed in this paper for enhancing the photoactive and photoelectrical properties of anatase TiO<sub>2</sub> films by applying an intermediate SiO<sub>2</sub> film between the TiO<sub>2</sub> film and the stainless steel substrate. TiO<sub>2</sub> and SiO<sub>2</sub> coatings are synthesized by a sol-gel method and the thickness of TiO<sub>2</sub> film is varied in order to obtain improved understanding on the role of thickness in photocatalytic and electrochemical performance. The obtained coatings are systematically characterized in terms of microstructure using such techniques as field-emission scanning electron microscopy (FE-SEM), Raman spectroscopy and X-ray diffraction (XRD), that demonstrate, e.g., the anatase phase structure of the TiO<sub>2</sub> films. The enhanced photocatalytic properties of SiO<sub>2</sub>/TiO<sub>2</sub> coatings as compared to TiO<sub>2</sub> films are verified using methylene blue (MB) discoloration tests, while the improved photoelectrochemical properties are shown by potentiodynamic i-V scans, open circuit potential (OCP) monitoring and electrochemical impedance spectroscopy (EIS). We attribute the beneficial effect of the intermediate SiO<sub>2</sub> film on the photocatalytic and photoelectrochemical performance to the high electrical resistance of the SiO<sub>2</sub> that imposes a high-energy barrier for electron transfer and, therefore, (partly) insulates the TiO<sub>2</sub> film from the substrate and acts as a capacitor for photo-generated electrons under illumination. The presented results show an effective way of enhancing the photocatalytic performance of anatase TiO<sub>2</sub> films.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Engineering materials science and solutions (EMASS), Frontier Photonics, Department of Materials Science, Research group: Ceramic materials, Optoelectronics Research Centre, Research group: Nanophotonics, Research group: Surface Engineering, Research group: Materials Characterization

Contributors: Nikkanen, J. P., Huttunen-Saarivirta, E., Salminen, T., Hyvärinen, L., Honkanen, M., Isotahdon, E., Heinonen, S., Levänen, E.

Number of pages: 11

Pages: 533-543

Publication date: 1 Sep 2015

Peer-reviewed: Yes

#### Publication information

Journal: Applied Catalysis B-Environmental

Volume: 174-175

ISSN (Print): 0926-3373

Ratings:

Scopus rating (2015): CiteScore 12.7 SJR 2.326 SNIP 2.213

Original language: English

ASJC Scopus subject areas: Catalysis, Process Chemistry and Technology, Environmental Science(all)

Keywords: Electrical resistance, Electrochemical impedance spectroscopy, Photocatalysis, Substrate, Titanium dioxide

DOIs:

10.1016/j.apcatb.2015.03.014

URLs:

<http://www.scopus.com/inward/record.url?scp=84937762118&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

ORG=mol,0.5

ORG=orc,0.5

Source: Scopus

Source ID: 84937762118

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

#### Evaluation of crushing strength of spray-dried MgAl<sub>2</sub>O<sub>4</sub> granule beds

The crushing strengths of four different experimental magnesium aluminate spinel (MgAl<sub>2</sub>O<sub>4</sub>) granule beds were monitored with the axial die pressing test after heat treatments. Precursor, magnesium hydroxide (Mg(OH)<sub>2</sub>) and magnesium oxide (MgO) as Mg precursor and aluminium oxide hydroxide Al(O)OH and α-Al<sub>2</sub>O<sub>3</sub> as Al precursor, were used for experimental granules, which were manufactured via a dispersion manufacturing and spray-drying process. After spray-drying, granules were heat treated in air at 1000, 1100, 1200, 1300 and 1400 °C. In order to understand the potential effect of precursor, phase structure, morphology, particle size distribution and density of granules on crushing strength behaviour, scanning X-ray diffraction (XRD) was used together with electron microscopy (SEM) and laser diffraction (LDPA) for characterisation. All precursor mixtures formed spherical granules during the spray-drying process and pure spinel phase structure during heat treatment. The crushing strength test results indicated that the Al precursor clearly affected the crushing strength behaviour of experimental granule beds. The highest strength was observed for granule beds with Al(O)OH as Al and Mg(OH)<sub>2</sub> as Mg precursor.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland

Contributors: Kanerva, U., Suhonen, T., Lagerbom, J., Levänen, E.

Number of pages: 7

Pages: 8494-8500

Publication date: 1 Aug 2015

Peer-reviewed: Yes

#### Publication information

Journal: Ceramics International

Volume: 41

Issue number: 7

ISSN (Print): 0272-8842

Ratings:

Scopus rating (2015): CiteScore 4 SJR 0.823 SNIP 1.353

Original language: English

ASJC Scopus subject areas: Ceramics and Composites, Process Chemistry and Technology, Electronic, Optical and Magnetic Materials, Surfaces, Coatings and Films, Materials Chemistry

Keywords: Axial pressing, Granule, MgAl<sub>2</sub>O<sub>4</sub> spinel, The crushing strength

DOIs:

10.1016/j.ceramint.2015.03.056

URLs:

<http://www.scopus.com/inward/record.url?scp=84929271760&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Lagerbom, Juha"

EXT="Kanerva, Ulla"

Source: Scopus

Source ID: 84929271760

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

#### A facile route to synthesis of S-doped TiO<sub>2</sub> nanoparticles for photocatalytic activity

There is always a market for cost effective methods of pollution degradation and one of the best areas to keep costs down is through synthesis techniques. This paper provides a simple technique to synthesise porous TiO<sub>2</sub> nanoparticles with

increased surface area through a scaffold template technique. Their photocatalytic activity is enhanced by incorporating sulphur as a dopant and were validated by analysing the degradation of malachite green (MG). The materials were doped at a molar ratio of 100:1 (Ti:S) and calcined at different temperatures to adjust the anatase/rutile content. Detailed characterisation of the materials was undertaken using XRD, BET, XPS, TEM and FTIR. The nanoparticles displayed a microporous structure and had an increased surface area of  $115 \text{ m}^2 \text{ g}^{-1}$  which was reduced by doping and temperature induced phase transformation. Photocatalytic testing showed that the doped materials calcined at  $700 \text{ }^\circ\text{C}$  performed the best in. It was observed that  $20 \text{ mg l}^{-1}$  of MG was decomposed in 30 min using a 40 W UV bulb at pH 9 and the results surpassed those achieved by the commercial catalyst P25 which was also tested for comparison.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Trinity College Dublin, University College Cork, Materials Chemistry and Analysis Group, Centre for Research on Adaptive Nanostructures and Nanodevices

Contributors: McManamon, C., O'Connell, J., Delaney, P., Rasappa, S., Holmes, J. D., Morris, M. A.

Pages: 51-57!

Publication date: 30 May 2015

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Molecular Catalysis A: Chemical

Volume: 406

ISSN (Print): 1381-1169

Ratings:

Scopus rating (2015): CiteScore 6.1 SJR 1.052 SNIP 1.262

Original language: English

ASJC Scopus subject areas: Catalysis, Physical and Theoretical Chemistry, Process Chemistry and Technology

Keywords: Band gap, Photocatalysis, S-doped,  $\text{TiO}_2$

DOIs:

10.1016/j.molcata.2015.05.002

URLs:

<http://www.scopus.com/inward/record.url?scp=84930210395&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84930210395

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

#### Large-area arrays of three-dimensional plasmonic subwavelength-sized structures from azopolymer surface-relief gratings

The field of plasmonics allows for confinement and control of light on the nanoscale. Due to potentially strong resonant interactions that light can have with metal nanoscale structures, metals are a good candidate to tailor interactions with light, e.g., periodic arrays of subwavelength metal structures can support extremely narrow resonances and show enhanced transmission. The field of plasmonics has evolved from using simple geometries to the desire to create complex nanostructures for improved control. The availability of fabrication techniques that provide for complex structures, however, is paired with the seemingly inevitable increase in complexity of fabrication techniques themselves. We present a facile and scalable method for the fabrication of periodic arrays of unique three-dimensional subwavelength-sized structures such as tapered holes and pyramidically shaped subwavelength-sized particles. The procedure consists of holographic inscription of a two-dimensional surface-relief grating in an azobenzene-containing polymer film, evaporative gold deposition and broad-beam ion milling of the relief structure. The method allows the fabrication of highly uniform arrays with tunable lattice parameters and dimensions over large sample areas. The optical response of the fabricated structures is determined experimentally and through simulation, which confirm the unique plasmonic response of the structures. While the proposed fabrication method has clear benefits for plasmonics, it could easily be applied also in other fields, for example by using other coating materials.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Delft University of Technology, COMP Centre of Excellence, Department of Applied Physics, Aalto University, Aalto University

Contributors: Moerland, R. J., Koskela, J. E., Kravchenko, A., Simberg, M., Van Der Vegte, S., Kaivola, M., Priimagi, A., Ras, R. H. A.

Number of pages: 7

Pages: 74-80

Publication date: 1 Jan 2014

Peer-reviewed: Yes

#### Publication information

Journal: Materials Horizons

Volume: 1

Issue number: 1

ISSN (Print): 2051-6347

Ratings:

Scopus rating (2014): CiteScore 2.8

Original language: English

ASJC Scopus subject areas: Materials Science(all), Mechanics of Materials, Process Chemistry and Technology, Electrical and Electronic Engineering

DOIs:

10.1039/c3mh00008g

URLs:

<http://www.scopus.com/inward/record.url?scp=84900804343&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84900804343

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

### **Effects of storage on characteristics and hygienic quality of digestates from four co-digestion concepts of manure and biowaste**

This study evaluated the effects of storage in northern winter conditions (5 °C) on the characteristics and nutrients separation of digestates from co-digestion of manure and biowaste as well as the hygienic quality of the digestates after digestion and storage. During 3-11 months' storage average nitrogen losses and reductions of total solids (TS) and volatile solids (VS) were 0-15%. With some exceptions, soluble chemical oxygen demand (SCOD) had increased slightly (from ~6.5 to ~7.5 g/l) after 3 months' storage, while after 9-11 months' it had decreased from 8.3-11 to 5.6-8.4 g/l. The concentrations of P<sub>tot</sub> and PO<sub>4</sub>-P in the separated liquid fractions decreased 40-57% after 3 months' storage and 71-91% after 9 months' storage compared to the initial concentrations. The methane potential losses during 9-11 months' storage corresponded 0-10% of the total methane potential without storage. The hygienic quality of the digestates from the 55 °C reactor and during storage fulfilled the Animal By-Products Regulation (ABPR) demands while the 35 °C digestate contained 0-105 cfu/g of indicator bacteria (faecal coliforms, enterobacteria, enterococcus) and >10 cfu/g of spiked salmonella, which amounts decreased slowly during storage. Sulphite reducing clostridia was not affected by either digestion or storage.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Paavola, T., Rintala, J.

Number of pages: 10

Pages: 7041-7050

Publication date: Oct 2008

Peer-reviewed: Yes

#### **Publication information**

Journal: Bioresource Technology

Volume: 99

Issue number: 15

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2008): SJR 1.736 SNIP 2.724

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology, Bioengineering, Environmental Engineering, Waste Management and Disposal

Keywords: Biowaste, Digestate, Hygienic quality, Manure, Solid/liquid separation

DOIs:

10.1016/j.biortech.2008.01.005

Source: Scopus

Source ID: 44449089925

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

### **Storing energy crops for methane production: Effects of solids content and biological additive**

The effect of storage on chemical characteristics and CH<sub>4</sub> yield (taking into account loss of VS during storage) of a mixture of grasses and ryegrass, ensiled as such (low solids content) and after drying (medium and high solids) with and without biological additive, were studied in field and laboratory trials. Up to 87% and 98% of CH<sub>4</sub> yield was preserved with low solids grass (initial TS 15.6%) and high solids ryegrass (initial TS 30.4%), respectively, after storage for 6 months, while under suboptimal conditions at most 37% and 52% of CH<sub>4</sub> yield were lost. Loss in CH<sub>4</sub> yield was mainly due to VS

loss, presumably caused by secondary fermentation as also suggested by increasing pH during storage. Biological additive did not assist in preserving the CH<sub>4</sub> yield.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Jyväskylän yliopisto, University of Jyväskylä  
Contributors: Pakarinen, O., Lehtomäki, A., Rissanen, S., Rintala, J.  
Number of pages: 9  
Pages: 7074-7082  
Publication date: Oct 2008  
Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology  
Volume: 99  
Issue number: 15  
ISSN (Print): 0960-8524  
Ratings:  
Scopus rating (2008): SJR 1.736 SNIP 2.724  
Original language: English  
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology, Bioengineering, Environmental Engineering, Waste Management and Disposal  
Keywords: Anaerobic digestion, Biogas, Energy crop, Grass, Storage  
DOIs:  
10.1016/j.biortech.2008.01.007  
Source: Scopus  
Source ID: 44449146372  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Group-specific quantification of methanotrophs in landfill gas-purged laboratory biofilters by tyramide signal amplification-fluorescence in situ hybridization

The aim of this study was to quantitatively analyse methanotrophs in two laboratory landfill biofilters at different biofilter depths and at temperatures which mimicked the boreal climatic conditions. Both biofilters were dominated by type I methanotrophs. The biofilter depth profiles showed that type I methanotrophs occurred in the upper layer, where relatively high O<sub>2</sub> and low CH<sub>4</sub> concentrations were present, whereas type II methanotrophs were mostly distributed in the zone with high CH<sub>4</sub> and low O<sub>2</sub> concentrations. The number of type I methanotrophic cells declined when the temperature was raised from 15 °C to 23 °C, but increased when lowered to 5 °C. A slight decrease in type II methanotrophs was also observed when the temperature was raised from 15 °C to 23 °C, whereas cell numbers remained constant when lowered to 5 °C. The results indicated that low temperature conditions favored both type I and type II methanotrophs in the biofilters.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Jyväskylän yliopisto, University of Tampere Institute of Medical Technology, University of Jyväskylä  
Contributors: Wang, H., Einola, J., Heinonen, M., Kulomaa, M., Rintala, J.  
Number of pages: 8  
Pages: 6426-6433  
Publication date: Sep 2008  
Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology  
Volume: 99  
Issue number: 14  
ISSN (Print): 0960-8524  
Ratings:  
Scopus rating (2008): SJR 1.736 SNIP 2.724  
Original language: English  
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology  
Keywords: Biofilter, Landfill cover soil, Methane oxidation, Methanotrophs, Tyramide signal amplification-fluorescence in situ hybridization  
DOIs:

10.1016/j.biortech.2007.11.050

Source: Scopus

Source ID: 43849105101

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

### Anaerobic digestion of grass silage in batch leach bed processes for methane production

Anaerobic digestion of grass silage in batch leach bed reactors, with and without a second stage upflow anaerobic sludge blanket (UASB) reactor, was evaluated. Sixty six percent of the methane potential in grass was obtained within the 55 days solids retention time in the leach bed-UASB process without pH adjustment, whereas in the one-stage leach bed process 20% of the methane potential in grass was extracted. In two-stage operation, adjustment of the pH of influent to the leach bed reactor to 6 with HCl led to inhibition of both hydrolysis/acidogenesis and methanogenesis. In the leach bed-UASB process 39% of the carbohydrates and 58% of the acid soluble lignin were solubilised within the 49 days of operation, whereas Klason lignin was most recalcitrant. The methane potential of the digestates varied from 0.141 to 0.204 m<sup>3</sup> CH<sub>4</sub> kg<sup>-1</sup> added volatile solids.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Lehtomäki, A., Huttunen, S., Lehtinen, T. M., Rintala, J. A.

Number of pages: 12

Pages: 3267-3278

Publication date: May 2008

Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology

Volume: 99

Issue number: 8

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2008): SJR 1.736 SNIP 2.724

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology

Keywords: Anaerobic digestion, Energy crop, Leach bed, Methane production, UASB

DOIs:

10.1016/j.biortech.2007.04.072

Source: Scopus

Source ID: 38849145183

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

### Leachate and gaseous emissions from initial phases of landfilling mechanically and mechanically-biologically treated municipal solid waste residuals

In this study, the behaviour, and leachate and gaseous emissions during the initial phases of landfilling mechanically (M) and mechanically-biologically (MB) treated municipal solid waste residuals in northern climatic conditions was compared using two landfill lysimeters (112 m<sup>3</sup>). The results demonstrate that the strong acid phase of M residuals degradation lasts at least 2 years, while in the MB residuals the acid phase lasts only a few months. The SCOD and NH<sub>4</sub>-N concentrations varied 20-100 g/l and 600-1800 mg/l in M leachate and 1-4 g/l and 100-400 mg/l in MB leachate, respectively. The leaching of SCOD was approximately 40-fold (24.2 and 0.6 kg/t TS) and leaching of NH<sub>4</sub>-N approximately 5-fold (356 and 60 g/t TS) from the M than MB residuals; thus the effect of biological stabilisation was more marked on the leaching of SCOD than of NH<sub>4</sub>-N. Moreover gas (methane, carbon dioxide and nitrous oxide) emissions were several-fold higher from the M than MB residuals.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, Matti Ettala Ltd., University of Jyväskylä

Contributors: Sormunen, K., Einola, J., Ettala, M., Rintala, J.

Number of pages: 11

Pages: 2399-2409

Publication date: May 2008

Peer-reviewed: Yes

## Publication information

Journal: Bioresource Technology

Volume: 99

Issue number: 7

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2008): SJR 1.736 SNIP 2.724

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology

Keywords: Landfill, Mechanical-biological, Methane, Nitrogen, Organic matter

DOIs:

10.1016/j.biortech.2007.05.009

Source: Scopus

Source ID: 38849165441

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

## Effects of solid-liquid separation on recovering residual methane and nitrogen from digested dairy cow manure

The feasibility of optimizing methane and nitrogen recovery of samples obtained from farm biogas digester (35 °C) and post-storage tank (where digested material is stored for 9-12 months) was studied by separating the materials into different fractions using 2, 1, 0.5 and 0.25 mm sieves. Mass-balances revealed that digested material mainly consists of <0.25 mm (60-69%) and >2 mm (18-27%) fractions, while fractions between 2 and 0.25 mm made the rest. Incubation of solid fractions >0.25 mm of digester material at 35 °C resulted in specific methane yields of 0.060-0.085 m<sup>3</sup> kg<sup>-1</sup> volatile solids (VS) during initial 30-50 d and 0.16-0.18 m<sup>3</sup> kg<sup>-1</sup> VS at the end of 340 d incubation. Similarly, fractions >0.25 mm of post-storage tank material produced 0.055-0.092 m<sup>3</sup> kg<sup>-1</sup> VS and 0.13-0.16 m<sup>3</sup> kg<sup>-1</sup> VS of methane after 30-50 d and after 250 d, respectively. Methane yields for fractions ≤0.25 mm of post-storage tank was 0.03 m<sup>3</sup> kg<sup>-1</sup> VS after 30-50 d and 0.05 m<sup>3</sup> kg<sup>-1</sup> VS after 250 d compared to 0.20 m<sup>3</sup> kg<sup>-1</sup> VS and 0.41 m<sup>3</sup> kg<sup>-1</sup> VS, respectively for the same fraction of digester material. Separation of digested cow manure into solids and liquid fractions to recover methane may be feasible only for post-storage tank material and not for digester material. Nitrogen management would not be feasible with neither material as total nitrogen and ammonium-nitrogen concentrations were equally distributed among the segregated fractions.

## General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Kaparaju, P. L. N., Rintala, J. A.

Number of pages: 8

Pages: 120-127

Publication date: Jan 2008

Peer-reviewed: Yes

## Publication information

Journal: Bioresource Technology

Volume: 99

Issue number: 1

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2008): SJR 1.736 SNIP 2.724

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology, Bioengineering, Environmental Engineering, Waste Management and Disposal

Keywords: Anaerobic digestion, Digested material, Farm-scale digester, Fractionation, Methane, Post-storage tank

DOIs:

10.1016/j.biortech.2006.11.046

Source: Scopus

Source ID: 34848884581

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

## Anaerobic on-site treatment of kitchen waste in combination with black water in UASB-septic tanks at low temperatures

Anaerobic on-site treatment of a mixture of black water and kitchen waste (BWKW) was studied using two-phased upflow anaerobic sludge blanket (UASB) septic tanks at the low temperatures of 20 and 10 °C. Black water (BW) was also treated alone as reference. The two-phased UASB-septic tanks removed over 95% of total suspended solids (TSS) and 90% of total chemical oxygen demand (COD<sub>t</sub>) from both BWKW (effluent COD<sub>t</sub> 171-199 mg/l) and BW (effluent COD<sub>t</sub> 92-100 mg/l). Also, little dissolved COD (COD<sub>dis</sub>) was left in the final effluents (BW 48-70 mg/l; BWKW 110-113 mg/l). Part of total

nitrogen ( $N_{\text{tot}}$ ) was removed (BW 18% and BWKW 40%) and especially at 20 °C ammonification was efficient. A two-phased process was required to obtain the high removals with BWKW at 10 °C, while with BW a single-phased process may have sufficed even at 10 °C. BWKW also produced more methane than BW alone. Sludge in phases 1 of BW and BWKW treatment was not completely stabilised after 198 d of operation.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Jyväskylän yliopisto, University of Jyväskylä  
Contributors: Luostarinen, S., Rintala, J.  
Number of pages: 7  
Pages: 1734-1740  
Publication date: Jul 2007  
Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology  
Volume: 98  
Issue number: 9  
ISSN (Print): 0960-8524  
Ratings:  
Scopus rating (2007): SJR 1.403 SNIP 2.411  
Original language: English  
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology  
Keywords: Anaerobic wastewater treatment, Black water, Kitchen waste, Low temperature, UASB-septic tank  
DOIs:  
10.1016/j.biortech.2006.07.022  
Source: Scopus  
Source ID: 33846677724  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Hydrolysis rates, methane production and nitrogen solubilisation of grey waste components during anaerobic degradation

Municipal grey waste (i.e. the remaining fraction in municipal waste management systems in which putrescibles (biowaste) and other recyclables (paper, metals, glass) are source-segregated) was manually sorted into six main fractions on the basis of composition and also separated by sieving (100 mm mesh size) into two fractions, oversized and undersized, respectively. In practice, in waste management plant the oversized fraction is (or will be) used to produce refuse-derived fuel and the undersized landfilled after biological stabilisation. The methane yields and nitrogen solubilisation of the grey waste and the different fractions (all studied samples were first milled to 5 mm particle samples) were determined in a 237-day methane production batch assay and in a water elution test, respectively. The grey waste was found to contain remnants of putrescibles and also a high amount of other biodegradable waste, including packaging, cartons and cardboard, newsprint, textiles and diapers. These waste fractions comprised 41%-w/w of the grey waste and produced 40-210 m<sup>3</sup> methane (total solids (TS))<sup>-1</sup> and less than 0.01 gNH<sub>4</sub>-NkgTS<sup>-1</sup><sub>added</sub> except diapers which produced 9.8 gNH<sub>4</sub>-N kgTS<sup>-1</sup><sub>added</sub> in the batch assays. In the case of the two sieved fractions and on mass bases, most of the methane originated from the oversized fraction, whereas most of the NH<sub>4</sub>-N was solubilised from the undersized fraction. The first-order kinetic model described rather well the degradation of each grey waste fraction and component, showing the different components to be in the range 0.021-0.058 d<sup>-1</sup>, which was around one-sixth of the values reported for the source-segregated putrescible fraction of MSW.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: University of Jyväskylä, Jyväskylän yliopisto, Russian Academy of Sciences  
Contributors: Jokela, J. P. Y., Vavilin, V. A., Rintala, J. A.  
Number of pages: 8  
Pages: 501-508  
Publication date: Mar 2005  
Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology  
Volume: 96  
Issue number: 4  
ISSN (Print): 0960-8524  
Ratings:

Scopus rating (2005): SJR 1.278 SNIP 1.99

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology

Keywords: Anaerobic degradation, Components, Grey waste, Hydrolysis rate, Landfill, Methane, Municipal solid waste, Nitrogen, Solubilisation, Source-segregation

DOIs:

10.1016/j.biortech.2004.03.009

Source: Scopus

Source ID: 7544250470

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

### Modeling solid waste decomposition

The hydrolysis rate coefficients of sorted municipal waste were evaluated from the biochemical methane potential tests using non-linear regression. A distributed mathematical model of anaerobic digestion of rich (food) and lean (non-food) solid wastes with greatly different rates of polymer hydrolysis/acidogenesis was developed to describe the balance between the rates of hydrolysis/acidogenesis and methanogenesis. The model was calibrated using previously published experimental data [Biores. Technol. 52 (1995) 245] obtained upon various initial food waste loadings. Simulations of one- and two-stage digestion systems were carried out. The results showed that initial spatial separation of food waste and inoculum enhances methane production and waste degradation in a one-stage solid-bed digester at high waste loading. A negative effect of vigorously mixing at high waste loading reported in some papers was discussed. It was hypothesized that the initiation methanogenic centers developing in time and expanding in space under minimal mixing conditions might be a key factor for efficient anaerobic conversion of solid waste into methane.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Russian Academy of Sciences, University of Jyväskylä, Jyväskylän yliopisto

Contributors: Vavilin, V. A., Lokshina, L. Y., Jokela, J. P. Y., Rintala, J. A.

Number of pages: 13

Pages: 69-81

Publication date: Aug 2004

Peer-reviewed: Yes

### Publication information

Journal: Bioresource Technology

Volume: 94

Issue number: 1

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2004): SJR 1.19 SNIP 1.658

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology

Keywords: Distributed mathematical model, Food waste, Hydrolysis kinetics, Initiation methanogenic centers, One- and two-stage anaerobic digestion, Solids biodegradation

DOIs:

10.1016/j.biortech.2003.10.034

Source: Scopus

Source ID: 1842663304

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

### Comparison of laboratory-scale thermophilic biofilm and activated sludge processes integrated with a mesophilic activated sludge process

A combined thermophilic-mesophilic wastewater treatment was studied using a laboratory-scale thermophilic activated sludge process (ASP) followed by mesophilic ASP or a thermophilic suspended carrier biofilm process (SCBP) followed by mesophilic ASP, both systems treating diluted molasses (dilution factor 1:500 corresponding GF/A-filtered COD ( $COD_{filt}$ ) of  $1900 \pm 190 \text{ mg l}^{-1}$ ). With hydraulic retention times (HRTs) of 12-18 h the thermophilic ASP and thermophilic SCBP removed  $60 \pm 13\%$  and  $62 \pm 7\%$  of  $COD_{filt}$ , respectively, with HRT of 8 h the removals were  $48 \pm 1\%$  and  $69 \pm 4\%$ . The sludge volume index (SVI) was notably lower in the thermophilic SCBP (measured from suspended sludge) than in the thermophilic ASP. Under the lowest HRT the mesophilic ASP gave better performance (as SVI,  $COD_{filt}$ , and  $COD_{tot}$  removals) after the thermophilic SCBP than after the thermophilic ASP. Measured sludge yields were low (less than 0.1 kg suspended solids (SS) kg  $COD_{filt}$  removed $^{-1}$ ) in all processes. Both thermophilic treatments removed 80-85% of soluble COD ( $COD_{sol}$ ) whereas suspended COD ( $COD_{susp}$ ) and colloidal COD ( $COD_{col}$ ) were increased. Both mesophilic post-treatments removed all  $COD_{col}$  and most of the  $COD_{susp}$  from the thermophilic effluents. In conclusion, combined

thermophilic-mesophilic treatment appeared to be easily operable and produced high effluent quality.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Jyväskylän yliopisto, University of Jyväskylä  
Contributors: Suvilampi, J., Lehtomäki, A., Rintala, J.  
Number of pages: 8  
Pages: 207-214  
Publication date: Jul 2003  
Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology  
Volume: 88  
Issue number: 3  
ISSN (Print): 0960-8524  
Ratings:  
Scopus rating (2003): SJR 0.942 SNIP 1.673  
Original language: English  
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology  
Keywords: Activated sludge process, Combined treatment, Mesophilic, Suspended carrier biofilm process, Thermophilic  
DOIs:  
10.1016/S0960-8524(03)00006-3  
Source: Scopus  
Source ID: 0037411631  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Anaerobic digestion of organic solid poultry slaughterhouse waste - A review

This work reviews the potential of anaerobic digestion for material recovery and energy production from poultry slaughtering by-products and wastes. First, we describe and quantify organic solid by-products and wastes produced in poultry farming and poultry slaughterhouses and discuss their recovery and disposal options. Then we review certain fundamental aspects of anaerobic digestion considered important for the digestion of solid slaughterhouse wastes. Finally, we present an overview of the future potential and current experience of the anaerobic digestion treatment of these materials.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: University of Jyväskylä, Jyväskylän yliopisto  
Contributors: Salminen, E., Rintala, J.  
Number of pages: 14  
Pages: 13-26  
Publication date: 2002  
Peer-reviewed: Yes

#### Publication information

Journal: Bioresource Technology  
Volume: 83  
Issue number: 1  
ISSN (Print): 0960-8524  
Ratings:  
Scopus rating (2002): SJR 0.868 SNIP 1.278  
Original language: English  
ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology  
Keywords: Ammonia, Anaerobic digestion, Inhibition, Long-chain fatty acids, Nutrients recovery, Renewable energy, Solid poultry slaughterhouse waste  
DOIs:  
10.1016/S0960-8524(01)00199-7  
Source: Scopus  
Source ID: 0036158732  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Anaerobically digested poultry slaughterhouse wastes as fertiliser in agriculture**

Chemical and physical analysis, 27-d plant growth assays with carrot (*Daucus carota*) and Chinese cabbage (*Brassica campestris* var. *chinensis*), and 5-d phytotoxicity assays with Chinese cabbage and perennial ryegrass (*Lolium perenne*) were used to investigate the suitability of anaerobically digested poultry slaughterhouse waste for fertiliser in agriculture and the effect of aerobic post-treatment on the properties of the digested material. The digested material appeared to be rich in nitrogen. In 27-d assays with digested material as nitrogen source, carrots grew almost as well as those fertilised with a commercial mineral fertiliser used as reference, whereas, the growth of Chinese cabbage was inhibited. In further 5-d phytotoxicity assays, the digested material inhibited the germination and root growth of ryegrass and Chinese cabbage, apparently because of organic acids present in it. Aerobic post-treatment of the material reduced its phytotoxicity but, probably due to the volatilisation of ammonia, resulted in loss of nitrogen.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Jyväskylä, Jyväskylän yliopisto

Contributors: Salminen, E., Rintala, J., Härkönen, J., Kuitunen, M., Högmänder, H., Oikari, A.

Number of pages: 8

Pages: 81-88

Publication date: 2001

Peer-reviewed: Yes

#### **Publication information**

Journal: Bioresource Technology

Volume: 78

Issue number: 1

ISSN (Print): 0960-8524

Ratings:

Scopus rating (2001): SJR 0.537 SNIP 1.208

Original language: English

ASJC Scopus subject areas: Agronomy and Crop Science, Food Science, Process Chemistry and Technology, Applied Microbiology and Biotechnology

Keywords: Aerobic post-treatment, Ammonia, Anaerobically digested material, Organic acids, Phytotoxicity assays, Plant growth assays, Poultry slaughterhouse waste

DOIs:

10.1016/S0960-8524(00)00160-7

Source: Scopus

Source ID: 0035142679

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