

### **Are there environmental or agricultural benefits in using forest residue biochar in boreal agricultural clay soil?**

Short-term agronomic and environmental benefits are fundamental factors in encouraging farmers to use biochar on a broad scale. The short-term impacts of forest residue biochar (BC) on the productivity and carbon (C) storage of arable boreal clay soil were studied in a field experiment. In addition, rain simulations and aggregate stability tests were carried out to investigate the potential of BC to reduce nutrient export to surface waters. A BC addition of 30 t ha<sup>-1</sup> increased soil test phosphorus and decreased bulk density in the surface soil but did not significantly change pH or water retention properties, and most importantly, did not increase the yield. There were no changes in the bacterial or fungal communities, or biomasses. Soil basal respiration was higher in BC-amended plots in the spring, but no differences in respiration rates were detected in the fall two years after the application. Rain simulation experiments did not support the use of BC in reducing erosion or the export of nutrients from the field. Of the C added, on average 80% was discovered in the 0–45 cm soil layer one year after the application. Amendment of boreal clay soil with a high rate of BC characterized by a moderately alkaline pH, low surface functionalities, and a recalcitrant nature, did not induce such positive impacts that would unambiguously motivate farmers to invest in BC. BC use seems unviable from the farmer's perspective but could play a role in climate change mitigation, as it will likely serve as long-term C storage.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Computational Biophysics and Imaging Group, BioMediTech, Natural Resources Institute Finland (Luke), HAMK University of Applied Sciences

Contributors: Soenne, H., Keskinen, R., Heikkinen, J., Hyväluoma, J., Uusitalo, R., Peltoniemi, K., Velmala, S., Pennanen, T., Fritze, H., Kaseva, J., Hannula, M., Rasa, K.

Publication date: 20 Aug 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Science of the Total Environment

Volume: 731

Article number: 138955

ISSN (Print): 0048-9697

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Waste Management and Disposal, Pollution

Keywords: Biochar, Carbon sequestration, Microbial community, Nutrient leaching, Soil productivity, Soil quality

Electronic versions:

1-s2.0-S0048969720324724-main

DOIs:

10.1016/j.scitotenv.2020.138955

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202007076343>

Source: Scopus

Source ID: 85084456173

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

### **Role of Lubricating Oil Properties in Exhaust Particle Emissions of an Off-Road Diesel Engine**

Particle number emissions from an off-road diesel engine without exhaust after-treatment were studied by using five different heavy-duty lubricating oils in the engine. The study extends understanding on how the properties of lubricating oil affect the nanoparticle emissions from an off-road diesel engine. The lubricants were selected among the performance classes of the European Automobile Manufacturers Association, at least one lubricant from each category intended for heavy-duty diesel engines. Particle size distributions were measured by the means of an engine exhaust particle sizer (EEPS), but soot emissions, gaseous emissions and the basic engine performance were also determined. During the non-road steady state cycle, the most of the differences were detected at the particle size range of 6-15 nm. In most cases, the lowest particle quantities were emitted when the highest performance category lubricant was used. Based on the results of this study, the low contents of Zn, P, and S in lubricating oil contributed to the reduced emission factors for engine-out nucleation mode particles at any load. In addition, the low content of sulfate ash was considered the main influential factor for the low particle number emissions.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, University of Vaasa (UVA), Neste Corporation

Contributors: Ovaska, T., Niemi, S., Sirviö, K., Nilsson, O., Karjalainen, P., Rönkkö, T., Kulmala, K., Keskinen, J.

Number of pages: 12

Publication date: 14 Apr 2020

### Host publication information

Title of host publication: SAE WCX 2020 World Congress Experience

Publisher: SAE International

Article number: 2020-01-0386

### Publication series

Name: SAE Technical Papers

Publisher: SAE International

ISSN (Print): 0148-7191

ASJC Scopus subject areas: Automotive Engineering, Safety, Risk, Reliability and Quality, Pollution, Industrial and Manufacturing Engineering

DOIs:

10.4271/2020-01-0386

Source: Scopus

Source ID: 85083842053

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### CFD modeling the diffusional losses of nanocluster-sized particles and condensing vapors in 90° bends of circular tubes

Particle and vapor measurements typically include sampling tubing causing sampling losses therein. Correcting measured concentrations from the sampling losses using the calculated penetration efficiencies of straight tubes is a satisfactory approximation if sub-micrometer particles are of interest. However, in addition to inertial impaction of larger particles, bends in the tubing can cause a significant increase in diffusional losses of particles smaller than 5 nm or of condensing vapor, such as sulfuric acid. Here, the effects of 90° bends with various curvatures (dimensionless curvatures of 1.3–67) on the diffusional losses in a wide range of Reynolds (25–10000) and Schmidt (0.48–1400) numbers were simulated using computational fluid dynamics. The results were parametrized to output the functions for the penetration efficiencies of a bend.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group

Contributors: Olin, M., Dal Maso, M.

Number of pages: 10

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: Journal of Aerosol Science

Volume: 150

Article number: 105618

ISSN (Print): 0021-8502

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Pollution, Mechanical Engineering, Fluid Flow and Transfer Processes, Atmospheric Science

Keywords: Bend, Diffusion, Nanocluster, Sulfuric acid

Electronic versions:

CFD modeling the diffusional losses 2020

DOIs:

10.1016/j.jaerosci.2020.105618

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008256644>

Source: Scopus

Source ID: 85087771556

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

### Effect of tungsten and selenium on C<sub>1</sub> gas bioconversion by an enriched anaerobic sludge and microbial community analysis

The effect of trace metals, namely tungsten and selenium, on the production of acids and alcohols through gas fermentation by a CO-enriched anaerobic sludge in a continuous gas-fed bioreactor was investigated. The CO-enriched sludge was first supplied with a tungsten-deficient medium (containing selenium) and in a next assay, a selenium-deficient medium (containing tungsten) was fed to the bioreactor, at a CO gas flow rate of 10 mL/min. In the absence of tungsten (tungstate), an initial pH of 6.2 followed by a pH decrease to 4.9 yielded 7.34 g/L acetic acid as the major acid during the high pH period. Subsequently, bioconversion of the acids at a lower pH of 4.9 yielded only 1.85 g/L ethanol and 1.2 g/L butanol in the absence of tungsten (tungstate). A similar follow up assay in the same bioreactor with two consecutive periods at different pH values (i.e., 6.2 and 4.9) with a selenium deficient medium yielded 6.6 g/L acetic acid at pH 6.2 and

4 g/L ethanol as well as 1.88 g/L butanol at pH 4.9. The results from the microbial community analysis showed that the only known CO fixing microorganism able to produce alcohols detected in the bioreactor was *Clostridium autoethanogenum*, both in the tungsten and the selenium deprived media, although that species has so far not been reported to be able to produce butanol. No other solventogenic acetogen was detected.

#### 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 La Coruña (UDC), UNESCO-IHE Institute for Water Education

Contributors: Chakraborty, S., Rene, E. R., Lens, P. N., Rintala, J., Veiga, M. C., Kennes, C.

Number of pages: 9

Publication date: 2020

Peer-reviewed: Yes

#### Publication information

Journal: Chemosphere

Volume: 250

Article number: 126105

ISSN (Print): 0045-6535

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Chemistry(all), Pollution, Health, Toxicology and Mutagenesis

Keywords: Acetic acid, Butanol, Carbon dioxide, Carbon monoxide, *Clostridium autoethanogenum*, Ethanol

DOIs:

10.1016/j.chemosphere.2020.126105

#### Bibliographical note

EXT="Chakraborty, Samayita"

EXT="Lens, Piet N.L."

Source: Scopus

Source ID: 85079666935

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

#### Measurement of the human respiratory tract deposited surface area of particles with an electrical low pressure impactor

Particle deposition in the human respiratory tract is considered to have negative effects on human health. The lung deposited surface area (LDSA) is an important metric developed to assess the negative health effects of particles deposited in the alveolar region of the human respiratory tract. The measurement of the LDSA is frequently based on the detection of the electrical current carried by diffusion charged particles. Various conversion factors can be used to convert the electric current into LDSA concentration with relatively good accuracy up to the size about 300-600 nm. In this study, we introduce stage-specific LDSA conversion factors for electrical low pressure impactor (ELPI+) data, which enable accurate and real time LDSA concentration and LDSA size distribution measurements in the particle size range from 6 nm to 10  $\mu\text{m}$ . This wide size range covers most of the alveolar deposition of particles, which has not been possible previously by electrical methods. Also, the conversion factors for tracheobronchial and head airways particle surface area deposition were determined, and the stage-specific conversion factors were compared with the single-factor data conversion method. Furthermore, the stage-specific calibration was tested against real-world particle size distributions by simulations and against laboratory-generated aerosols. Particles larger than 300 nm were observed to significantly affect the total LDSA concentration. Stage-specific conversion factors are especially required while measuring aerosols containing larger particles or when considering the surface area deposition in the tracheobronchial region and head airways. The method and the conversion factors introduced in this study can be used to monitor LDSA concentrations reliably in various environments containing particles in different size ranges.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research group: Aerosol Synthesis, Tampere University, Dekati Ltd

Contributors: Lepistö, T., Kuuluvainen, H., Juuti, P., Järvinen, A., Arffman, A., Rönkkö, T.

Number of pages: 15

Pages: 958-971

Publication date: 2020

Peer-reviewed: Yes

#### Publication information

Journal: Aerosol Science and Technology

Volume: 54

Issue number: 8  
ISSN (Print): 0278-6826  
Original language: English  
ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution  
Keywords: Pramod Kulkarni  
DOIs:  
10.1080/02786826.2020.1745141

#### Bibliographical note

INT=phys,"Lepistö, Teemu"  
EXT="Arffman, Anssi"  
Source: Scopus  
Source ID: 85084367755  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Particle growth with photochemical age from new particle formation to haze in the winter of Beijing, China

Secondary aerosol formation in the aging process of primary emission is the main reason for haze pollution in eastern China. Pollution evolution with photochemical age was studied for the first time at a comprehensive field observation station during winter in Beijing. The photochemical age was used as an estimate of the timescale attributed to the aging process and was estimated from the ratio of toluene to benzene in this study. A low photochemical age indicates a fresh emission. The photochemical age of air masses during new particle formation (NPF) days was lower than that on haze days. In general, the strongest NPF events, along with a peak of the formation rate of 1.5 nm ( $J_{1.5}$ ) and 3 nm particles ( $J_3$ ), were observed when the photochemical age was between 12 and 24 h while rarely took place with photochemical ages less than 12 h. When photochemical age was larger than 48 h, haze occurred and NPF was suppressed. The sources and sinks of nanoparticles had distinct relation with the photochemical age. Our results show that the condensation sink (CS) showed a valley with photochemical ages ranging from 12 to 24 h, while  $H_2SO_4$  concentration showed no obvious trend with the photochemical age. The high concentrations of precursor vapours within an air mass lead to persistent nucleation with photochemical age ranging from 12 to 48 h in winter. Coincidentally, the fast increase of  $PM_{2.5}$  mass was also observed during this range of photochemical age. Noteworthy, CS increased with the photochemical age on NPF days only, which is the likely reason for the observation that the  $PM_{2.5}$  mass increased faster with photochemical age on NPF days compared with other days. The evolution of particles with the photochemical age provides new insights into understanding how particles originating from NPF transform to haze pollution.

#### General information

Publication status: E-pub ahead of print  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Beijing University of Chemical Technology, University of Helsinki, Shanghai Institute of Ceramics Chinese Academy of Sciences, Research Center for Eco-Environmental Sciences Chinese Academy of Sciences, Tsinghua University, Nanjing University  
Contributors: Chu, B., Dada, L., Liu, Y., Yao, L., Wang, Y., Du, W., Cai, J., Dällenbach, K. R., Chen, X., Simonen, P., Zhou, Y., Deng, C., Fu, Y., Yin, R., Li, H., He, X. C., Feng, Z., Yan, C., Kangasluoma, J., Bianchi, F., Jiang, J., Kujansuu, J., Kerminen, V. M., Petäjä, T., He, H., Kulmala, M.  
Number of pages: 7  
Publication date: 2020  
Peer-reviewed: Yes

#### Publication information

Journal: Science of the Total Environment  
Volume: 753  
Article number: 142207  
ISSN (Print): 0048-9697  
Original language: English  
ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Waste Management and Disposal, Pollution  
Keywords: Condensation sink, Haze, New particle formation, Photochemical aging, Pollution evolution  
DOIs:  
10.1016/j.scitotenv.2020.142207  
Source: Scopus  
Source ID: 85090708523  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Particulate emissions of a modern diesel passenger car under laboratory and real-world transient driving conditions

Exhaust emissions from diesel vehicles are significant sources of air pollution. In this study, particle number emissions and size distributions of a modern Euro 5b -compliant diesel passenger car exhaust were measured under the NEDC and US06 standard cycles as well as during different transient driving cycles. The measurements were conducted on a chassis

dynamometer; in addition, the transient cycles were repeated on-road by a chase method. Since the diesel particulate filter (DPF) removed practically all particles from the engine exhaust, it was by-passed during most of the measurements in order to determine effects of lubricant on the engine-out exhaust aerosol. Driving conditions and lubricant properties strongly affected exhaust emissions, especially the number emissions and volatility properties of particles. During acceleration and steady speeds particle emissions consisted of non-volatile soot particles mainly larger than ~50 nm independently of the lubricant used. Instead, during engine motoring particle number size distribution was bimodal with the modes peaking at 10–20 nm and 100 nm. Thermal treatment indicated that the larger mode consisted of non-volatile particles, whereas the nanoparticles had a non-volatile core with volatile material condensed on the surfaces; approximately, 59–64% of the emitted nanoparticles evaporated. Since during engine braking the engine was not fueled, the origin of these particles is lubricant oil. The particle number emission factors over the different cycles varied from  $1.0 \times 10^{14}$  to  $1.3 \times 10^{15}$  #/km, and engine motoring related particle emissions contributed 12–65% of the total particle emissions. The results from the laboratory and on-road transient tests agreed well. According to authors' knowledge, high particle formation during engine braking under real-world driving conditions has not been reported from diesel passenger cars.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Metropolia University of Applied Sciences, Neste Oyj

Contributors: Wihersaari, H., Pirjola, L., Karjalainen, P., Saukko, E., Kuuluvainen, H., Kulmala, K., Keskinen, J., Rönkkö, T.

Number of pages: 10

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: Environmental Pollution

Volume: 265

Issue number: Part B

Article number: 114948

ISSN (Print): 0269-7491

Original language: English

ASJC Scopus subject areas: Toxicology, Pollution, Health, Toxicology and Mutagenesis

Keywords: Diesel exhaust, Engine motoring, Lubricant, Nanoparticle emissions, Real-drive emissions

Electronic versions:

Particulate emissions of a modern diesel 2020

DOIs:

[10.1016/j.envpol.2020.114948](https://doi.org/10.1016/j.envpol.2020.114948)

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202007026307>

### Bibliographical note

INT=phys,"Wihersaari, Hugo"

Source: Scopus

Source ID: 85086386411

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

### Toward elemental analysis of ambient single particles using electrodynamic balance and laser-induced breakdown spectroscopy

In this article, we present a novel method for the elemental analysis of airborne aerosol particles using electrodynamic balance (EDB) trapping followed by laser-induced breakdown spectroscopy. The setup consists of a newly designed corona-based aerosol charger, double-ring electrodynamic balance trap and optical arrangement for the spectroscopy. Experimental laboratory measurements using the method show that the minimum particle size for successful analysis is 1  $\mu\text{m}$  in diameter, and the minimum airborne concentration is of the order of 1 particle/ $\text{cm}^3$ . In addition to the method, we will present results on the charging efficiency of the developed charger and novel stability analysis of the EDB at the charge region. The results from the stability analysis will ease the way toward analyzing submicron particles with the technique.

### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics

Contributors: Heikkilä, P., Rossi, J., Rostedt, A., Huhtala, J., Järvinen, A., Toivonen, J., Keskinen, J.

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: Aerosol Science and Technology

ISSN (Print): 0278-6826

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

Keywords: Kihong Park

DOIs:

10.1080/02786826.2020.1727408

Source: Scopus

Source ID: 85081358750

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

### Towards bioproduction of poly- $\alpha$ -olefins from lignocellulose

Bioprocesses involving more than one species can alleviate restrictions posed by limited substrate range of single species. Coupled, multistage cultures can be useful when heterogeneous substrates, such as lignocellulosic biomass, are exploited. Here, microbial production of  $\alpha$ -olefins (C11) from lignocellulosic substrates, namely cellulose and technical lignin, was investigated. A two-stage culture with cellulose fermentation to organic acids by *Clostridium cellulolyticum* and subsequent upgrading of the organic acids to 1-undecene by engineered *Acinetobacter baylyi* ADP1 was established. As a result, *A. baylyi* ADP1 synthesised 107  $\mu\text{g L}^{-1}$  of 1-undecene from cellulose. Additionally, ligninolytic effects by *A. baylyi* ADP1 on softwood were confirmed and downstream processing for continuous 1-undecene collection was introduced. In addition, the synthesis of poly- $\alpha$ -olefin trimers (C33) by the oligomerization of 1-undecene was demonstrated. This study demonstrates the potential of integrated multistage processes in treating challenging substrates.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy

Contributors: Salmela, M., Lehtinen, T., Efimova, E., Santala, S., Santala, V.

Number of pages: 10

Pages: 5067-5076

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: Green Chemistry

Volume: 22

Issue number: 15

ISSN (Print): 1463-9262

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution

Electronic versions:

Towards bioproduction of poly- $\alpha$ -olefins 2020

DOIs:

10.1039/d0gc01617a

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008316780>

Source: Scopus

Source ID: 85089692039

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

### MicroEnv: A microsimulation model for quantifying the impacts of environmental policies on population health and health inequalities

The Sustainable Development Goals (SDGs) recognise the critical need to improve population health and environmental sustainability. This paper describes the development of a microsimulation model, MicroEnv, aimed at quantifying the impact of environmental exposures on health as an aid to selecting policies likely to have greatest benefit. Its methods allow the integration of morbidity and mortality outcomes and the generation of results at high spatial resolution. We illustrate its application to the assessment of the impact of air pollution on health in London. Simulations are performed at Lower Layer Super Output Area (LSOA), the smallest geographic unit (population of around 1500 inhabitants) for which detailed socio-demographic data are routinely available in the UK. The health of each individual in these LSOAs is simulated year-by-year using a health-state-transition model, where transition probabilities from one state to another are based on published statistics modified by relative risks that reflect the effect of environmental exposures. This is done through linkage of the simulated population in each LSOA with  $1 \times 1$  km annual average  $\text{PM}_{2.5}$  concentrations and area-based deprivation indices. Air pollution is a leading cause of mortality and morbidity globally, and improving air quality is

critical to the SDGs for Health (Goal 3) and Cities (Goal 11). The evidence of MicroEnv is aimed at providing better understanding of the benefits for population health and health inequalities of policy actions that affect exposure such as air quality, and thus to help shape policy decisions. Future work will extend the model to integrate other environmental determinants of health.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, London School of Hygiene and Tropical Medicine

Contributors: Symonds, P., Hutchinson, E., Ibbetson, A., Taylor, J., Milner, J., Chalabi, Z., Davies, M., Wilkinson, P.

Publication date: 20 Dec 2019

Peer-reviewed: Yes

#### Publication information

Journal: Science of the Total Environment

Volume: 697

Article number: 134105

ISSN (Print): 0048-9697

Ratings:

Scopus rating (2019): CiteScore 8.6 SJR 1.661 SNIP 1.977

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Waste Management and Disposal, Pollution

Keywords: Air pollution, Deprivation, Environmental risks, Health modelling, Microsimulation, SDGs

DOIs:

10.1016/j.scitotenv.2019.134105

URLs:

<http://www.scopus.com/inward/record.url?scp=85071636750&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85071636750

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

#### Characterization of laboratory and real driving emissions of individual Euro 6 light-duty vehicles – Fresh particles and secondary aerosol formation

Emissions from passenger cars are one of major sources that deteriorate urban air quality. This study presents characterization of real-drive emissions from three Euro 6 emission level passenger cars (two gasoline and one diesel) in terms of fresh particles and secondary aerosol formation. The gasoline vehicles were also characterized by chassis dynamometer studies. In the real-drive study, the particle number emissions during regular driving were 1.1–12.7 times greater than observed in the laboratory tests (4.8 times greater on average), which may be caused by more effective nucleation process when diluted by real polluted and humid ambient air. However, the emission factors measured in laboratory were still much higher than the regulatory value of  $6 \times 10^{11}$  particles  $\text{km}^{-1}$ . The higher emission factors measured here result probably from the fact that the regulatory limit considers only non-volatile particles larger than 23 nm, whereas here, all particles (also volatile) larger than 3 nm were measured. Secondary aerosol formation potential was the highest after a vehicle cold start when most of the secondary mass was organics. After the cold start, the relative contributions of ammonium, sulfate and nitrate increased. Using a novel approach to study secondary aerosol formation under real-drive conditions with the chase method resulted mostly in emission factors below detection limit, which was not in disagreement with the laboratory findings.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Finnish Meteorological Institute, Aristotle University of Thessaloniki, Laboratory of Applied Thermodynamics

Contributors: Simonen, P., Kalliokoski, J., Karjalainen, P., Rönkkö, T., Timonen, H., Saarikoski, S., Aurela, M., Bloss, M., Triantafyllopoulos, G., Kontses, A., Amanatidis, S., Dimaratos, A., Samaras, Z., Keskinen, J., Dal Maso, M., Ntziachristos, L.

Publication date: 1 Dec 2019

Peer-reviewed: Yes

#### Publication information

Journal: Environmental Pollution

Volume: 255

Article number: 113175

ISSN (Print): 0269-7491

Ratings:

Scopus rating (2019): CiteScore 9.3 SJR 1.968 SNIP 1.805

Original language: English

ASJC Scopus subject areas: Toxicology, Pollution, Health, Toxicology and Mutagenesis

Keywords: Particle number, PM, RDE, Secondary organic aerosol, SOA

Electronic versions:

1-s2.0-S0269749119329586-main

DOIs:

10.1016/j.envpol.2019.113175

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201909303591>

### **Bibliographical note**

EXT="Amanatidis, Stavros"

Source: Scopus

Source ID: 85072289192

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

### **Anaerobic treatment of LCFA-containing synthetic dairy wastewater at 20°C: Process performance and microbial community dynamics**

Facilitating anaerobic degradation of long-chain fatty acids (LCFA) is key for tapping the high methane production potential of the fats, oil and grease (FOG) content of dairy wastewaters. In this study, the feasibility of using high-rate granular sludge reactors for the treatment of mixed LCFA-containing synthetic dairy wastewater (SDW) was assessed at 20 °C. The effects of the LCFA concentration (33–45% of COD) and organic loading rates (2–3 gCOD/L·d) were determined using three parallel expanded granular sludge bed reactors. For the first time, long term anaerobic treatment of LCFA-containing feed at 20 °C was shown to be feasible and was linked to the microbial community dynamics in high-rate reactors. During a two-month operation, a soluble COD removal of 84–91% and COD to methane conversion of 44–51% was obtained. However, granular sludge flotation and washout occurred after two months in all reactors without volatile fatty acids (VFA) accumulation, emphasizing the need for sludge retention for long-term granular sludge reactor operation with LCFA-containing feed at low ambient temperatures. The temporal shifts in microbial community structure were studied in the high-rate treatment of SDW, and the process disturbances (elevated LCFA loading, LCFA accumulation, and batch operation) were found to decrease the microbial community diversity. The relative abundance of Methanosaeta increased with higher LCFA accumulation in the settled and flotation layer granules in the three reactors, therefore, acetoclastic methanogenesis was found to be crucial for the high-rate treatment of SDW at 20 °C. This study provides an initial understanding of the continuous anaerobic treatment of LCFA-containing industrial wastewaters at low ambient temperatures.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science and Environmental Engineering, Tampere Water, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Natl. University of Ireland, Galway

Contributors: Singh, S., Rinta-Kanto, J. M., Kettunen, R., Tolvanen, H., Lens, P., Collins, G., Kokko, M., Rintala, J.

Number of pages: 9

Pages: 960-968

Publication date: 15 Nov 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Science of the Total Environment

Volume: 691

ISSN (Print): 0048-9697

Ratings:

Scopus rating (2019): CiteScore 8.6 SJR 1.661 SNIP 1.977

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Waste Management and Disposal, Pollution

Keywords: Dairy wastewater, Expanded granular sludge bed (EGSB), Granule disintegration, Long chain fatty acids (LCFA), Methanogenesis pathway, Microbial community dynamics

DOIs:

10.1016/j.scitotenv.2019.07.136

Source: Scopus

Source ID: 85069487981

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



### **Fabrication of fiber filters with antibacterial properties for VOC and particle removal**

The use of filters to control air quality has been implemented widely in all types of structures. Unfortunately, filters risk becoming platforms for the growth of bacteria, which can then be dispersed further in the air stream. To combat this, antibacterial materials are being incorporated into filter media. In this work, we tested two routes for introducing nanoscale silver into filters containing activated carbon fibers (ACF): first, by adding silver nanofibers directly to the fiber fabrication process and second, by coating a pre-existing filter with silver nanoparticles generated by a liquid flame spray (LFS). The resultant filters were evaluated for methanol adsorption, particle penetration and antibacterial activity. The results show that both methods are suitable for producing antibacterial filters as well as being highly tailorable and scalable for specific needs.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Aerosol Synthesis, Research area: Aerosol Physics, Tampere University, Turku University Hospital, Turku University of Applied Science, University of Eastern Finland, Sanzen Seishi Co. Ltd., Kanazawa University

Contributors: Juuti, P., Nikka, M., Gunell, M., Eerola, E., Saarinen, J. J., Omori, Y., Seto, T., Mäkelä, J. M.

Number of pages: 8

Pages: 1892-1899

Publication date: 1 Aug 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Aerosol and Air Quality Research

Volume: 19

Issue number: 8

ISSN (Print): 1680-8584

Ratings:

Scopus rating (2019): CiteScore 5.4 SJR 0.965 SNIP 0.966

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution

Keywords: Adsorption, Air filtration, Liquid flame spray, Nanoscale silver

DOIs:

10.4209/aaqr.2018.12.0474

Source: Scopus

Source ID: 85073273179

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

### **Particle emissions of Euro VI, EEV and retrofitted EEV city buses in real traffic**

Emission control technologies used in Euro VI buses are effectively reducing soot and NO<sub>x</sub> emissions in real operation, but small sub-3 nm particles exist in variable concentrations in the exhaust of Euro VI, EEV and retrofitted EEV buses.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics, Finnish Meteorological Institute, Helsinki Region Environmental Services Authority HSY

Contributors: Järvinen, A., Timonen, H., Karjalainen, P., Bloss, M., Simonen, P., Saarikoski, S., Kuuluvainen, H., Kalliokoski, J., Dal Maso, M., Niemi, J. V., Keskinen, J., Rönkkö, T.

Number of pages: 9

Pages: 708-716

Publication date: 1 Jul 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Environmental Pollution

Volume: 250

ISSN (Print): 0269-7491

Ratings:

Scopus rating (2019): CiteScore 9.3 SJR 1.968 SNIP 1.805

Original language: English

ASJC Scopus subject areas: Toxicology, Pollution, Health, Toxicology and Mutagenesis

Keywords: Diesel exhaust, Emission factor, Particle emissions, Retrofit

Electronic versions:

1-s2.0-S0269749118352382-main

DOIs:

10.1016/j.envpol.2019.04.033

URLs:

<http://urn.fi/URN:NBN:fi:tty-201906111886>

Source: Scopus

Source ID: 85064601738

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

### **Application of an indoor air pollution metamodel to a spatially-distributed housing stock**

Estimates of population air pollution exposure typically rely on the outdoor component only, and rarely account for populations spending the majority of their time indoors. Housing is an important modifier of air pollution exposure due to outdoor pollution infiltrating indoors, and the removal of indoor-sourced pollution through active or passive ventilation. Here, we describe the application of an indoor air pollution modelling tool to a spatially distributed housing stock model for England and Wales, developed from Energy Performance Certificate (EPC) data and containing information for approximately 11.5 million dwellings. First, we estimate indoor/outdoor (I/O) ratios and total indoor concentrations of outdoor air pollution for PM<sub>2.5</sub> and NO<sub>2</sub> for all EPC dwellings in London. The potential to estimate concentration from both indoor and outdoor sources is then demonstrated by modelling indoor background CO levels for England and Wales pre- and post-energy efficient adaptation, including heating, cooking, and smoking as internal sources. In London, we predict a median I/O ratio of 0.60 (99% CIs; 0.53–0.73) for outdoor PM<sub>2.5</sub> and 0.41 (99% CIs; 0.34–0.59) for outdoor NO<sub>2</sub>; Pearson correlation analysis indicates a greater spatial modification of PM<sub>2.5</sub> exposure by housing ( $\rho = 0.81$ ) than NO<sub>2</sub> ( $\rho = 0.88$ ). For the demonstrative CO model, concentrations ranged from 0.4–9.9 ppm (99% CIs) (median = 3.0 ppm) in kitchens and 0.3–25.6 ppm (median = 6.4 ppm) in living rooms. Clusters of elevated indoor concentration are found in urban areas due to higher outdoor concentrations and smaller dwellings with reduced ventilation potential, with an estimated 17.6% increase in the number of living rooms and 63% increase in the number of kitchens exceeding recommended exposure levels following retrofit without additional ventilation. The model has the potential to rapidly calculate indoor pollution exposure across large housing stocks and estimate changes to exposure under different pollution or housing policy scenarios.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, University of Edinburgh

Contributors: Taylor, J., Shrubsole, C., Symonds, P., Mackenzie, I., Davies, M.

Number of pages: 10

Pages: 390-399

Publication date: 1 Jun 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Science of the Total Environment

Volume: 667

ISSN (Print): 0048-9697

Ratings:

Scopus rating (2019): CiteScore 8.6 SJR 1.661 SNIP 1.977

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Waste Management and Disposal, Pollution

Keywords: Air pollution, Building physics, I/O ratios, NO, PM

DOIs:

10.1016/j.scitotenv.2019.02.341

URLs:

<http://www.scopus.com/inward/record.url?scp=85062229013&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85062229013

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

### **Distinguishing fuel and lubricating oil combustion products in diesel engine exhaust particles**

The main sources of particulate emissions from engines are fuel and lubricating oil. In this study, particles emitted by a medium speed diesel engine for locomotive use were characterized chemically by using a soot particle aerosol mass spectrometer (SP-AMS). Additionally, positive matrix factorization (PMF) was applied to the SP-AMS data for the separation of fuel from lubricating oil and/or oil additives in diesel engine emissions. The mass spectra of refractory species, i.e., metals and rBC, were included in the PMF input matrix in addition to organics in order to utilize the benefit of

the SP-AMS to measure non-refractory and refractory species. In general, particulate matter emitted by the diesel engine was dominated by organics (51%) followed by refractory black carbon (rBC; 48%), trace metals and inorganic species (1%). Regarding the sources of particles, PMF indicated four factors for particle mass of which two were related to lubricating oil-like aerosol (LOA1, 29% and LOA2, 24%) and two others to diesel-like fuel aerosol (DFA1, 35% and DFA2, 12%). The main difference between LOA1 and LOA2 was the presence of soot in LOA1 and metals in LOA2 factors. DFA factors represented burned (DFA1) and unburned fuel (DFA2). The results from the PMF analysis were completed with particle size distributions, volatility measurements and particle morphology analyses.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics

Contributors: Carbone, S., Timonen, H. J., Rostedt, A., Happonen, M., Rönkkö, T., Keskinen, J., Ristimäki, J., Korpi, H., Artaxo, P., Canagaratna, M., Worsnop, D., Canonaco, F., Prévôt, A. S., Hillamo, R., Saarikoski, S.

Number of pages: 14

Pages: 594-607

Publication date: 4 May 2019

Peer-reviewed: Yes

### Publication information

Journal: Aerosol Science and Technology

Volume: 53

Issue number: 5

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2019): CiteScore 4.4 SJR 0.811 SNIP 1.01

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

DOIs:

10.1080/02786826.2019.1584389

Source: Scopus

Source ID: 85063483456

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

### Applicability of optical and diffusion charging-based particulate matter sensors to urban air quality measurements

High spatial resolution particulate matter measurements are necessary to accurately characterize urban air quality issues. This study investigates how sensors can be used in an urban area to complement existing air quality measurements. A measurement campaign was conducted during winter in Helsinki, Finland, where the performance of a custom-built optical instrument—the Prototype Aerosol Sensor (PAS; uses Shinyei PPD60PV and PPD42NS sensor modules)—and three commercial diffusion charging-based sensors (Pegasor AQ Urban, DiSCmini and Partector) was evaluated against reference instruments. The results showed that the PAS was able to measure the coarse ( $PM_{2.5-10}$ ; range: 0–400  $\mu\text{g m}^{-3}$ ) and fine ( $PM_{2.5}$ ; range: 0–50  $\mu\text{g m}^{-3}$ ) fractions with reasonably high correlations ( $R^2 = 0.87$  and  $0.77$ ) when compared to a gravimetric monitor. Likewise, the lung deposited surface area (LDSA) concentrations delivered by the three diffusion charging sensors indicated good performance ( $R^2$ : 0.92–0.97) when compared to LDSA concentrations calculated from the size distribution data of the differential mobility particle sizer. A clear correlation ( $R^2 = 0.77$ ) between the black carbon and Pegasor-measured LDSA concentrations, as well as similar diurnal cycles, was observed, suggesting a common source. The optical sensors were useful for measuring the mass concentrations of coarse local particles. By contrast, the diffusion charging sensors were applicable in urban environments, where ultrafine particles from traffic or other local combustion sources affect air quality.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics, Finnish Meteorological Institute, Helsinki Region Environmental Services Authority (HSY), Pegasor Oyj

Contributors: Kuula, J., Kuuluvainen, H., Rönkkö, T., Niemi, J. V., Saukko, E., Portin, H., Aurela, M., Saarikoski, S., Rostedt, A., Hillamo, R., Timonen, H.

Number of pages: 16

Pages: 1024-1039

Publication date: 1 May 2019

Peer-reviewed: Yes

### Publication information

Journal: Aerosol and Air Quality Research

Volume: 19

Issue number: 5  
ISSN (Print): 1680-8584  
Ratings:

Scopus rating (2019): CiteScore 5.4 SJR 0.965 SNIP 0.966  
Original language: English  
ASJC Scopus subject areas: Environmental Chemistry, Pollution  
Keywords: Diffusion charging, Low-cost sensor, Optical, PM, Urban air quality  
DOIs:  
10.4209/aaqr.2018.04.0143

#### **Bibliographical note**

EXT="Saukko, Erkkä"  
Source: Scopus  
Source ID: 85068919113  
Research output: Contribution to journal > Article > Scientific > peer-review

#### **Emission measurements with gravimetric impactors and electrical devices: An aerosol instrument comparison**

Particulate matter in the atmosphere is known to affect Earth's climate and to be harmful to human health. Accurately measuring particles from emission sources is important, as the results are used to inform policies and climate models. This study compares the results of two ELPI+ devices, two PM10 cascade impactors and an eFilter, in combustion emission measurements. The comparison of the instruments in a realistic setting shows what types of challenges arise from measuring an emission aerosol with unknown particle morphologies and densities, different particle concentrations and high temperature. Our results show that the PM10 cascade impactors have very good intercorrelation when the collected mass is greater than 150 µg, but below that, the uncertainty of the results increases with decreasing mass. The raw signals of two ELPI+ devices were nearly identical in most samples, as well as the particle number concentrations and size distributions calculated from raw signals; however, transforming the current distributions into mass distributions showed variation in the mass concentration of particles larger than 1 µm. The real-time time signal measured by eFilter was similar to the total current measured by ELPI+. The eFilter and PM10 cascade impactors showed similar particle mass concentrations, whereas ELPI+ showed clearly higher ones in most cases. We concluded that the difference is at least partially due to volatile components being measured by ELPI+, but not by the mass collection measurements.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics, Estonian Environmental Research Centre, Dekati Ltd, Tallinn University of Technology, Finnish Meteorological Institute  
Contributors: Salo, L., Mylläri, F., Maasikmets, M., Niemelä, V., Konist, A., Vainumäe, K., Kupri, H. L., Titova, R., Simonen, P., Aurela, M., Bloss, M., Keskinen, J., Timonen, H., Rönkkö, T.  
Number of pages: 14  
Pages: 526-539  
Publication date: 1 Mar 2019  
Peer-reviewed: Yes

#### **Publication information**

Journal: Aerosol Science and Technology  
Volume: 53  
Issue number: 5  
ISSN (Print): 0278-6826  
Ratings:  
Scopus rating (2019): CiteScore 4.4 SJR 0.811 SNIP 1.01  
Original language: English  
ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution  
DOIs:  
10.1080/02786826.2019.1578858  
URLs:  
<http://www.scopus.com/inward/record.url?scp=85062494308&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 85062494308  
Research output: Contribution to journal > Article > Scientific > peer-review

#### **Considerations in analysing elemental carbon from marine engine exhaust using residual, distillate and biofuels**

Elemental carbon (EC) concentrations in the exhaust of a medium-speed marine engine was evaluated using thermal-optical analysis (TOA). Particulate matter (PM) samples were collected at 75% and 25% engine loads using residual and distillate fuels with sulphur contents of 2.5%, 0.5% and 0.1%, and a biofuel (30% of bio-component). The EC analysis of

PM samples from a marine engine proved to be challenging. For example, transformations of structure of the sampled particles in the inert and the oxygen mode were observed for marine engine exhaust samples. The relationship between constituents present in the samples from the marine engine using different fuels, and phenomena observed in the thermograms are discussed. Temperature protocol selection and sample pre-treatment (extractions and drying) affected the reported EC mass. Modifications in the methodology were suggested to increase the accuracy of the analysis. Repeatability and reproducibility of the EC analysis was studied in the round-robin of three laboratories.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics, VTT Technical Research Centre of Finland, Finnish Meteorological Institute, University of Eastern Finland, Public Health Service (GGD) Amsterdam

Contributors: Aakko-Saksa, P., Koponen, P., Aurela, M., Vesala, H., Piimäkorpi, P., Murtonen, T., Sippula, O., Koponen, H., Karjalainen, P., Kuitinen, N., Panteliadis, P., Rönkkö, T., Timonen, H.

Number of pages: 14

Pages: 191-204

Publication date: Dec 2018

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Aerosol Science

Volume: 126

ISSN (Print): 0021-8502

Ratings:

Scopus rating (2018): CiteScore 3.9 SJR 0.696 SNIP 1.054

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

Keywords: Elemental carbon EC, Fuel, Marine engine, Round-robin, Thermal-optical analysis TOA, Thermogram

DOIs:

10.1016/j.jaerosci.2018.09.005

Source: Scopus

Source ID: 85054296019

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 ( $\text{SeO}_4^{2-}$ ), sulfate ( $\text{SO}_4^{2-}$ ) and nitrate ( $\text{NO}_3^-$ ) 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  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{Se}_{\text{total}}$  and  $\text{Se}_{\text{diss}}$ , 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  $\text{Se}^0$  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., Nanchaiah, Y. V., Lu, S., van Hullebusch, E. D., Gerlach, R., Lens, P. N.

Number of pages: 10

Pages: 684-693

Publication date: 1 Nov 2018

Peer-reviewed: Yes

#### Publication information

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:

10.1016/j.chemosphere.2018.07.079

Source: Scopus

Source ID: 85053212365

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<sup>3</sup>d and hydraulic retention times (HRT) of 60 d resulting in methane yields of 201 ± 18 L CH<sub>4</sub>/kg VS. Co-digestion of sedimented fiber with sewage sludge at an OLR of 1.5 kg VS/m<sup>3</sup>d and HRT of 20 d resulted in a methane production of 246 ± 10 L CH<sub>4</sub>/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.

#### **General information**

Publication status: Published

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.

Number of pages: 9

Pages: 209-217

Publication date: 15 Oct 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Water Research

Volume: 143

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2018): CiteScore 12.6 SJR 2.721 SNIP 2.486

Original language: English

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

DOIs:

10.1016/j.watres.2018.06.054

#### **Bibliographical note**

INT=keb, "Lahtinen, Leija"

Source: Scopus

Source ID: 85053165247

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

### **Removal and recovery of uranium(VI) by waste digested activated sludge in fed-batch stirred tank reactor**

This study demonstrated the removal and recovery of uranium(VI) in a fed-batch stirred tank reactor (STR) using waste digested activated sludge (WDAS). The batch adsorption experiments showed that WDAS can adsorb 200 (±9.0) mg of uranium(VI) per g of WDAS. The maximum adsorption of uranium(VI) was achieved even at an acidic initial pH of 2.7 which increased to a pH of 4.0 in the equilibrium state. Desorption of uranium(VI) from WDAS was successfully demonstrated from the release of more than 95% of uranium(VI) using both acidic (0.5 M HCl) and alkaline (1.0 M Na<sub>2</sub>CO<sub>3</sub>) eluents. Due to the fast kinetics of uranium(VI) adsorption onto WDAS, the fed-batch STR was successfully operated at a mixing time of 15 min. Twelve consecutive uranium(VI) adsorption steps with an average adsorption efficiency of 91.5% required only two desorption steps to elute more than 95% of uranium(VI) from WDAS. Uranium(VI) was shown to interact predominantly with the phosphoryl and carboxyl groups of the WDAS, as revealed by in situ infrared spectroscopy and

time-resolved laser-induced fluorescence spectroscopy studies. This study provides a proof-of-concept of the use of fed-batch STR process based on WDAS for the removal and recovery of uranium(VI).

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Helmholtz-Zentrum Dresden-Rossendorf, Ita-Suomen yliopisto

Contributors: Jain, R., Peräniemi, S., Jordan, N., Vogel, M., Weiss, S., Foerstendorf, H., Lakaniemi, A.

Number of pages: 9

Pages: 167-175

Publication date: 1 Oct 2018

Peer-reviewed: Yes

#### Publication information

Journal: Water Research

Volume: 142

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2018): CiteScore 12.6 SJR 2.721 SNIP 2.486

Original language: English

ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Adsorption, Desorption, Infrared spectroscopy, Sludge, STR, Uranium

DOIs:

10.1016/j.watres.2018.05.042

Source: Scopus

Source ID: 85047810396

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

#### Vertical profiles of lung deposited surface area concentration of particulate matter measured with a drone in a street canyon

The vertical profiles of lung deposited surface area (LDSA) concentration were measured in an urban street canyon in Helsinki, Finland, by using an unmanned aerial system (UAS) as a moving measurement platform. The street canyon can be classified as an avenue canyon with an aspect ratio of 0.45 and the UAS was a multicopter drone especially modified for emission measurements. In the experiments of this study, the drone was equipped with a small diffusion charge sensor capable of measuring the alveolar LDSA concentration of particles. The drone measurements were conducted during two days on the same spatial location at the kerbside of the street canyon by flying vertically from the ground level up to an altitude of 50 m clearly above the rooftop level (19 m) of the nearest buildings. The drone data were supported by simultaneous measurements and by a two-week period of measurements at nearby locations with various instruments. The results showed that the averaged LDSA concentrations decreased approximately from  $60 \mu\text{m}^2/\text{cm}^3$  measured close to the ground level to  $36\text{--}40 \mu\text{m}^2/\text{cm}^3$  measured close to the rooftop level of the street canyon, and further to  $16\text{--}26 \mu\text{m}^2/\text{cm}^3$  measured at 50 m. The high-resolution measurement data enabled an accurate analysis of the functional form of vertical profiles both in the street canyon and above the rooftop level. In both of these regions, exponential fits were used and the parameters obtained from the fits were thoroughly compared to the values found in literature. The results of this study indicated that the role of turbulent mixing caused by traffic was emphasized compared to the street canyon vortex as a driving force of the dispersion. In addition, the vertical profiles above the rooftop level showed a similar exponential decay compared to the profiles measured inside the street canyon. The high-resolution vertical profiles of lung deposited surface area obtained in this study are valuable with respect to exposure estimations, urban planning, and urban air quality models.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics, Finnish Meteorological Institute, Aeromon Ltd, Helsinki Region Environmental Services Authority HSY

Contributors: Kuuluvainen, H., Poikkimäki, M., Järvinen, A., Kuula, J., Irjala, M., Dal Maso, M., Keskinen, J., Timonen, H., Niemi, J. V., Rönkkö, T.

Number of pages: 10

Pages: 96-105

Publication date: 1 Oct 2018

Peer-reviewed: Yes

#### Publication information

Journal: Environmental Pollution

Volume: 241

ISSN (Print): 0269-7491

Ratings:

Scopus rating (2018): CiteScore 7 SJR 1.673 SNIP 1.612

Original language: English

ASJC Scopus subject areas: Toxicology, Pollution, Health, Toxicology and Mutagenesis

Keywords: Aerosol, Lung deposited surface area, Street canyon, Urban air quality, Vertical profile

Electronic versions:

Manuscript. Embargo ended: 23/05/20

DOIs:

10.1016/j.envpol.2018.04.100

URLs:

<http://urn.fi/URN:NBN:fi:ttty-201903261339>. Embargo ended: 23/05/20

Source: Scopus

Source ID: 85047239842

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

### **Performance evaluation of the HR-ELPI + inversion**

Data inversion methods used in aerosol measurement instruments have significant influence on the resolution and quality of the result. A freshly launched new electrical low pressure impactor (ELPI) instrument version, high resolution ELPI+ (HR-ELPI+, Dekati Ltd.), uses an iterative inversion calculation method to improve particle size resolution, concentration, and data analysis quality. In this article, the performance of the HR-ELPI + is critically analyzed by simulations and experiments in laboratory and field conditions, and the results are compared with a conventional inversion data analysis method (cut-point diameter concept) and with common reference instruments (e.g., SMPS and EEPS). The results showed that the HR-ELPI + inversion has limited performance at the lower and upper limits of the instrument's size range, and can suffer if the raw currents have signal dependent noise more than 50% or electric noise more than 1%. However, the HR-ELPI + clearly provide remarkably better resolution and quality with low oscillation risk compared to the conventional cut-point diameter concept of the ELPI. The HR-ELPI + also showed generally very similar size distributions and number concentrations compared to the reference instruments.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics

Contributors: Saari, S., Arffman, A., Harra, J., Rönkkö, T., Keskinen, J.

Number of pages: 11

Pages: 1037-1047

Publication date: 2 Sep 2018

Peer-reviewed: Yes

### **Publication information**

Journal: Aerosol Science and Technology

Volume: 52

Issue number: 9

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2018): CiteScore 3.8 SJR 0.786 SNIP 0.995

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

Keywords: Pramod Kulkarni

DOIs:

10.1080/02786826.2018.1500679

Source: Scopus

Source ID: 85052142628

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

### **Quantitative characterization of pore structure of several biochars with 3D imaging**

Pore space characteristics of biochars may vary depending on the used raw material and processing technology. Pore structure has significant effects on the water retention properties of biochar amended soils. In this work, several biochars were characterized with three-dimensional imaging and image analysis. X-ray computed microtomography was used to image biochars at resolution of 1.14  $\mu\text{m}$  and the obtained images were analysed for porosity, pore size distribution, specific surface area and structural anisotropy. In addition, random walk simulations were used to relate structural anisotropy to diffusive transport. Image analysis showed that considerable part of the biochar volume consist of pores in size range relevant to hydrological processes and storage of plant available water. Porosity and pore size distribution were



found to depend on the biochar type and the structural anisotropy analysis showed that used raw material considerably affects the pore characteristics at micrometre scale. Therefore, attention should be paid to raw material selection and quality in applications requiring optimized pore structure.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Biomaterials and Tissue Engineering Group, Research group: Computational Biophysics and Imaging Group, BioMediTech, Natural Resources Institute Finland (Luke), VTT Technical Research Centre of Finland

Contributors: Hyvälouma, J., Kulju, S., Hannula, M., Wikberg, H., Källi, A., Rasa, K.

Number of pages: 11

Pages: 1-11

Publication date: Sep 2018

Peer-reviewed: Yes

Early online date: 24 Mar 2017

#### Publication information

Journal: Environmental Science and Pollution Research

Volume: 25

Issue number: 26

ISSN (Print): 0944-1344

Ratings:

Scopus rating (2018): CiteScore 4.5 SJR 0.828 SNIP 1.05

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution, Health, Toxicology and Mutagenesis

Keywords: Biochar, Image analysis, Pore structure, Soil amendment, Water retention, X-ray tomography

DOIs:

10.1007/s11356-017-8823-x

#### Bibliographical note

EXT="Kulju, Sampo"

Source: Scopus

Source ID: 8501599251

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

#### Extending the Faraday cup aerosol electrometer based calibration method up to 5 µm

A Faraday cup aerosol electrometer based electrical aerosol instrument calibration setup from nanometers up to micrometers has been designed, constructed, and characterized. The set-up utilizes singly charged seed particles, which are grown to the desired size by condensation of diethylhexyl sebacate. The calibration particle size is further selected with a Differential Mobility Analyzer (DMA). For micrometer sizes, a large DMA was designed, constructed, and characterized. The DMA electrical mobility resolution was found to be 7.95 for 20 L/min sheath and 2 L/min sample flows. The calibration is based on comparing the instrument's response against the concentration measured with a reference Faraday cup aerosol electrometer. The set-up produces relatively high concentrations in the micrometer size range (more than 2500 1/cm<sup>3</sup> at 5.3 µm). A low bias flow mixing and splitting between the reference and the instrument was constructed from a modified, large-sized mixer and a four-port flow splitter. It was characterized at different flow rates and as a function of the particle size. Using two of the four outlet ports at equal 1.5 L/min flow rates, the particle concentration bias of the flow splitting was found to be less than ±1% in the size range of 3.6 nm–5.3 µm. The developed calibration set-up was used to define the detection efficiency of a condensation particle counter from 3.6 nm to 5.3 µm with an expanded measurement uncertainty ( $k = 2$ ) of less than 4% over the entire size range and less than 2% for most of the measurement points.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics

Contributors: Järvinen, A., Keskinen, J., Yli-Ojanperä, J.

Number of pages: 13

Pages: 828-840

Publication date: 3 Aug 2018

Peer-reviewed: Yes

#### Publication information

Journal: Aerosol Science and Technology

Volume: 52  
Issue number: 8  
ISSN (Print): 0278-6826  
Ratings:

Scopus rating (2018): CiteScore 3.8 SJR 0.786 SNIP 0.995

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

Keywords: Pramod Kulkarni

Electronic versions:

Järvinen\_et\_al\_Calibration\_rev\_11

DOIs:

10.1080/02786826.2018.1472742

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910033665>

Source: Scopus

Source ID: 85051115278

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

### **Selenate removal in biofilm systems: Effect of nitrate and sulfate on selenium removal efficiency, biofilm structure and microbial community**

**BACKGROUND:** Selenium (Se) discharged into natural waterbodies can accumulate over time and have negative impacts on the environment. Se-laden wastewater streams can be treated using biological processes. However, the presence of other electron acceptors in wastewater, such as nitrate ( $\text{NO}_3^-$ ) and sulfate ( $\text{SO}_4^{2-}$ ), can influence selenate ( $\text{SeO}_4^{2-}$ ) reduction and impact the efficiency of biological treatment systems. **RESULTS:**  $\text{SeO}_4^{2-}$  removal by biofilms formed from an anaerobic sludge inoculum was investigated in the presence of  $\text{NO}_3^-$  and  $\text{SO}_4^{2-}$  using drip flow reactors operated continuously for 10 days at pH 7.0 and 30°C. The highest total Se (~60%) and  $\text{SeO}_4^{2-}$  (~80%) removal efficiencies were observed when the artificial wastewater contained  $\text{SO}_4^{2-}$ . A maximum amount of  $68 \mu\text{mol Se cm}^{-2}$  was recovered from the biofilm matrix in  $\text{SO}_4^{2-}$ + $\text{SeO}_4^{2-}$  exposed biofilms and biofilm mass was 2.7-fold increased for biofilms grown in the presence of  $\text{SO}_4^{2-}$ . When  $\text{SeO}_4^{2-}$  was the only electron acceptor, biofilms were thin and compact. In the simultaneous presence of  $\text{NO}_3^-$  or  $\text{SO}_4^{2-}$ , biofilms were thicker (> 0.6 mm), less compact and exhibited gas pockets. **CONCLUSION:** The presence of  $\text{SO}_4^{2-}$  had a beneficial effect on biofilm growth and the  $\text{SeO}_4^{2-}$  removal efficiency, while the presence of  $\text{NO}_3^-$  did not have a significant effect on  $\text{SeO}_4^{2-}$  removal by the biofilms.

#### **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, Montana State University (MSU), Bhabha Atomic Research Centre, UPEM

Contributors: Tan, L. C., Espinosa-Ortiz, E. J., Nancharaiah, Y. V., van Hullebusch, E. D., Gerlach, R., Lens, P. N.

Pages: 2380-2389

Publication date: Aug 2018

Peer-reviewed: Yes

Early online date: 1 Jan 2018

#### **Publication information**

Journal: Journal of Chemical Technology and Biotechnology

Volume: 93

Issue number: 8

ISSN (Print): 0268-2575

Ratings:

Scopus rating (2018): CiteScore 4.8 SJR 0.715 SNIP 0.891

Original language: English

ASJC Scopus subject areas: Biotechnology, Chemical Engineering(all), Renewable Energy, Sustainability and the Environment, Fuel Technology, Waste Management and Disposal, Pollution, Organic Chemistry, Inorganic Chemistry

Keywords: Biofilm, Biofilm characterization, Co-electron acceptors, Nitrate, Selenate, Selenium removal, Sulfate

DOIs:

10.1002/jctb.5586

Source: Scopus

Source ID: 85043713774

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

### **Investigating the kinetics and biofuel properties of *Alstonia congensis* and *Ceiba pentandra* via torrefaction**

*Alstonia congensis* (Ahun) and *Ceiba pentandra* (Araba) were chosen as representations of tropical wood in this study. The use of untreated wood for energy recovery could lead to a high loss in efficiency. One way of circumventing this in a

developing country such as Nigeria is by exposing the fuel materials to a pre-treatment, such as torrefaction, prior to deployment. Attempts were made to improve the combustion properties of these resources and also to investigate their torrefaction kinetics. Derivations of kinetic parameters using Coats-Redfern method were discontinued due to inconsistent results. A non-linear regression method was then employed and the results compared to the average value obtained by the FWO method, which was considered more viable than the Coats-Redfern method. The kinetic parameters ( $E_a$ ,  $A$  and  $n$ ) derived by the regression method are 134.45 kJ/mol,  $1.83E+13 \text{ min}^{-1}$  and 2.15, respectively, for Araba and 143.38 kJ/mol,  $1.90E+10 \text{ min}^{-1}$  and 2.28, respectively, for Ahun. The thermal behaviour of the samples showed that a lower mass yield resulted in a lower energy yield, while the heating values increased with the temperature of torrefaction. The results obtained in this study affirm the possibility of obtaining an optimum conversion of these resources for energy recovery.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, University of Borås, Laboratory of Chemistry and Bioengineering

Contributors: Oluoti, K., Doddapaneni, T. R. K., Richards, T.

Number of pages: 8

Pages: 134-141

Publication date: 1 May 2018

Peer-reviewed: Yes

#### Publication information

Journal: Energy

Volume: 150

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2018): CiteScore 8.5 SJR 2.048 SNIP 1.842

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Pollution, Energy(all), Mechanical Engineering, Industrial and Manufacturing Engineering, Electrical and Electronic Engineering

Keywords: *Alstonia congensis*, *Ceiba pentandra*, Energy densification, Kinetic parameters, Mini-grid, Torrefaction

DOIs:

10.1016/j.energy.2018.02.086

Source: Scopus

Source ID: 85042679330

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

#### Anaerobic digestion of 30–100-year-old boreal lake sedimented fibre from the pulp industry: Extrapolating methane production potential to a practical scale

Since the 1980s, the pulp and paper industry in Finland has resulted in the accumulation of fibres in lake sediments. One such site in Lake Näsijärvi contains approximately 1.5 million  $\text{m}^3$  sedimented fibres. In this study, the methane production potential of the sedimented fibres (on average 13% total solids (TS)) was determined in batch assays. Furthermore, the methane production from solid (on average 20% TS) and liquid fractions of sedimented fibres after solid-liquid separation was studied. The sedimented fibres resulted in fast methane production and high methane yields of  $250 \pm 80 \text{ L CH}_4/\text{kg}$  volatile solids (VS). The main part (ca. 90%) of the methane potential was obtained from the solid fraction of the sedimented fibres. In addition, the VS removal from the total and solid sedimented fibres was high, 61–65% and 63–78%, respectively. The liquid fraction also contained a large amount of organics (on average 8.8 g COD/L), treatment of which also has to be considered. The estimations of the methane production potentials in the case area showed potential up to 40 million  $\text{m}^3$  of methane from sedimented fibres.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering

Contributors: Kokko, M., Koskue, V., Rintala, J.

Number of pages: 9

Pages: 218-226

Publication date: 15 Apr 2018

Peer-reviewed: Yes

#### Publication information

Journal: Water Research

Volume: 133

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2018): CiteScore 12.6 SJR 2.721 SNIP 2.486

Original language: English

ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Anaerobic digestion, Methane, Pulp and paper industry, Sedimented fibre

DOIs:

10.1016/j.watres.2018.01.041

Source: Scopus

Source ID: 85041395267

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 ( $45 \text{ mW/cm}^2$ ), 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 ( $15 \text{ mW/cm}^2$ ) photocurrent increases from  $183 \mu\text{A/cm}^2$  to  $306 \mu\text{A/cm}^2$  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

### **Assessing urban population vulnerability and environmental risks across an urban area during heatwaves – Implications for health protection**

Heatwaves can lead to a range of adverse impacts including increased risk of illness and mortality; the heatwave in August 2003 has been associated with ~ 70,000 deaths across Europe. Due to climate change, heatwaves are likely to become more intense, more frequent and last longer in the future. A number of factors may influence risks associated with heat exposure, such as population age, housing type, and location within the Urban Heat Island, and such factors may not be evenly distributed spatially across a region. We simulated and analysed two major heatwaves in the UK, in August

2003 and July 2006, to assess spatial vulnerability to heat exposure across the West Midlands, an area containing ~ 5 million people, and how ambient temperature varies in relation to factors that influence heat-related health effects, through weighting of ambient temperatures according to distributions of these factors across an urban area. Additionally we present quantification of how particular centres such as hospitals are exposed to the UHI, by comparing temperatures at these locations with average temperatures across the region, and presenting these results for both day and night times. We find that UHI intensity was substantial during both heatwaves, reaching a maximum of + 9.6 °C in Birmingham in July 2006. Previous work has shown some housing types, such as flats and terraced houses, are associated with increased risk of overheating, and our results show that these housing types are generally located within the warmest parts of the city. Older age groups are more susceptible to the effects of heat. Our analysis of distribution of population based on age group showed there is only small spatial variation in ambient temperature that different age groups are exposed to. Analysis of relative deprivation across the region indicates more deprived populations are located in the warmest parts of the city.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Public Health England, London School of Hygiene and Tropical Medicine, University of Birmingham, University College London, Institute of Occupational Medicine

Contributors: Macintyre, H. L., Heaviside, C., Taylor, J., Picetti, R., Symonds, P., Cai, X. M., Vardoulakis, S.

Number of pages: 13

Pages: 678-690

Publication date: 1 Jan 2018

Peer-reviewed: Yes

### Publication information

Journal: Science of the Total Environment

Volume: 610-611

ISSN (Print): 0048-9697

Ratings:

Scopus rating (2018): CiteScore 7.4 SJR 1.536 SNIP 1.84

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Waste Management and Disposal, Pollution

Keywords: Health effects, Heat waves, Spatial vulnerability, Urban Heat Island

DOIs:

10.1016/j.scitotenv.2017.08.062

URLs:

<http://www.scopus.com/inward/record.url?scp=85027502140&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85027502140

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

### Bio-electrochemical conversion of industrial wastewater-COD combined with downstream methanol synthesis-an economic and life cycle assessment

Herein, a techno-economic and environmental performance evaluation (i.e. Life Cycle Assessment (LCA)) of a 45 kW Microbial Electrolysis Cell (MEC) system is presented in the context of industrial wastewater remediation. This system produces H<sub>2</sub> and CO<sub>2</sub>-suitable for downstream CH<sub>3</sub>OH synthesis-based on the bio-electrochemical conversion of chemical industry wastewater with an organic content of 3.9 g(COD) L<sup>-1</sup>. A cost-benefit analysis indicates that the MEC system hardware costs, share of CO<sub>2</sub> captured from the MEC and MEC operating current density (i.e. 1.0 mA cm<sup>-2</sup>) are crucial parameters influencing the total cost and represent areas for potential cost reductions. It was established based on the present study that MEC system operation with renewable electricity leads to H<sub>2</sub> production costs of 4-5.7€ kg(H<sub>2</sub>)<sup>-1</sup> (comparable to H<sub>2</sub>O electrolysis) and CH<sub>3</sub>OH production costs of 900€ t(CH<sub>3</sub>OH)<sup>-1</sup>. At the current CH<sub>3</sub>OH market prices, however, the production is currently not profitable. In turn, the cost-efficient construction of the MEC system and the use of less expensive materials could lead to improved CH<sub>3</sub>OH production economics based on this route. Our results indicate that the use of low-cost materials has greater potential with regard to cost reduction compared to reducing the internal resistance and polarization losses via the use of expensive high-performance materials in MEC construction. A complementary LCA of the proposed system, based on a "cradle-to-gate" definition, indicates that waste-based is superior to fossil-based CH<sub>3</sub>OH production with respect to global warming potential and cumulated fossil energy demand, provided the system is operated with 100% renewable electricity and CO<sub>2</sub> sourced only from the MEC. However, with regard to the impact categories Metal Depletion and Freshwater Eutrophication Potential, the system was found to perform less satisfactorily (i.e. in comparison with fossil-based CH<sub>3</sub>OH production).

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Fraunhofer Institute for Solar Energy Systems ISE, Albert-Ludwig-University of Freiburg, Karlsruhe Institute of Technology, Institute for Technical Physics, Germany, University of Freiburg, Laboratory for MEMS Applications, University of Bremen

Contributors: Streeck, J., Hank, C., Neuner, M., Gil-Carrera, L., Kokko, M., Pauliuk, S., Schaadt, A., Kerzenmacher, S., White, R. J.

Number of pages: 21

Pages: 2742-2762

Publication date: 2018

Peer-reviewed: Yes

#### Publication information

Journal: Green Chemistry

Volume: 20

Issue number: 12

ISSN (Print): 1463-9262

Ratings:

Scopus rating (2018): CiteScore 15.7 SJR 2.517 SNIP 1.84

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution

DOIs:

10.1039/c8gc00543e

Source: Scopus

Source ID: 85048986666

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

#### Comparative performance of a thermal denuder and a catalytic stripper in sampling laboratory and marine exhaust aerosols

The performance of a thermal denuder (thermodenuder—TD) and a fresh catalytic stripper (CS) was assessed by sampling laboratory aerosol, produced by different combinations of sulfuric acid, octacosane, and soot particles, and marine exhaust aerosol produced by a medium-speed marine engine using high sulfur fuels. The intention was to study the efficiency in separating non-volatile particles. No particles could be detected downstream of either device when challenged with neat octacosane particles at high concentration. Both laboratory and marine exhaust aerosol measurements showed that sub-23 nm semi-volatile particles are formed downstream of the thermodenuder when upstream sulfuric acid approached 100 ppbv. Charge measurements revealed that these are formed by re-nucleation rather than incomplete evaporation of upstream aerosol. Sufficient dilution to control upstream sulfates concentration and moderate TD operation temperature (250°C) are both required to eliminate their formation. Use of the CS following an evaporation tube seemed to eliminate the risk for particle re-nucleation, even at a ten-fold higher concentration of semi-volatiles than in case of the TD. Particles detected downstream of the CS due to incomplete evaporation of sulfuric acid and octacosane aerosol, did not exceed 0.01% of upstream concentration. Despite the superior performance of CS in separating non-volatile particles, the TD may still be useful in cases where increased sensitivity over the traditional evaporation tube method is needed and where high sulfur exhaust concentration may fast deplete the catalytic stripper adsorption capacity.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Aristotle University of Thessaloniki, VTT Technical Research Centre of Finland, Finnish Meteorological Institute

Contributors: Amanatidis, S., Ntziachristos, L., Karjalainen, P., Saukko, E., Simonen, P., Kuittinen, N., Aakko-Saksa, P., Timonen, H., Rönkkö, T., Keskinen, J.

Number of pages: 13

Pages: 1-13

Publication date: 2018

Peer-reviewed: Yes

Early online date: 13 Jan 2018

#### Publication information

Journal: Aerosol Science and Technology

Volume: 52

Issue number: 4

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2018): CiteScore 3.8 SJR 0.786 SNIP 0.995

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

DOIs:

10.1080/02786826.2017.1422236

Source: Scopus

Source ID: 85041130555

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

### **Flow rate-independent electrical aerosol sensor**

A new diffusion charging-based aerosol instrument design is presented, intended to be a starting point for a low-cost particle concentration sensor. The aim in the design is to minimize instrument response dependence on the sample flow rate. The operation principle, response functions of the components, and performance of a prototype instrument are reported. Based on the performance evaluation, the instrument response remained constant within  $\pm 15\%$  over a wide sample flow rate range of 3 to 10 lpm. While in the design some sensitivity is sacrificed to minimize flow rate dependency, the detection limit is still sufficient for a practical sensor application.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research area: Aerosol Physics, Physics

Contributors: Rostedt, A., Keskinen, J.

Pages: 1283-1292

Publication date: 2018

Peer-reviewed: Yes

Early online date: 2018

### **Publication information**

Journal: Aerosol Science and Technology

Volume: 52

Issue number: 11

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2018): CiteScore 3.8 SJR 0.786 SNIP 0.995

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

Keywords: Jingkun Jiang

Electronic versions:

flow\_rate\_independent\_electrical\_aerosol\_2018

DOIs:

10.1080/02786826.2018.1498586

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910234052>

Source: Scopus

Source ID: 85052286150

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

### **Technology review: prototyping platforms for monitoring ambient conditions**

The monitoring of ambient conditions in indoor spaces is very essential owing to the amount of time spent indoors. Specifically, the monitoring of air quality is significant because contaminated air affects the health, comfort and productivity of occupants. This research work presents a technology review of prototyping platforms for monitoring ambient conditions in indoor spaces. It involves the research on sensors (for CO<sub>2</sub>, air quality and ambient conditions), IoT platforms, and novel and commercial prototyping platforms. The ultimate objective of this review is to enable the easy identification, selection and utilisation of the technologies best suited for monitoring ambient conditions in indoor spaces. Following the review, it is recommended to use metal oxide sensors, optical sensors and electrochemical sensors for IAQ monitoring (including NDIR sensors for CO<sub>2</sub> monitoring), Raspberry Pi for data processing, ZigBee and Wi-Fi for data communication, and ThingSpeak IoT platform for data storage, analysis and visualisation.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation and Hydraulic Engineering, Research group: Automation and Systems Theory

Contributors: Afolaranmi, S. O., Ramis Ferrer, B., Martinez Lastra, J. L.

Number of pages: 27

Pages: 253-279

Publication date: 2018

Peer-reviewed: Yes  
Early online date: 9 May 2018

### Publication information

Journal: International Journal of Environmental Health Research

Volume: 28

Issue number: 3

ISSN (Print): 0960-3123

Ratings:

Scopus rating (2018): CiteScore 2.7 SJR 0.49 SNIP 0.715

Original language: English

ASJC Scopus subject areas: Pollution, Public Health, Environmental and Occupational Health, Health, Toxicology and Mutagenesis

Keywords: ambient conditions monitoring, CO monitoring, indoor air quality, prototyping platforms, Technology review

DOIs:

10.1080/09603123.2018.1468423

Source: Scopus

Source ID: 85046644339

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

### CFD based reactivity parameter determination for biomass particles of multiple size ranges in high heating rate devolatilization

This work presents a methodology that combines experimental measurements and Computational Fluid Dynamics (CFD) modeling to determine the global reaction kinetics of high heating rate biomass devolatilization. Three particle size ranges of woody biomass are analyzed: small (SF), medium (MF) and large (LF) fractions. Devolatilization mass loss is measured for each fraction in a laminar Drop-Tube Reactor (DTR) in nitrogen atmosphere, using two nominal reactor temperatures of 873 and 1173 K. Single First Order Reaction (SFOR) kinetics are determined by coupling an optimization routine with CFD models of the DTR. The global pre-exponential factors and activation energies for the SF, MF and LF particles are 5880 1/s and 42.7 kJ/mol, 48.1 1/s and 20.2 kJ/mol, and 102 1/s and 24.8 kJ/mol, respectively. These parameters are optimized for the isothermal heat transfer model available in CFD programs, and it is recommended that the specific heat capacity that was used in the optimization (1500 J/kgK) is used together with the parameters. Using the SF kinetics for small wood particles and either of the MF or LF kinetics for large particles, it is expected that more accurate devolatilization predictions can be obtained for the whole fuel size distribution in large scale CFD simulations.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Power Plant and Combustion Technology, Valmet Technologies Oy

Contributors: Niemelä, N. P., Tolvanen, H., Saarinen, T., Leppänen, A., Joronen, T.

Number of pages: 12

Pages: 676-687

Publication date: 1 Jun 2017

Peer-reviewed: Yes

### Publication information

Journal: Energy

Volume: 128

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2017): CiteScore 8.1 SJR 1.99 SNIP 1.946

Original language: English

ASJC Scopus subject areas: Pollution, Energy(all)

Keywords: Biomass, Computational Fluid Dynamics (CFD), Devolatilization, High heating rate, Pyrolysis, Single First Order Reaction (SFOR)

DOIs:

10.1016/j.energy.2017.04.023

Source: Scopus

Source ID: 85018474683

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

### Biohydrogen production from xylose by fresh and digested activated sludge at 37, 55 and 70 °C

Two heat-treated inocula, fresh and digested activated sludge from the same municipal wastewater treatment plant, were compared for their H<sub>2</sub> production via dark fermentation at mesophilic (37 °C), thermophilic (55 °C) and hyperthermophilic (70 °C) conditions using xylose as the substrate. At both 37 and 55 °C, the fresh activated sludge yielded more H<sub>2</sub> than



the digested sludge, whereas at 70 °C, neither of the inocula produced H<sub>2</sub> effectively. A maximum yield of 1.85 mol H<sub>2</sub> per mol of xylose consumed was obtained at 55 °C. H<sub>2</sub> production was linked to acetate and butyrate production, and there was a linear correlation ( $R^2 = 0.96$ ) between the butyrate and H<sub>2</sub> yield for the fresh activated sludge inoculum at 55 °C. Approximately 2.4 mol H<sub>2</sub> per mol of butyrate produced were obtained against a theoretical maximum of 2.0, suggesting that H<sub>2</sub> was produced via the acetate pathway prior to switching to the butyrate pathway due to the increased H<sub>2</sub> partial pressure. Clostridia sp. were the prevalent species at both 37 and 55 °C, irrespectively of the inoculum type. Although the two inocula originated from the same plant, different thermophilic microorganisms were detected at 55 °C. Thermoanaerobacter sp., detected only in the fresh activated sludge cultures, may have contributed to the high H<sub>2</sub> yield obtained with such an inoculum.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Industrial Bioengineering and Applied Organic Chemistry, Institute for Water Education, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education

Contributors: Dessi, P., Lakaniemi, A., Lens, P. N. L.

Number of pages: 10

Pages: 120-129

Publication date: 15 May 2017

Peer-reviewed: Yes

### Publication information

Journal: Water Research

Volume: 115

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2017): CiteScore 11.5 SJR 2.601 SNIP 2.388

Original language: English

ASJC Scopus subject areas: Ecological Modelling, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Biohydrogen, Butyrate, Dark fermentation, Inocula, Temperature, Xylose

Electronic versions:

Dessi et al 2017 - Biohydrogen production from xylose. Embargo ended: 28/02/19

DOIs:

10.1016/j.watres.2017.02.063

URLs:

<http://urn.fi/URN:NBN:fi:tty-201902051212>. Embargo ended: 28/02/19

Source: Scopus

Source ID: 85014366720

Research output: Contribution to journal › 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<sub>4</sub>-N), phosphorus (as phosphate PO<sub>4</sub>-P), and potassium (as K<sup>+</sup>) from urine. Using a synthetic urine medium, the BECs could reach high current densities of up to 37.6 A m<sup>-2</sup> at E<sub>we</sub> values of 0.0 versus the standard hydrogen electrode (SHE) and 50 A m<sup>-2</sup> 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<sub>4</sub>-N m<sup>-3</sup> day<sup>-1</sup>, 0.52 kg of PO<sub>4</sub>-P m<sup>-3</sup> day<sup>-1</sup>, and 1.62 kg of K<sup>+</sup> m<sup>-3</sup> day<sup>-1</sup> into a concentrate stream (containing 1.87 M NH<sub>4</sub>-N, 0.29 M PO<sub>4</sub>-P, and 0.18 M K<sup>+</sup>). Finally, this communication demonstrates the recovery of a nitrogen-rich solid from the synthetic urine (in the form of pure NH<sub>4</sub>HCO<sub>3</sub> 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

Publication status: Published

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

Pages: 119-124

Publication date: 14 Mar 2017

Peer-reviewed: Yes

### Publication information

Journal: Environmental Science and Technology Letters

Volume: 4

Issue number: 3

ISSN (Print): 2328-8930

Ratings:

Scopus rating (2017): SNIP 1.767

Original language: English

ASJC Scopus subject areas: Ecology, Environmental Chemistry, Health, Toxicology and Mutagenesis, Pollution, Waste Management and Disposal, Water Science and Technology

DOIs:

10.1021/acs.estlett.7b00024

Source: Scopus

Source ID: 85017618476

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

## Chasing measurements for real-world emissions of city buses

### General information

Publication status: Published

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Atmospheric Composition Research, Finnish Meteorological Institute, Helsinki Region Environmental Services Authority (HSY), Department of Environmental Sciences, Helsinki University

Contributors: Järvinen, A., Karjalainen, P., Bloss, M., Potila, O., Simonen, P., Kuuluvainen, H., Timonen, H., Saarikoski, S., Niemi, J. V., Keskinen, J., Rönkkö, T.

Publication date: 2017

Peer-reviewed: Unknown

Event: Paper presented at European Aerosol Conference 2017, Zürich, Switzerland.

ASJC Scopus subject areas: Automotive Engineering, Pollution, Energy (miscellaneous)

Keywords: Exhaust emissions, bus emissions, Air quality

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

### Differential diffusion analyzer

In this article, a proof of concept of a new measurement instrument, differential diffusion analyzer (DDA), is established. The DDA enables the measurement of the size distribution of sub-10 nm aerosol particles, and it can also be used as a size classifier to separate a certain particle size from a size distribution for subsequent analysis. The developed technique is based on the diffusion separation of different size particles. Thus, the main advantage of the DDA compared to other methods is that particle charging is not required. Simulated and experimentally measured transmission efficiencies show that the diffusion-based differential size classification is a feasible concept, and moreover, shows that particle size is inversely proportional to the square root of the total flow rate.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group

Contributors: Arffman, A., Juuti, P., Harra, J., Keskinen, J.

Pages: 1429-1437

Publication date: 2017

Peer-reviewed: Yes

Early online date: 7 Sep 2017

### Publication information

Journal: Aerosol Science and Technology

Volume: 51

Issue number: 12

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2017): CiteScore 3.6 SJR 0.875 SNIP 0.958

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

DOIs:

10.1080/02786826.2017.1367089

Source: Scopus

Source ID: 85029444156

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

### **Fate of metallic engineered nanomaterials in constructed wetlands: prospection and future research perspectives**

Metallic engineered nanomaterials (ENMs) undergo various transformations in the environment which affect their fate, toxicity and bioavailability. Although constructed wetlands (CWs) are applied as treatment systems for waste streams potentially containing metallic ENMs, little is known about the fate and effects of ENMs in CWs. Hence, literature data from related fields such as activated sludge wastewater treatment and natural wetlands is used to predict the fate and effects of ENMs in CWs and to analyze the risk of nanomaterials being released from CWs into surface waters. The ENMs are likely to reach the CW (partly) transformed and the transformations will continue in the CW. The main transformation processes depend on the type of ENM and the ambient environmental conditions in the CW. In general, ENMs are expected to undergo sorption onto (suspended) organic matter and plant roots. Although the risk of ENMs being released at high concentrations from CWs is estimated low, caution is warranted because of the estimated rise in the production of these materials. As discharge of (transformed) ENMs from CWs during normal operation is predicted to be low, future research should rather focus on the effects of system malfunctions (e.g. short-circuiting). Efficient retention in the CW and increasing production volumes in the future entail increasing concentrations within the CW substrate and further research needs to address possible adverse effects caused.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Laboratory of Industrial Water and Ecotechnology, Universiteit Gent, Laboratory of Analytical Chemistry and Applied Ecochemistry, Laboratory of Chemistry and Bioengineering, Royal Military College of Canada

Contributors: Auvinen, H., Gagnon, V., Rousseau, D. P. L., du Laing, G.

Number of pages: 16

Pages: 207–222

Publication date: 2017

Peer-reviewed: Yes

Early online date: 5 Apr 2017

#### **Publication information**

Journal: Reviews in Environmental Science and Bio-Technology

Volume: 16

Issue number: 2

ISSN (Print): 1569-1705

Ratings:

Scopus rating (2017): CiteScore 8.5 SJR 1.615 SNIP 2.383

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Applied Microbiology and Biotechnology, Waste Management and Disposal, Pollution

Keywords: Discharge, Effluent, Nanoparticle, Transformation, TSS, Wastewater

DOIs:

10.1007/s11157-017-9427-0

Source: Scopus

Source ID: 85021244022

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

### **Finding H<sub>2</sub>SO<sub>4</sub>-H<sub>2</sub>O nucleation rates in high H<sub>2</sub>SO<sub>4</sub> concentrations**

#### **General information**

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group

Contributors: Olin, M., Kausiala, O., Alanen, J., Rönkkö, T., Dal Maso, M.

Number of pages: 4

Pages: 476-479

Publication date: 2017

#### **Host publication information**

Title of host publication: Proceedings of the 20th International Conference on Nucleation and Atmospheric Aerosols

Publisher: Aerosolitutkimusseura r.y., Finnish Association for Aerosol Research c/o University of Helsinki, Department of Physics

Editors: Halonen, R., Nikandrova, A., Kontkanen, J., Enroth, J. A., Vehkamäki, H.

ISBN (Print): 978-952-7091-84-5

ISBN (Electronic): 978-952-7091-85-2

#### Publication series

Name: Report Series in Aerosol Science

Publisher: Aerosolitutkimusseura r.y.

No.: 200

ISSN (Electronic): 0784-3496

ASJC Scopus subject areas: Pollution

URLs:

<http://www.atm.helsinki.fi/FAAR/reportseries/rs-200.pdf>

#### Bibliographical note

INT=fys,"Kausiala, O."

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific

#### Indoor thermal environment, air exchange rates, and carbon dioxide concentrations before and after energy retro fits in Finnish and Lithuanian multi-family buildings

Impacts of energy retrofits on indoor thermal environment, i.e. temperature (T) and relative humidity (RH), as well as ventilation rates and carbon dioxide (CO<sub>2</sub>) concentrations, were assessed in 46 Finnish and 20 Lithuanian multi-family buildings, including 39 retrofitted case buildings in Finland and 15 in Lithuania (the remaining buildings were control buildings with no retrofits). In the Finnish buildings, high indoor T along with low RH levels was commonly observed both before and after the retrofits. Ventilation rates (l/s per person) were higher after the retrofits in buildings with mechanical exhaust ventilation than the corresponding values before the retrofits. Measured CO<sub>2</sub> levels were low in vast majority of buildings. In Lithuania, average indoor T levels were low before the retrofits and there was a significant increase in the average T after the retrofits. In addition, average ventilation rate was lower and CO<sub>2</sub> levels were higher after the retrofits in the case buildings (N = 15), both in apartments with natural and mixed ventilation. Based on the results, assessment of thermal conditions and ventilation rates after energy retrofits is crucial for optimal indoor environmental quality and energy use.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Kaunas University of Technology, National Public Health Institute

Contributors: Leivo, V., Prasauskas, T., Du, L., Turunen, M., Kiviste, M., Aaltonen, A., Martuzevicius, D., Haverinen-Shaughnessy, U.

Number of pages: 9

Pages: 398-406

Publication date: 2017

Peer-reviewed: Yes

#### Publication information

Journal: Science of the Total Environment

Volume: 621

ISSN (Print): 0048-9697

Ratings:

Scopus rating (2017): CiteScore 7.5 SJR 1.546 SNIP 1.68

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Environmental Chemistry, Waste Management and Disposal, Pollution

Keywords: Air exchange rate, CO concentration, Energy retrofit, Multi-family buildings, Thermal environment

Electronic versions:

STOTEN\_FINAL\_revision. Embargo ended: 27/11/19

DOIs:

10.1016/j.scitotenv.2017.11.227

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911196077>. Embargo ended: 27/11/19

Source: Scopus

Source ID: 85034947532

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

#### Performance of ventilation filtration technologies on characteristic traffic related aerosol down to nanocluster size

Near traffic routes and urban areas, the outdoor air particle number concentration is typically dominated by ultrafine particles. These particles can enter into the nearby buildings affecting the human exposure on ultrafine particles indoors. In this study, we demonstrate an aerosol generation system which mimics the characteristic traffic related aerosol. The aerosol generation system was used to determine the size-resolved particle filtration efficiencies of five typical commercial

filters in the particle diameter range of 1.3–240 nm. Two different HEPA filters were observed to be efficient in all particle sizes. A fibrous filter (F7) was efficient at small particle sizes representing the nucleation mode of traffic related aerosol, but its efficiency decreased down to 60% with the increasing particle size. In contrast, the filtration efficiency of an electrostatic precipitator (ESP) increased as a function of the particle size, being more efficient for the soot mode of traffic related aerosol than for the nucleation mode. An electret filter with a charger was relatively efficient (filtration efficiency >85%) at all the observed particle sizes. The HEPA, F7 and electret filters were found to practically remove the particles/nanoclusters smaller than 3 nm. All in all, the filtration efficiencies were observed to be strongly dependent on the particle size and significant differences were found between different filters. Based on these results, we suggest that the particulate filter test standards should be extended to cover the ultrafine particles, which dominate the particle concentrations in outdoor air and are hazardous for public health.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, VTT Technical Research Centre of Finland

Contributors: Karjalainen, P., Saari, S., Kuuluvainen, H., Kalliohaka, T., Taipale, A., Rönkkö, T.

Number of pages: 11

Pages: 1398-1408

Publication date: 2017

Peer-reviewed: Yes

#### Publication information

Journal: Aerosol Science and Technology

Volume: 51

Issue number: 12

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2017): CiteScore 3.6 SJR 0.875 SNIP 0.958

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

Electronic versions:

ast\_v8\_04072017\_TUTCRIS. Embargo ended: 7/08/18

DOIs:

10.1080/02786826.2017.1356904

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712192401>. Embargo ended: 7/08/18

Source: Scopus

Source ID: 85027077005

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

#### Improving urban air quality measurements by a diffusion charger based electrical particle sensors: A field study in Beijing, China

High aerosol loadings contribute significantly to the air quality problems of Asian megacities. To address this, monitoring data for aerosol mass and number that is spatially and temporally of high resolution is needed, while the cost of obtaining such data remains high. Here, we present a field study in a polluted megacity, Beijing, using a diffusion-chargebased electrical aerosol sensor, the Pegasor PPS-M, which is a robust and comparatively low-cost instrument for the monitoring of both aerosol mass and number simultaneously. We present data over several months in the year 2014, and for varying aerosol size distributions, and analyze the performance against particle number and mass (volume) measured using a wide range particle sizer (WPS) and beta-attenuation-based PM<sub>2.5</sub> observations. We show that using a single trap voltage, the PPS-M correlates well with particle mass, but not so well with particle number due to the variability in particle size distributions. However, the instrument response to number was improved by running the instrument with a variable trap voltage, and using the ratio of the different signals to gain information on the particle average volume. With this method, we were able to improve the correlation of the PPS-M; with the observed particle number from  $R = 0.14$  to  $R = 0.72$  for the measurement time period. Altogether, the PPS-M instrument displayed robustness and low maintenance requirements, and it showed good correlation with the other instruments in this study.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research area: Aerosol Physics, Collaborative Innovation Center of Atmospheric Environment and Equipment Technology, Pegasor Oyj

Contributors: Dal Maso, M., Gao, J., Järvinen, A., Li, H., Luo, D., Janka, K., Rönkkö, T.

Number of pages: 11

Pages: 3001-3011

Publication date: 1 Dec 2016

Peer-reviewed: Yes

### Publication information

Journal: Aerosol and Air Quality Research

Volume: 16

Issue number: 12

ISSN (Print): 1680-8584

Ratings:

Scopus rating (2016): CiteScore 4.1 SJR 0.95 SNIP 1.159

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution

Keywords: Aerosol instrumentation, China air quality, Diffusion charging, Urban aerosol

URLs:

[http://www.aaqr.org/Doi.php?id=3\\_AAQR-15-09-OA-0546](http://www.aaqr.org/Doi.php?id=3_AAQR-15-09-OA-0546)

Source: Scopus

Source ID: 85002251340

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

### Methodological approaches for fractionation and speciation to estimate trace element bioavailability in engineered anaerobic digestion ecosystems: An overview

Optimal supply of trace elements (TE) is a prerequisite for microbial growth and activity in anaerobic digestion (AD) bioprocesses. However, the required concentrations and ratios of essential TE for AD biotechnologies strongly depend on prevailing operating conditions as well as feedstock composition. Furthermore, TE in AD bioreactors undergo complex physicochemical reactions and may be present as free ions, complex bound or as precipitates depending on pH, or on the presence of sulfur compounds or organic macromolecules. To overcome TE deficiency, various commercial mineral products are typically applied to AD processes. The addition of heavy metals poses the risk of overdosing operating systems, which may be toxic to microbial consortia and ultimately the environment. Adequate supplementation, therefore, requires appropriate knowledge not only about the composition, but also on the speciation and bioavailability of TE. However, very little is yet fully understood on this specific issue. Evaluations of TE typically only include the measurement of total TE concentrations but do not consider the chemical forms in which TE exist. Thus detailed information on bioavailability and potential toxicity cannot be provided. This review provides an overview of the state of the art in approaches to determine bioavailable TE in anaerobic bioprocesses, including sequential fractionation and speciation techniques. Critical aspects and considerations, including with respect to sampling and analytical procedures, as well as mathematical modeling, are examined. The approaches discussed in this review are based on our experiences and on previously published studies in the context of the "COST Action 1302: European Network on Ecological Roles of Trace Metals in Anaerobic Biotechnologies."

### 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, Université Paris-Est, Groupement de Recherche Eau Sol Environnement, Wageningen University and Research Centre, Linköping University, Campus Universidad Pablo de Olavide, Federal Institute of Hydrology, University of Birmingham, Université Reims Champagne Ardenne, Swedish University of Agricultural Sciences, Univ Porto, Universidade do Porto, Fac Med, Dept Med Imaging, Centro Ricerche Produzioni Animali (CRPA), ENEA/CREATE/Università Degli Studi Napoli Federico II, University of Cassino and Southern Lazio, BIOENERGY 2020 GmbH, Natl. University of Ireland, Galway

Contributors: van Hullebusch, E. D., Guibaud, G., Simon, S., Lenz, M., Yekta, S. S., Feroso, F. G., Jain, R., Duyster, L., Roussel, J., Guillon, E., Skyllberg, U., Almeida, C. M. R., Pechaud, Y., Garuti, M., Frunzo, L., Esposito, G., Carliell-Marquet, C., Ortner, M., Collins, G.

Number of pages: 43

Pages: 1324-1366

Publication date: 17 Aug 2016

Peer-reviewed: Yes

### Publication information

Journal: Critical Reviews in Environmental Science and Technology

Volume: 46

Issue number: 16

ISSN (Print): 1064-3389

Ratings:

Scopus rating (2016): CiteScore 9.5 SJR 1.75 SNIP 2.153

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Water Science and Technology, Waste Management and Disposal, Pollution

Keywords: Anaerobic digestion, analytical methods, bioavailability, fractionation, speciation, trace elements

DOIs:

10.1080/10643389.2016.1235943

Source: Scopus

Source ID: 84991813353

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

### **Real-time effective density monitor (DENSMO) for aerosol nanoparticle production**

A new instrument, density monitor (DENSMO), for aerosol particle size distribution characterization and monitoring has been developed. DENSMO is operationally simple and capable of measuring the effective density as well as the aerodynamic and the mobility median diameters with a time resolution of 1 s, from unimodal particle size distributions. The characterization is performed with a zeroth order mobility analyzer in series with a low pressure impactor and a filter stage. The operation of DENSMO was investigated with sensitivity analysis and, based on the results, optimal operation parameters were determined. DENSMO was also compared, in lab test measurements, against a reference method with several particle materials with bulk densities from 0.92 to 10.5 g/cm<sup>3</sup>. The results show that the deviation from the reference method was less than 25% for suitable materials.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis

Contributors: Juuti, P., Arffman, A., Rostedt, A., Harra, J., Mäkelä, J. M., Keskinen, J.

Number of pages: 10

Pages: 487-496

Publication date: 3 May 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Aerosol Science and Technology

Volume: 50

Issue number: 5

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2016): CiteScore 3.7 SJR 0.992 SNIP 0.901

Original language: English

ASJC Scopus subject areas: Materials Science(all), Environmental Chemistry, Pollution

DOIs:

10.1080/02786826.2016.1168511

Source: Scopus

Source ID: 84964337077

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

### **Effect of temperature on selenium removal from wastewater by UASB reactors**

The effect of temperature on selenium (Se) removal by upflow anaerobic sludge blanket (UASB) reactors treating selenate and nitrate containing wastewater was investigated by comparing the performance of a thermophilic (55 °C) versus a mesophilic (30 °C) UASB reactor. When only selenate (50 µM) was fed to the UASB reactors (pH 7.3; hydraulic retention time 8 h) with excess electron donor (lactate at 1.38 mM corresponding to an organic loading rate of 0.5 g COD L<sup>-1</sup> d<sup>-1</sup>), the thermophilic UASB reactor achieved a higher total Se removal efficiency (94.4 ± 2.4%) than the mesophilic UASB reactor (82.0 ± 3.8%). When 5000 µM nitrate was further added to the influent, total Se removal was again better under thermophilic (70.1 ± 6.6%) when compared to mesophilic (43.6 ± 8.8%) conditions. The higher total effluent Se concentration in the mesophilic UASB reactor was due to the higher concentrations of biogenic elemental Se nanoparticles (BioSeNPs). The shape of the BioSeNPs observed in both UASB reactors was different: nanospheres and nanorods, respectively, in the mesophilic and thermophilic UASB reactors. Microbial community analysis showed the presence of selenate respirers as well as denitrifying microorganisms.

#### **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, Institute for Water Education, UNESCO-IHE Institute for Water Education, Dept. of Civil-Environmental Engineering and Architecture, DICAAR, Université Paris-Est, UPEM, Department of Biochemical Engineering and Biotechnology, Indian Institute of Technology, Delhi, India, IRD UMR 206

Contributors: Dessi, P., Jain, R., Singh, S., Seder-Colomina, M., van Hullebusch, E. D., Rene, E. R., Ahammad, S. Z., Carucci, A., Lens, P. N. L.

Number of pages: 9  
Pages: 146-154  
Publication date: 1 May 2016  
Peer-reviewed: Yes

#### Publication information

Journal: Water Research  
Volume: 94  
ISSN (Print): 0043-1354  
Ratings:

Scopus rating (2016): CiteScore 10.9 SJR 2.663 SNIP 2.583

Original language: English

ASJC Scopus subject areas: Water Science and Technology, Waste Management and Disposal, Pollution, Ecological Modelling

Keywords: Nitrate, Selenate, Selenium nanoparticles, Thermophilic, UASB

DOIs:

10.1016/j.watres.2016.02.007

Source: Scopus

Source ID: 84959326965

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

#### Improving the signal-to-noise ratio of Faraday cup aerosol electrometer based aerosol instrument calibrations

This study introduces a new bipolar measurement routine for particle number concentration calibrations. In the new routine, singly-charged particles of opposite polarities are measured sequentially with a Faraday cup aerosol electrometer (FCAE). We compared the bipolar routine to the traditional FCAE routine, where particle signal and electrometer offset are measured in turns, by calibrating a single CPC on a wide particle number concentration range (from 1000 to 77,000 cm<sup>-3</sup>) with both routines. By increasing the signal-to-noise ratio, the bipolar routine decreases the type A uncertainty of the calibration especially at low particle concentrations. In practice, the new routine enables shortening the measurement times by 80% at the lowest particle concentrations which, in practice, corresponds to hours.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Aerosol Physics, Aerosol Physics Laboratory

Contributors: Pihlava, K., Keskinen, J., Yli-Ojanperä, J.

Number of pages: 7

Pages: 373-379

Publication date: 2 Apr 2016

Peer-reviewed: Yes

#### Publication information

Journal: Aerosol Science and Technology  
Volume: 50

Issue number: 4

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2016): CiteScore 3.7 SJR 0.992 SNIP 0.901

Original language: English

ASJC Scopus subject areas: Materials Science(all), Environmental Chemistry, Pollution

DOIs:

10.1080/02786826.2016.1153035

Source: Scopus

Source ID: 84962883045

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

#### Release and characteristics of fungal fragments in various conditions

Intact spores and submicrometer size fragments are released from moldy building materials during growth and sporulation. It is unclear whether all fragments originate from fungal growth or if small pieces of building materials are also aerosolized as a result of microbial decomposition. In addition, particles may be formed through nucleation from secondary metabolites of fungi, such as microbial volatile organic compounds (MVOCs). In this study, we used the elemental composition of particles to characterize the origin of submicrometer fragments released from materials contaminated by fungi. Particles from three fungal species (*Aspergillus versicolor*, *Cladosporium cladosporioides* and *Penicillium brevicompactum*), grown on agar, wood and gypsum board were aerosolized using the Fungal Spore Source Strength Tester (FSSST) at three air velocities (5, 16 and 27 m/s). Released spores (optical size,  $d_p \geq 0.8 \mu\text{m}$ ) and fragments ( $d_p \leq 0.8 \mu\text{m}$ ) were counted using direct-reading optical aerosol instruments. Particles were also collected on



filters, and their morphology and elemental composition analyzed using scanning electron microscopes (SEMs) coupled with an Energy-Dispersive X-ray spectroscopy (EDX). Among the studied factors, air velocity resulted in the most consistent trends in the release of fungal particles. Total concentrations of both fragments and spores increased with an increase in air velocity for all species whereas fragment-spore (F/S) ratios decreased. EDX analysis showed common elements, such as C, O, Mg and Ca, for blank material samples and fungal growth. However, N and P were exclusive to the fungal growth, and therefore were used to differentiate biological fragments from non-biological ones. Our results indicated that majority of fragments contained N and P. Because we observed increased release of fragments with increased air velocities, nucleation of MVOCs was likely not a relevant process in the formation of fungal fragments. Based on elemental composition, most fragments originated from fungi, but also fragments from growth material were detected.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Aerosol Physics, Research area: Optics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Department of Environmental Science, University of Eastern Finland, Ita-Suomen yliopisto, SIB Labs, Department of Environmental Health, University of Cincinnati

Contributors: Mensah-Attipoe, J., Saari, S., Veijalainen, A. M., Pasanen, P., Keskinen, J., Leskinen, J. T. T., Reponen, T.

Number of pages: 10

Pages: 234-243

Publication date: 15 Mar 2016

Peer-reviewed: Yes

#### Publication information

Journal: Science of the Total Environment

Volume: 547

ISSN (Print): 0048-9697

Ratings:

Scopus rating (2016): CiteScore 6.9 SJR 1.652 SNIP 1.869

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution, Waste Management and Disposal, Environmental Engineering

Keywords: Air velocity, Elemental analysis, Energy Dispersive X-ray spectroscopy, Fragments, Scanning electron microscope

DOIs:

10.1016/j.scitotenv.2015.12.095

Source: Scopus

Source ID: 84953924447

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

#### HPLC-SEC: a new approach to characterise complex wastewater effluents

This work investigates the use of HPLC-SEC to characterise dissolved organic matter (DOM) of complex wastewater effluents. A silica-based column, sodium acetate eluent and multiple detections were employed: UV-254 absorbance for humic-type, and tryptophan-like (Ex/Em = 270/355) and tyrosine-like (Ex/Em = 270/310) fluorescence for protein type compounds. Effects of eluent pH, eluent ionic strength and injection volume on separation efficiency were tested. Humic-type and protein-type fractions were clearly differentiated and eluted within and out of calibration range. Eluent ionic strength had the greatest influence on global resolution; the lowest eluent concentration of 0.01 M produced the best separation for all wastewater effluents tested at any detection. UV-254 absorbance was higher at neutral and basic eluent pH while tryptophan-like fluorescence depended on the sample composition rather than on the eluent pH or ionic strength. Tyrosine-like fluorescence decreased significantly with the increase of eluent ionic strength. Accurate molecular weight measurements could not be done, the separation being influenced by secondary interactions, but could be approximated using separate calibrations with sodium salts of polystyrene-sulfonates and protein standards. The results show that this method is suitable for determining DOM in wastewater at low eluent concentrations (up to 0.03 M), at neutral or slightly basic pH.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Degree Programme in Energy and Environmental Engineering, Tampere University of Applied Sciences, Department of Biological and Environmental Science, University of Jyväskylä

Contributors: Szabo, H. M., Lepistö, R., Tuhkanen, T.

Number of pages: 14

Pages: 257-270

Publication date: 19 Feb 2016

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Environmental Analytical Chemistry

Volume: 96

Issue number: 3

ISSN (Print): 0306-7319

Ratings:

Scopus rating (2016): CiteScore 2.5 SJR 0.368 SNIP 0.501

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Environmental Chemistry, Soil Science, Health, Toxicology and Mutagenesis, Pollution, Waste Management and Disposal, Water Science and Technology, Public Health, Environmental and Occupational Health

Keywords: DOM, Fluorescence, greywater, humic, ionic strength, proteins, tryptophan, UV-254

DOIs:

10.1080/03067319.2016.1150463

### Bibliographical note

EXT="Tuhkanen, Tuula"

Source: Scopus

Source ID: 84961206778

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

### Identification of single microbial particles using electro-dynamic balance assisted laser-induced breakdown and fluorescence spectroscopy

Online characterization of fungal and bacterial spores is important in various applications due to their health and climatic relevance. The aim of this study was to demonstrate the capability of the combination of electro-dynamic balance assisted laser-induced breakdown spectroscopy (LIBS) and laser-induced fluorescence (LIF) techniques for the online detection of single fungal spores (*Aspergillus versicolor* and *Penicillium brevicompactum*) and bacteria (*Bacillus aureus*). The method enabled sensitive and repeatable LIBS analysis of common elemental components (Ca, Na, and K) from single microbial particles for the first time. Significant differences in the concentrations of these elements were observed between the species, e.g., bacterial spores had over three orders of magnitude higher Ca concentration ( $2 \times 10^{-12}$  g/particle) compared to fungal spores ( $3-5 \times 10^{-16}$  g/particle). The LIF analysis has previously been used to distinguish bioaerosols from other aerosols due to their fluorescence ability. This study showed that combination of LIF and LIBS analysis is a promising tool for identification of different bioaerosol particle types.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Aerosol Physics, Research area: Optics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Department of Environmental Science, Ita-Suomen yliopisto, Department of Environmental Health, University of Cincinnati

Contributors: Saari, S., Järvinen, S., Reponen, T., Mensah-Attipoe, J., Pasanen, P., Toivonen, J., Keskinen, J.

Number of pages: 7

Pages: 126-132

Publication date: 1 Feb 2016

Peer-reviewed: Yes

### Publication information

Journal: Aerosol Science and Technology

Volume: 50

Issue number: 2

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2016): CiteScore 3.7 SJR 0.992 SNIP 0.901

Original language: English

ASJC Scopus subject areas: Materials Science(all), Environmental Chemistry, Pollution

DOIs:

10.1080/02786826.2015.1134764

Source: Scopus

Source ID: 84958169635

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

### **Triboelectric charging of fungal spores during resuspension and rebound**

The triboelectric charging of fungal spores was experimentally characterized during rebound and resuspension. A fungal spore source strength tester (FSSST) was used as a primary aerosol generator for spores of three fungal species and two powders (silicon carbide and silver). The critical velocity of rebound was determined using a variable nozzle area impactor (VNAI), and the charging state of particles after resuspension and rebound was measured using the FSSST, different impactor setups, electrometers, and optical particle counters. In the impactor setups and the FSSST, five different surface materials relevant for indoor environments were used (steel, glass, polystyrene, paper, and polytetrafluoroethylene). The critical velocity of rebound was determined to be 0.57 m/s for fungal spores, which is relatively low compared to silicon carbide and previous results for micron-sized aerosol particles. Based on the rebound impactor measurements, we were able to define the crucial parameters of charge transfer for different particle-surface material pairs. A contact charge parameter, which describes the triboelectric charging during rebound, was found to have a negative correlation with the charging state of the particles after the resuspension from an impactor. This connects the triboelectric charging during rebound and resuspension to each other. Based on the contact charge parameter values, quantified triboelectric series could be formed. The results of this work show that fungal spores can be charged both positively and negatively during rebound and resuspension depending on the fungal species and surface material.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Aerosol Physics, Research area: Optics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, University of Eastern Finland, University of Cincinnati

Contributors: Kuuluvainen, H., Saari, S., Mensah-Attipoe, J., Arffman, A., Pasanen, P., Reponen, T., Keskinen, J.

Number of pages: 11

Pages: 187-197

Publication date: 1 Feb 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Aerosol Science and Technology

Volume: 50

Issue number: 2

ISSN (Print): 0278-6826

Ratings:

Scopus rating (2016): CiteScore 3.7 SJR 0.992 SNIP 0.901

Original language: English

ASJC Scopus subject areas: Materials Science(all), Environmental Chemistry, Pollution

DOIs:

10.1080/02786826.2016.1141164

Source: Scopus

Source ID: 84958163401

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

### **Downstream integration of microalgae harvesting and cell disruption by means of cationic surfactant-decorated Fe<sub>3</sub>O<sub>4</sub> nanoparticles**

Microalgal biofuel, albeit an exciting potential fossil-fuel-replacement candidate, still requires the development of more advanced downstream processing technology for its price competitiveness. The major challenge in a microalgae-based biorefinery is the efficient separation of microalgae from low-concentration culture broth. The post-harvesting cell-disruption step necessary to render microalgae suitable for lipid extraction, moreover, further raises energy consumption and cost. For the mitigation of biorefinery complexity and costs, we suggest herein a new scheme that integrates the critical downstream processes (harvesting and cell disruption) by means of cationic surfactant-decorated Fe<sub>3</sub>O<sub>4</sub> nanoparticles. The cationic surfactants' quaternary ammonium heads play an important role in not only flocculating negatively charged microalgae but also weakening thick cell walls. In the present study, the harvesting efficiency and cell-damaging effects of three cationic surfactants - cetrimonium bromide (CTAB), cetylpyridinium chloride (CPC), and cetylpyridinium bromide (CPB) - were evaluated. The CTAB-decorated Fe<sub>3</sub>O<sub>4</sub> nanoparticles, which were found to be the most effective, achieved a 96.6% microalgae harvesting efficiency at a dosage of 0.46 g particle per g cell. Next, for the purposes of magnetic nanoparticle recycling and high-purity microalgal biomass obtainment, microalgae detachment from microalgae-Fe<sub>3</sub>O<sub>4</sub> flocs was performed by addition of an anionic surfactant, sodium dodecyl sulfate (SDS). The detached CTAB-decorated Fe<sub>3</sub>O<sub>4</sub> nanoparticles showed a steady reuse efficiency of about 80%. Furthermore, microalgae harvesting by CTAB-decorated Fe<sub>3</sub>O<sub>4</sub> nanoparticles could contribute to a great improvement in the total extracted lipid content and greener wet extraction without the additional energy-intensive cell-disruption step, thus demonstrating the cell-disruption ability of CTAB-decorated Fe<sub>3</sub>O<sub>4</sub> nanoparticles.

#### **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, National NanoFab Center, Korea Institute of Energy Research, Korea Advanced Institute of Science and Technology (KAIST), Chungnam National University

Contributors: Seo, J. Y., Ramasamy, P., Kim, B., Seo, J. C., Park, J. Y., Na, J. G., Jeon, S. G., Park, S. B., Lee, K., Oh, Y. K.

Number of pages: 9

Pages: 3981-3989

Publication date: 2016

Peer-reviewed: Yes

#### Publication information

Journal: Green Chemistry

Volume: 18

Issue number: 14

ISSN (Print): 1463-9262

Ratings:

Scopus rating (2016): CiteScore 13.8 SJR 2.598 SNIP 2.029

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution

DOIs:

10.1039/c6gc00904b

Source: Scopus

Source ID: 84978832811

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

#### Sorption of zinc onto elemental selenium nanoparticles immobilized in *Phanerochaete chrysosporium* pellets

The use of a novel hybrid biosorbent, elemental selenium nanoparticles ( $n\text{Se}^0$ ) immobilized in pellets of *Phanerochaete chrysosporium*, to remove Zn from aqueous solutions was investigated. Fungal pellets containing  $n\text{Se}^0$  ( $n\text{Se}^0$ -pellets) showed to be better biosorbents as they removed more Zn ( $88.1 \pm 5.3\%$ ) compared to Se-free fungal pellets ( $56.2 \pm 2.8\%$ ) at pH 4.5 and an initial Zn concentration of  $10 \text{ mg L}^{-1}$ . The enhanced sorption capacity of  $n\text{Se}^0$ -pellets was attributed to a higher concentration of sorption sites resulting in a more negative surface charge density, as determined by analysis of the potentiometric titration data. Fourier transform infrared spectroscopy (FT-IR) analysis of fungal pellets prior to and after being loaded with Zn showed the functional groups, including hydroxyl and carboxyl groups, involved in the sorption process. The experimental data indicated that the sorption rate of the  $n\text{Se}^0$ -pellets fitted well to the pseudo-second order kinetic model ( $R^2 = 0.99$ ), and the sorption isotherm was best represented by the Sips model (Langmuir-Freundlich) with heterogeneous factor  $n = 1$  ( $R^2 = 0.99$ ), which is equivalent to the Langmuir model. Operational advantages of fungal pelleted reactors and the Zn removal efficiencies achieved by  $n\text{Se}^0$ -pellets under mild acidic conditions make  $n\text{Se}^0$ -pellet based bioreactors an efficient biosorption process.

#### 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, Hydraulic and Environmental Engineering (IHE) Inst. for Water Education, Environmental Engineering and Water Technology Department, Université Paris-Est

Contributors: Espinosa-Ortiz, E. J., Shakya, M., Jain, R., Rene, E. R., van Hullebusch, E. D., Lens, P. N. L.

Number of pages: 12

Pages: 21619-21630

Publication date: 2016

Peer-reviewed: Yes

#### Publication information

Journal: Environmental Science and Pollution Research

Volume: 23

Issue number: 21

ISSN (Print): 0944-1344

Ratings:

Scopus rating (2016): CiteScore 4 SJR 0.891 SNIP 1.127

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Medicine(all), Pollution, Health, Toxicology and Mutagenesis

Keywords: Fungal pellets, Hybrid biosorbent, *Phanerochaete chrysosporium*, Selenium nanoparticles, Zinc biosorption

DOIs:

10.1007/s11356-016-7333-6

Source: Scopus

Source ID: 84982179903

### **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<sub>4</sub> kg<sup>-1</sup> 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<sub>4</sub> kg<sup>-1</sup> VS for untreated biosludge and was increased by 77% (138 NL CH<sub>4</sub> kg<sup>-1</sup> 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

### **Power generation in fed-batch and continuous up-flow microbial fuel cell from synthetic wastewater**

Up-flow bioreactors have the advantages of retaining very high cell density and having high mass transfer efficiency. The recirculation rate could improve the up-flow rate in up-flow bioreactor. A two-chamber UFMFC (up-flow microbial fuel cell) is constructed with flat graphite electrodes and anion exchange membrane for electricity generation. The anode chamber is seeded with compost culture enriched on xylose and operated on synthetic wastewater with 0.5 g/L xylose, external resistance of 100 Ω, at pH 7.0 and 37 °C in fed-batch mode. The cathode chamber in the top of the UFMFC is filled with potassium ferricyanide (pH 7.0) as the electron acceptor. The effects of different recirculation rates of 1.2, 2.4, 4.8 and 7.2 RV (reactor-volumes)/h to increase the mass transfer and electricity production are determined in fed-batch mode. At a recirculation rate of 4.8 RV/h, a power density of 356 ± 24 mW/m<sup>2</sup> with CE (coulombic efficiency) of 21.3 ± 1.0% is obtained. Decreasing HRT (hydraulic retention time) could improve the electricity production performance of UFMFC in continuous mode. The power generation is increased to 372 ± 20 mW/m<sup>2</sup>, while CE remains at 13.4 ± 0.5% with HRT of 1.7 d and optimum recirculation rate of 4.8 RV/h on continuous mode. Microbial communities were characterized with PCR (polymerase chain reaction) - DGGE (denaturing gradient gel electrophoresis). In the end of the experiment, the biofilm contained both fermenting and exoelectrogenic bacteria, while fermenting and nitrate-reducing bacteria were mainly

present in the anodic solutions. Moreover, some changes occurred in the microbial communities of the anodic solutions when the MFCs were switched from fed-batch to continuous mode, while the differences were minor between different recirculation rates in fed-batch mode.

#### 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: Lay, C., Kokko, M. E., Puhakka, J. A.

Number of pages: 7

Pages: 235-241

Publication date: 1 Nov 2015

Peer-reviewed: Yes

#### Publication information

Journal: Energy

Volume: 91

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2015): CiteScore 7.4 SJR 2.22 SNIP 2.027

Original language: English

ASJC Scopus subject areas: Energy(all), Pollution

Keywords: Continuous mode, Microbial fuel cell, Recirculation rate, Two chamber, Up-flow, Xylose

DOIs:

10.1016/j.energy.2015.08.029

URLs:

<http://www.scopus.com/inward/record.url?scp=84946031190&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84946031190

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

### Modelling new particle formation and growth using combined power law and log-normal distribution model

#### General information

Publication status: Published

MoE publication type: D3 Professional conference proceedings

Organisations: Department of Physics, Research area: Aerosol Physics

Contributors: Olin, M., Dal Maso, M.

Publication date: 8 Sep 2015

#### Host publication information

Title of host publication: EAC 2015, European Aerosol Conference

Place of publication: Milan, Italy

Publisher: Italian Aerosol Society

ASJC Scopus subject areas: Pollution

URLs:

<http://www.eac2015.it/> (Conference website)

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Professional

### The critical velocity of rebound determined for sub-micron silver particles with a variable nozzle area impactor

The critical velocity of rebound was determined for spherical silver aerosol particles in the size range of 20-1000. nm. A novel instrument, a variable nozzle area impactor, was especially designed for measuring the particle-surface interaction as a function of the particle impact velocity. The experimental results were combined with a numerical model in order to obtain the impact velocities. The experiments were carried out using a plain aluminum collection substrate in the impactor. Our results show that the critical velocity of rebound decreases from 14 to 0.022. m/s as the particle size increases from 20 to 1000. nm. Furthermore, the critical velocity was found to be proportional to the power of -1.6 of the particle size, instead of the theoretical inverse proportionality. This result is in line with the previous studies for micron-sized particles. In the nanoparticle size range, the obtained values are approximately 3-10 times greater than the recent literature values. This discrepancy can most likely be explained by the different surface materials. All in all, our results give valuable information about the particle-surface interactions in the sub-micron size range.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Aerosol Physics, Research group: Aerosol Synthesis, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Engineering materials science and solutions (EMASS), Urban circular bioeconomy (UrCirBio)

Contributors: Arffman, A., Kuuluvainen, H., Harra, J., Vuorinen, O., Juuti, P., Yli-Ojanperä, J., Mäkelä, J., Keskinen, J.

Number of pages: 12

Pages: 32-43

Publication date: 1 Aug 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of Aerosol Science

Volume: 86

ISSN (Print): 0021-8502

Ratings:

Scopus rating (2015): CiteScore 4.4 SJR 1.071 SNIP 1.314

Original language: English

ASJC Scopus subject areas: Materials Science(all), Environmental Chemistry, Pollution

Keywords: Silver nanoparticle, Rebound, Critical velocity, Low-pressure impactor, LOW-PRESSURE IMPACTOR, ORGANIC AEROSOL-PARTICLES, NANOPARTICLES, BOUNCE, MONODISPERSE, FRAGMENTATION, RESOLUTION, SURFACES, CAPTURE, DENSITY

DOIs:

10.1016/j.jaerosci.2015.04.003

URLs:

<http://www.scopus.com/inward/record.url?scp=84928686591&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84928686591

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

### Experimental Investigation of Cyclic Variability on Combustion and Emissions of a High-Speed SI Engine

Cyclic combustion variability (CCV) is an undesirable characteristic of spark ignition (SI) engines, and originates from variations in gas motion and turbulence, as well as from differences in mixture composition and homogeneity in each cycle. In this work, the cycle to cycle variability on combustion and emissions is experimentally investigated on a high-speed, port fuel injected, spark ignition engine. Fast response analyzers were placed at the exhaust manifold, directly downstream of the exhaust valve of one cylinder, for the determination of the cycle-resolved carbon monoxide (CO) and nitric oxide (NO) emissions. A piezoelectric transducer, integrated in the spark-plug, was also used for cylinder pressure measurement. The impact of engine operating parameters, namely engine speed, load, equivalence ratio and ignition timing on combustion and emissions variability, was evaluated. The variations in mixture stoichiometry were found to have a strong effect on engine combustion variability. Rich cyclic mixture compositions exhibit lower coefficient of variation (COV) for the indicated mean effective pressure (IMEP) and NO emissions ( $COV_{NO}$ ) compared with lean mixtures. The mean value of CO emission was found to be mainly affected by stoichiometry while  $COV_{CO}$  is affected by lambda fluctuations. At higher engine loads, maximum cylinder pressure and IMEP are increased, while  $COV_{IMEP}$  decreased. Furthermore, ignition timing was found to strongly affect combustion and NO emissions, as it is related with early flame kernel development and thereby with flame propagation. Maximum braking torque (MBT) operation exhibits maximum IMEP and minimum  $COV_{IMEP}$ . Compared to MBT operating conditions, advanced ignition timing leads to higher maximum cylinder pressure, higher NO and  $COV_{NO}$ , while retarded ignition timings lead to lower maximum cylinder pressure, lower NO concentration and higher NO variability ( $COV_{NO}$ ).

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Urban circular bioeconomy (UrCirBio), Aristotle University of Thessaloniki, Laboratory of Applied Thermodynamics, Combustion Ltd

Contributors: Karvountzis-Kontakiotis, A., Ntziachristos, L., Samaras, Z., Dimaratos, A., Peckham, M.

Publication date: 14 Apr 2015

### Host publication information

Title of host publication: SAE 2015 World Congress and Exhibition

Volume: 2015-April

Publisher: SAE International

Edition: April

ASJC Scopus subject areas: Automotive Engineering, Safety, Risk, Reliability and Quality, Pollution, Industrial and Manufacturing Engineering

DOIs:

10.4271/2015-01-0742

URLs:

<http://www.scopus.com/inward/record.url?scp=84938319889&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84938319889

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

## Modelling particle distribution using combined power-law and log-normal distribution model

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research area: Aerosol Physics, Department of Physics

Contributors: Olin, M. P., Dal Maso, M. I.

Publication date: 12 Mar 2015

### Host publication information

Title of host publication: Proceedings of the NOSA-FAAR Symposium 2015

Place of publication: Kuopio, Finland

Publisher: Aerosolitutkimusseura r.y., Finnish Association for Aerosol Research c/o University of Helsinki, Department of Physics

ISBN (Electronic): 978-952-7091-17-3

ASJC Scopus subject areas: Pollution

URLs:

<http://www.atm.helsinki.fi/FAAR/reportseries/rs-165.pdf>

### Bibliographical note

xabstract

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

### Breaking dormancy: An energy-efficient means of recovering astaxanthin from microalgae

*Haematococcus pluvialis*, in the dormant aplanospore (cyst) status after 30 d of cultivation, accumulates high levels of a superpotent antioxidant, astaxanthin, which has been demonstrated to have enormous therapeutic benefits. However, owing to the robust structure of its trilayered cell wall, the recovery of astaxanthin from the cyst cells remains an energy-intensive process. In the present study, a novel strategy utilizing a short-period germination based on the natural life cycle of *H. pluvialis* was developed as an energy-efficient pretreatment for the extraction of astaxanthin using ionic liquids (ILs) as green solvents. The germination resulted in damage and deconstruction of the cyst cell wall, and thereby facilitated the extraction of astaxanthin by ILs at room temperature. By this natural pretreatment with 1-ethyl-3-methylimidazolium ethylsulfate for a very short reaction time of 1 min, a high astaxanthin yield of 19.5 pg per cell was obtained, which was about 82% of a conventional volatile organic solvent extraction by strong, 30 000 psi French-pressure-cell homogenization. The maximal astaxanthin-extraction yield from *H. pluvialis* cells was observed for 12-18 h germination. The germination rate furthermore could be improved by manipulating the nutritional composition (especially the nitrate concentration) of the culture medium. In light of these results, it can be posited that natural germination following the principles of green chemistry can be a uniquely simple method of robust microalgal cyst cell pretreatment and extraction of astaxanthin with room-temperature ILs.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Biomass and Waste Energy Laboratory, Korea Institute of Energy Research (KIER), Korea Institute of Energy Research

Contributors: Ramasamy, P., Lee, K., Lee, J., Oh, Y. K.

Number of pages: 9

Pages: 1226-1234

Publication date: 1 Feb 2015

Peer-reviewed: Yes

### Publication information

Journal: Green Chemistry

Volume: 17

Issue number: 2

ISSN (Print): 1463-9262

Ratings:

Scopus rating (2015): CiteScore 12.8 SJR 2.452 SNIP 1.901

Original language: English



ASJC Scopus subject areas: Environmental Chemistry, Pollution

DOIs:

10.1039/c4gc01413h

URLs:

<http://www.scopus.com/inward/record.url?scp=84922794041&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84922794041

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

### Seasonal and diurnal variations of fluorescent bioaerosol concentration and size distribution in the urban environment

A recently introduced fluorescence based real-time bioaerosol instrument, BioScout, and an ultraviolet aerodynamic particle sizer (UVAPS) were used to study fluorescent bioaerosol particles (FBAP) in the Helsinki metropolitan area, Finland, during winter and summer. Two FBAP modes at 0.5–1.5  $\mu\text{m}$  (fine) and 1.5–5  $\mu\text{m}$  (coarse) were detected during the summer, whereas the fine mode dominated in the winter. The concentration and proportion of the coarse FBAP was high in summer (0.028  $\text{\#/cm}^3$ , 23%) and low in winter (0.010  $\text{\#/cm}^3$ , 6%). Snow cover and low biological activity were assumed to be the main reasons for the low coarse FBAP concentration in the wintertime. Both the fine and the coarse FBAP fraction typically increased at nighttime during the summer. Correlations between the BioScout and the UVAPS were high with the coarse ( $R = 0.83$ ) and fine ( $R = 0.92$ ) FBAP. The BioScout showed 2.6 and 9.7 times higher detection efficiencies for the coarse and fine FBAP, respectively, compared to the UVAPS. A long-range transport episode of particles from Eastern Europe increased the fine FBAP concentration by over two orders of magnitude compared to the clean period in the winter, but these FBAP probably also included fluorescent non-biological particles. Correlation analysis indicates that local combustion sources did not generate fluorescent non-biological particles that can disturb fine FBAP counting. The results provide information that can be used to estimate health risks and climatic relevance of bioaerosols in the urban environment.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Urban circular bioeconomy (UrCirBio), Helsinki University, Helsinki Region Environmental Services Authority (HSY), Department of Environmental Sciences, Metropolia University of Applied Science, Atmospheric Composition Research, Finnish Meteorological Institute

Contributors: Saari, S., Niemi, J. V., Rönkkö, T., Kuuluvainen, H., Järvinen, A., Pirjola, L., Aurela, M., Hillamo, R., Keskinen, J.

Number of pages: 10

Pages: 572-581

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: Aerosol and Air Quality Research

Volume: 15

Issue number: 2

ISSN (Print): 1680-8584

Ratings:

Scopus rating (2015): CiteScore 3.9 SJR 1.002 SNIP 1.143

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution

Keywords: Bacteria, BioScout, Fluorescence, Fungal spores, UVAPS

DOIs:

10.4209/aaqr.2014.10.0258

URLs:

<http://www.scopus.com/inward/record.url?scp=84925957527&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84925957527

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

### Evaluating Particulate Emissions from a Flexible Fuel Vehicle with Direct Injection when Operated on Ethanol and Iso-butanol Blends

The relationship between ethanol and iso-butanol fuel concentrations and vehicle particulate matter emissions was investigated. This study utilized a gasoline direct injection (GDI) flexible fuel vehicle (FFV) with wall-guided fueling system tested with four fuels, including E10, E51, E83, and an iso-butanol blend at a proportion of 55% by volume. Emission measurements were conducted over the Federal Test Procedure (FTP) driving cycle on a chassis dynamometer with an emphasis on the physical and chemical characterization of particulate matter (PM) emissions. The results indicated that the addition of higher ethanol blends and the iso-butanol blend resulted in large reductions in PM mass, soot, and total

and solid particle number emissions. PM emissions for the baseline E10 fuel were characterized by a higher fraction of elemental carbon (EC), whereas the PM emissions for the higher ethanol blends were more organic carbon (OC) in nature. The higher ethanol blends and the iso-butanol blend showed lower concentrations of accumulation mode particles and size distributions shifted to smaller particle sizes compared to E10. In addition, the majority of trace elements and metals showed clear reductions with increasing alcohol content into gasoline.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Urban circular bioeconomy (UrCirBio), University of California, Riverside, University of California Transportation Center (UCTC, Aristotle University of Thessaloniki, Instrumentation and Control Systems

Contributors: Karavalakis, G., Short, D., Chen, V., Espinoza, C., Berte, T., Durbin, T., Asa-Awuku, A., Jung, H., Ntziachristos, L., Amanatidis, S., Bergmann, A.

Publication date: 13 Oct 2014

#### Host publication information

Title of host publication: SAE 2014 International Powertrains, Fuels and Lubricants Meeting, FFL 2014

Volume: 2014-October

Publisher: SAE International

ASJC Scopus subject areas: Automotive Engineering, Safety, Risk, Reliability and Quality, Pollution, Industrial and Manufacturing Engineering

DOIs:

10.4271/2014-01-2768

URLs:

<http://www.scopus.com/inward/record.url?scp=84938516224&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84938516224

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

### Simulation of the Formation Process of Diesel Exhaust Particle Emissions

#### General information

Publication status: Unpublished

MoE publication type: A4 Article in a conference publication

Organisations: Research area: Aerosol Physics, Department of Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group

Contributors: Olin, M. P., Arffman, A. S., Dal Maso, M. I., Keskinen, J. O., Rönkkö, T. S.

Publication date: 12 Mar 2014

#### Host publication information

Title of host publication: Physics Days 2014

Place of publication: Tampere, Finland

Publisher: Finnish Physical Society

ASJC Scopus subject areas: Pollution

URLs:

[http://webhotel2.tut.fi/fys/physicsdays/program/Physics\\_Days\\_2014\\_Proceedings.pdf](http://webhotel2.tut.fi/fys/physicsdays/program/Physics_Days_2014_Proceedings.pdf)

#### Bibliographical note

xabstract

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

### Tuberculosis transmission: Modelled impact of air-tightness in dwellings in the UK

High CO<sub>2</sub> emissions from the residential sector have forced UK authorities to promote measures to improve energy efficiency through retrofit. Air-tightening can reduce infiltration rates, thereby decreasing ventilation heat losses, but also reducing indoor air quality. This paper presents an initial investigation of the increase in airborne transmission risk of Tuberculosis (TB) due to air-tightening in two of the most commonly-occurring dwelling types in London (purpose-built flat and terraced). EnergyPlus is used to calculate the ventilation rate of the main bedroom over a year for a range of building permeabilities representing the current and air-tightened stock. The Wells-Riley equation is then used to calculate the risk of infection under three different rates of TB generation. Results indicate the potential for increased airborne TB transmission between building occupants following air-tightening, with occupants of flats more susceptible to infection, particularly at high TB generation rates.

#### General information

Publication status: Published

MoE publication type: Not Eligible  
Organisations: University College London  
Contributors: Taylor, J., Altamirano-Medina, H., Shrubsole, C., Das, P., Biddulph, P., Davies, M., Mavrogianni, A., Oikonomou, E.  
Number of pages: 8  
Pages: 60-67  
Publication date: 1 Jan 2014  
Peer-reviewed: Unknown  
Event: Paper presented at 13th International Conference on Indoor Air Quality and Climate, Indoor Air 2014, Hong Kong, Hong Kong.  
ASJC Scopus subject areas: Pollution, Building and Construction, Health, Toxicology and Mutagenesis, Computer Science Applications  
Keywords: Building archetypes, Building simulation, EnergyPlus, London, Tuberculosis  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84924718680&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84924718680  
Research output: Other conference contribution › Paper, poster or abstract › Scientific

## Using probabilistic sampling-based sensitivity analyses for indoor air quality modelling

### General information

Publication status: Published  
MoE publication type: Not Eligible  
Organisations: London School of Hygiene and Tropical Medicine, University of Nottingham, University College London  
Contributors: Das, P., Chalabi, Z., Davies, M., Hamilton, I., Jones, B., Mavrogianni, A., Shrubsole, C., Taylor, J.  
Number of pages: 3  
Pages: 553-555  
Publication date: 1 Jan 2014  
Peer-reviewed: Unknown  
Event: Paper presented at 13th International Conference on Indoor Air Quality and Climate, Indoor Air 2014, Hong Kong, Hong Kong.  
ASJC Scopus subject areas: Pollution, Building and Construction, Health, Toxicology and Mutagenesis, Computer Science Applications  
Keywords: Housing stock, Indoor air quality, Intervention, Metamodel, Probabilistic sensitivity analysis  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84924692116&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84924692116  
Research output: Other conference contribution › Paper, poster or abstract › Scientific

## Review of motor vehicle particulate emissions sampling and measurement: From smoke and filter mass to particle number

Particulate emissions from motor vehicles have received increased attention over the past two decades owing to associations observed between ambient particulate matter (PM) levels and health effects. This has led to numerous changes in emissions regulations worldwide, including more stringent standards, the broadening of these to include non-road engines, and the adoption of new metrics. These changes have created a demand for new instruments that are capable of real time measurement, enhanced sensitivity, and on-board vehicle operation. In response, researchers and instrument manufacturers have developed an array of new and improved instruments and sampling methods. It is generally recognized that the exhaust aerosol concentration measured depends on both the sampling technique and the instrument used. Hence, many of the new instruments are complementary and offer merits in measuring a variety of particulate emissions attributes. However, selecting the best instrument for each application is not a straightforward task; it requires on one hand a clear measurement objective and, on the other, an understanding of the characteristics of the instrument employed. This paper reviews how vehicle exhaust particulate emission measurements have evolved over the years. The focus is on current and newly evolving instrumentation, including gravimetric filter measurement, chemical analysis of filters, light extinction, scattering and absorption instruments, and instruments based on the electrical detection of exhaust aerosols. Correlations between the various instruments are examined in the context of steadily more stringent exhaust emissions standards. The review concludes with a discussion of future instrument and sampling requirements for the changing nature of exhaust aerosols from current and future vehicles.

### General information

Publication status: Published  
MoE publication type: A2 Review article in a scientific journal  
Organisations: Urban circular bioeconomy (UrCirBio), European Commission-JRC, Ford Motor Company, Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Desert Research Institute, AVL DiTest Fahrzeugdiagnose GmbH, AVL List GmbH, AVL North America Inc

Contributors: Giechaskiel, B., Maricq, M., Ntziachristos, L., Dardiotis, C., Wang, X., Axmann, H., Bergmann, A., Schindler, W.

Number of pages: 39

Pages: 48-86

Publication date: Jan 2014

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Aerosol Science

Volume: 67

ISSN (Print): 0021-8502

Ratings:

Scopus rating (2014): CiteScore 4.2 SJR 1.081 SNIP 1.594

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Materials Science(all), Pollution

Keywords: Aerosol instrumentation, Aerosol sampling, Emission regulations, Exhaust aerosol

DOIs:

10.1016/j.jaerosci.2013.09.003

URLs:

<http://www.scopus.com/inward/record.url?scp=84886264597&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84886264597

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

#### Building energy-efficiency interventions in North-East Europe: Effects on indoor environmental quality and public health

INSULAtE project aims to develop a common protocol for assessment of improving energy efficiency (EE) of dwellings on indoor environmental quality (IEQ) and public health in Europe. So far, measurement data on IEQ parameters (PM, CO, CO<sub>2</sub>, VOCs, formaldehyde, NO<sub>2</sub>, radon, T and RH) and questionnaire data from occupants were collected from 16 multifamily buildings (94 apartments) in Finland and 20 (96 apartments) in Lithuania before renovation. Most parameters were within recommended limits; however, the data revealed different baselines (before renovation) for each country both in terms of the IEQ parameters and the respondents' satisfaction regarding their residence and indoor air quality. Post renovation data (from one building in each country) showed potential changes in the measured parameters, while further analyses are needed once the data have been collected. The results of this project will be used in developing guidance and support the implementation of the related policies.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Research group: Concrete and Bridge Structures, Department of Civil Engineering, Research group: Responsible Construction, National Public Health Institute, Kaunas University of Technology

Contributors: Du, L., Prasauskas, T., Leivo, V., Turunen, M., Aaltonen, A., Kiviste, M., Martuzevicius, D., Haverinen-Shaughnessy, U.

Number of pages: 3

Pages: 637-639

Publication date: 2014

#### Host publication information

Title of host publication: Indoor Air 2014 - 13th International Conference on Indoor Air Quality and Climate

Publisher: International Society of Indoor Air Quality and Climate

ASJC Scopus subject areas: Pollution, Building and Construction, Health, Toxicology and Mutagenesis, Computer Science Applications

Keywords: Environmental monitoring, Exposure, Health questionnaire, Residential buildings

URLs:

<http://www.scopus.com/inward/record.url?scp=84924672127&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84924672127

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Characterization of charge in airborne fungal spores

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Physics, Research area: Aerosol Physics, Research area: Optics, Urban circular bioeconomy (UrCirBio), University of Cincinnati, Ita-Suomen yliopisto, Dekati Ltd  
Contributors: Reponen, T., Saari, S., Mensah-Attipoe, J., Ukkonen, A., Veijalainen, A., Pasanen, P., Keskinen, J.  
Number of pages: 3  
Pages: 359-361  
Publication date: 2014

#### Host publication information

Title of host publication: Indoor Air 2014 - 13th International Conference on Indoor Air Quality and Climate  
Publisher: International Society of Indoor Air Quality and Climate  
ASJC Scopus subject areas: Pollution, Building and Construction, Health, Toxicology and Mutagenesis, Computer Science Applications  
Keywords: Aerosolization, Agar, Air velocity, Surface  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84924739791&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84924739791  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Use of a PPS sensor in evaluating the impact of fuel efficiency improvement technologies on the particle emissions of a euro 5 diesel car

The effect of "Start & Stop" and "Gear Shift Indicator" - two widespread fuel saving technologies - on fuel consumption and particle emissions of a Euro 5 passenger car is evaluated in this paper. The vehicle was subjected to a series of different driving cycles, including the current (NEDC) and future (WLTC) cycles implemented in the European type approval procedure at cold and hot start condition and particle number was measured with an AVL Particle Counter. In addition, we have utilized two Pegasor Particle Sensor units positioned in different locations along the sampling line to assess the impact of the sampling location on the particle characteristics measured during highly transient events. The results showed that the particle number emission levels over the WLTC were comparable to the NEDC ones, whereas  $\text{NO}_x$  emissions were more than twofold higher. Both fuel saving technologies can lead to reduced fuel consumption and, subsequently  $\text{CO}_2$  emissions, in the order of 5%. However, their impact on particle emissions was not straightforward, as the impact of the DPF loading was found much more significant than the effect of these technologies. However, in several occasions, the frequent start and stops of the engine actually led to an increase in particle emissions over the baseline. On the other hand, the reduced engine speed imposed when the gear shift indicator was respected generally led to lower particle emissions. Transient impacts on particle emissions such as those resulted by the fuel saving technologies studied can be much better monitored with raw exhaust sampling than following the type approval sampling procedure. This recommendation tends to be forgotten in regular research works.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, EMISIA SA, Pegasor Oy  
Contributors: Amanatidis, S., Ntziachristos, L., Samaras, Z., Kouridis, C., Janka, K., Tikkanen, J.  
Publication date: 2014

#### Host publication information

Title of host publication: SAE 2014 World Congress and Exhibition  
Volume: 1  
Publisher: SAE International  
ASJC Scopus subject areas: Automotive Engineering, Safety, Risk, Reliability and Quality, Pollution, Industrial and Manufacturing Engineering  
DOIs:  
10.4271/2014-01-1601  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84899583551&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84899583551  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Impact of the dropping activity with vehicle age on air pollutant emissions

Road transport is a major source of air pollution especially in cities. Detailed calculations are needed to support road transport emission inventories due to the variance of technologies and operating conditions encountered on the roads. The annual distance driven by cars in relation to their characteristics is an important variable in such calculations. In this work, a large amount of mileage data were collected from second-hand car sellers in Italy and were then analyzed in order to understand the influence of vehicle age on annual mileage driven. The available data enabled the development of

dropping functions of annual mileage with vehicle age. It was found that the average mileage of 10 year old cars is only approximately 40% of the mileage driven on year one. This drops to approximately only 10% for 20-year old cars. The findings are of paramount importance in environmental calculations as road transport NO<sub>x</sub> and PM emissions drop by more than 20% when the corrected functions are used compared to using a constant mileage. Not introducing such a correction may result to an approximately 8% higher nation-wide NO<sub>x</sub> emissions with negative implications towards meeting the national emission ceilings. In terms of policy implications, the dropping activity with age results to a decrease in the importance of accelerated scrappage schemes and of environmental zones in air quality.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Politecnico di Milano, EEA - European Environment Agency, Redecam Group, Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki

Contributors: Caserini, S., Pastorello, C., Gaifami, P., Ntziachristos, L.

Number of pages: 8

Pages: 282-289

Publication date: Jul 2013

Peer-reviewed: Yes

#### Publication information

Journal: Atmospheric Pollution Research

Volume: 4

Issue number: 3

ISSN (Print): 1309-1042

Ratings:

Scopus rating (2013): CiteScore 2 SJR 0.661 SNIP 0.874

Original language: English

ASJC Scopus subject areas: Pollution, Waste Management and Disposal, Atmospheric Science

Keywords: Air quality, Emissions, NO, Road transport, Vehicle activity

DOIs:

10.5094/APR.2013.031

URLs:

<http://www.scopus.com/inward/record.url?scp=84882799559&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84882799559

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

#### Biochemical changes of fresh water cyanobacteria dolichospermum flos-aquae NTMS07 to chromium-induced stress with special reference to antioxidant enzymes and cellular fatty acids

This investigation examined the efficiency of Dolichospermum flos-aquae NTMS07 in the removal of Cr(VI) from exposure water at various concentrations (2.5, 5, 7.5, 10 mg/L) over different time intervals of contact (1-5 days). Chromium removal was maximum at 2.5 mg/L, and decreased with increased concentration. The responses of the antioxidative enzymes superoxide dismutase (SOD) and catalase (CAT) were measured, and the composition of fatty acids was evaluated at a concentration of 5 mg Cr/L. Significant increases in the activity levels of SOD and CAT were obtained. The level of total unsaturated fatty acids decreased with exposure to Cr. It is proposed that the observed decrease in total unsaturated fatty acid level is a defense mechanism against Cr-induced oxidative stress and cell membrane damage.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Bharathidasan University, Korea Institute of Energy Research

Contributors: Kumar, M. S., Praveenkumar, R., Ilavarasi, A., Rajeshwari, K., Thajuddin, N.

Number of pages: 6

Pages: 730-735

Publication date: Jun 2013

Peer-reviewed: Yes

#### Publication information

Journal: Bulletin of Environmental Contamination and Toxicology

Volume: 90

Issue number: 6

ISSN (Print): 0007-4861

Ratings:

Scopus rating (2013): CiteScore 2 SJR 0.548 SNIP 0.8

Original language: English

ASJC Scopus subject areas: Health, Toxicology and Mutagenesis, Pollution, Toxicology

Keywords: CAT, Chromium, Dolichospermum flos-aquae, Fatty acid profile, SOD

DOIs:

10.1007/s00128-013-0984-9

URLs:

<http://www.scopus.com/inward/record.url?scp=84879843367&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84879843367

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

### Organic silicon compounds in biogases produced from grass silage, grass and maize in laboratory batch assays

In the present study the occurrence of volatile organic silicon compounds in biogas produced from grass silage, grass and maize in laboratory batch assays was analyzed and methane potentials were determined. Inoculum from a mesophilic farm digester was used, and its effects were subtracted. Methane yields from grass silage, grass and maize were 0.38, 0.42 and 0.34 m<sup>3</sup>CH<sub>4</sub>/kg - volatile solids added (VS<sub>add</sub>), respectively. Trimethyl silanol, hexamethylcyclotrisiloxane (D3), octamethylcyclotetrasiloxane (D4) and decamethylcyclopentasiloxane (D5) were detected from all the biogases. Higher yields of volatile organic silicon compounds in the grass (from 21.8 to 37.6 µg/kgVS<sub>add</sub>) were detected than in grass silage or maize assays (from 14.7 to 20.4 and from 7.4 to 12.1 µg/kgVS<sub>add</sub>, respectively). Overall, it is important to consider silicon-containing compounds also in biogases in energy crop digestion as the number of biogas plants using energy crops as feeding material increases and some biogas applications are sensitive to organic silicon compounds. © 2013 Elsevier Ltd.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, Tampere University of Technology

Contributors: Rasi, S., Seppälä, M., Rintala, J.

Number of pages: 6

Pages: 137-142

Publication date: 1 Apr 2013

Peer-reviewed: Yes

### Publication information

Journal: Energy

Volume: 52

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2013): CiteScore 7.2 SJR 2.458 SNIP 2.545

Original language: English

ASJC Scopus subject areas: Energy(all), Pollution

Keywords: Anaerobic digestion, Biogas, Energy crops, Methane, Siloxanes

DOIs:

10.1016/j.energy.2013.01.015

URLs:

<http://www.scopus.com/inward/record.url?scp=84875804553&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

Contribution: organisation=keb,FACT1=1<br/>Portfolio EDEND: 2013-06-29<br/>Publisher name: Elsevier Ltd.

Source: researchoutputwizard

Source ID: 3235

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

### Application of the Pegasor Particle Sensor for the Measurement of Mass and Particle Number Emissions

The Pegasor Particle Sensor (PPS) is a small and lightweight sensor that can be used directly in raw exhaust to provide the mass and number concentration of exhaust aerosol. Its operation principle is based on the electrical charging of exhaust aerosol and determination of particle concentration by measuring the charge accumulated on the particles. In this paper we have applied the PPS in a variety of vehicle exhaust configurations to evaluate its performance characteristics. First, the output signal of the instrument was calibrated with diesel exhaust to deliver either the mass or the number concentration of exhaust aerosol. Linear response with the soot mass concentration measured by a Photo Acoustic Soot Sensor and number concentration measured by an Electrical Low Pressure Impactor was established. Based on this calibration, the instrument was then used to measure particle concentrations at levels produced by a gasoline direct injection vehicle and diesel exhaust filtered by particle filters of variable efficiency. Hence, the complete range of concentrations and particle characteristics typically encountered in automotive exhaust has been examined. The results

show that the PPS signal can provide a repeatable measurement of aerosol concentration in the exhaust of current vehicles, offering a very good correlation both to the mass and number of particles, as measured by existing techniques.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Pegasor Oyj

Contributors: Ntziachristos, L., Amanatidis, S., Samaras, Z., Janka, K., Tikkanen, J.

Publication date: Apr 2013

Peer-reviewed: Yes

#### Publication information

Journal: SAE International Journal of Fuels and Lubricants

Volume: 6

Issue number: 2

ISSN (Print): 1946-3952

Ratings:

Scopus rating (2013): CiteScore 2.8 SJR 1.202 SNIP 1.145

Original language: English

ASJC Scopus subject areas: Fuel Technology, Pollution

URLs:

<http://www.scopus.com/inward/record.url?scp=84876567866&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84876567866

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

#### Use of a Catalytic Stripper as an Alternative to the Original PMP Measurement Protocol

The Particle Measurement Programme (PMP) developed an exhaust particle number measurement protocol that has been adopted by current light duty vehicle emission regulations in Europe. This includes thermal treatment of the exhaust aerosol to isolate solid particles only and a number counting device with a lower cutpoint of 23 nm to avoid measurement of smaller particles that may affect the repeatability of the measurement. In this paper, we examine a potential alternative to the PMP system, where the thermal treatment is replaced by a catalytic stripper (CS). This offers oxidation and not just evaporation of the volatile components. Alternative sampling systems, either fulfilling the PMP recommendations or utilizing a CS, have been explored in terms of their volatile particle removal efficiency. Tests have been conducted on diesel exhaust, diesel equipped with DPF and gasoline direct injection emissions. The results showed that the CS offers similar performance characteristics to the PMP when tested on diesel exhaust. In tests with the gasoline vehicle, the CS has been shown of leading to lower particle concentrations than the PMP, indicating that a larger number of particles can be removed as volatiles. Moreover, steady speed tests at 120 kph revealed that the PMP protocol was not sufficient in removing particles below 10 nm, which were completely eliminated when the CS was positioned downstream of an evaporation tube. The results of the study once more confirm the robustness of the PMP protocol for diesel exhaust sampling but also suggest that more analysis is needed before extending the protocol to other vehicle types and/or particle sizes.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, AVL List GmbH

Contributors: Ntziachristos, L., Amanatidis, S., Samaras, Z., Giechaskiel, B., Bergmann, A.

Publication date: Apr 2013

Peer-reviewed: Yes

#### Publication information

Journal: SAE International Journal of Fuels and Lubricants

Volume: 6

Issue number: 2

ISSN (Print): 1946-3952

Ratings:

Scopus rating (2013): CiteScore 2.8 SJR 1.202 SNIP 1.145

Original language: English

ASJC Scopus subject areas: Fuel Technology, Pollution

URLs:

<http://www.scopus.com/inward/record.url?scp=84876549342&partnerID=8YFLogxK> (Link to publication in Scopus)



Source: Scopus

Source ID: 84876549342

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

### **Evaluation of an oxidation catalyst ("catalytic stripper") in eliminating volatile material from combustion aerosol**

Combustion aerosol is a mixture of solid and volatile particulate matter. Separation of solid particles for research or regulatory purposes is often conducted with thermal treatment of the aerosol. For example, European automotive emission regulations address solid particles above 23. nm, which are separated by dilution and heating in a volatile particle remover (VPR). This study evaluated an oxidation catalyst - often referred to as a "catalytic stripper" (CS) - as an alternative technique to remove volatile components. A version of the CS was examined in this paper, where the oxidation catalyst was combined with a sulphur trap in order to oxidise hydrocarbon species and to bind sulphates on the CS surface. In order to characterise the performance of the CS, the position of the sulphur trap upstream or downstream of the oxidation catalyst was examined in relation to the light-off temperature, hydrocarbon oxidation efficiency, and sulphur storage capacity, defined as the point where sulphate particles start to form downstream of the CS. With the best performance achieved when the trap was positioned downstream of the oxidation catalyst, the CS was then characterised in terms of particle losses in the range 6-100. nm. Losses were found rather independent of particle size above 30. nm but significantly increased below 23. nm. The efficiency in removing volatile particles was characterised using tetracontane particles. Furthermore, the overall performance of the CS was compared against the VPR by using diesel nucleation mode particles as the challenge aerosol. Results showed that the CS could directly be used as an alternative to VPR for combustion aerosol measurements if only particles above 23. nm were considered. Extending the measurement below this range would also be possible. This would however require an evaporation tube to vaporise material before this reached the CS and attention in addressing the rapidly increasing losses with decreasing particle size in this range.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, AVL List GmbH

Contributors: Amanatidis, S., Ntziachristos, L., Giechaskiel, B., Katsaounis, D., Samaras, Z., Bergmann, A.

Number of pages: 12

Pages: 144-155

Publication date: Mar 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Aerosol Science

Volume: 57

ISSN (Print): 0021-8502

Ratings:

Scopus rating (2013): CiteScore 4.5 SJR 1.187 SNIP 1.836

Original language: English

ASJC Scopus subject areas: Materials Science(all), Environmental Chemistry, Pollution

Keywords: Exhaust aerosol, Exhaust sampling, Particle emissions, Sampling conditions

DOIs:

10.1016/j.jaerosci.2012.12.001

URLs:

<http://www.scopus.com/inward/record.url?scp=84872531978&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84872531978

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

### **Applicability of the Pegasor particle sensor to measure particle number, mass and PM emissions**

The Pegasor Particle Sensor (PPS) has been earlier presented by Ntziachristos et al. (SAE Paper 2011-01-0626) as a novel small and robust instrument that can be directly installed in the exhaust line to measure exhaust particles without any dilution. The instrument is based on the electrical detection of aerosol. It is increasingly being used to measure exhaust particles from engines and vehicles with different exhaust configurations. In this study, a number of tests have been conducted using two sensors in parallel, one directly installed in the tailpipe and one installed in the CVS, side by side to the PM sampling filter. Aim of the study was to make recommendations on the proper use of the sensor and to check how the sensor signal compares to particulate mass, soot concentration, and particle number. A first finding is that external heating has to be provided to the sensor to avoid condensation. Second, very good linearity of the sensor signal is established for all three particle concentrations examined. The only exception was PM at very low concentrations, where positive adsorption artifacts determine the mass collected on the filter. Also, the original calibration provided with the sensor offers a satisfactory match with the absolute level of mass and number measured with other instruments. Improving this requires either specific calibration of the sensor for a particular emission source, or, at least, knowledge of the particle size distribution.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Pegasor Oy

Contributors: Amanatidis, S., Ntziachristos, L., Samaras, Z., Janka, K., Tikkanen, J.

Publication date: 2013

### Host publication information

Title of host publication: 11th International Conference on Engines and Vehicles, ICE 2013

Volume: 6

ASJC Scopus subject areas: Automotive Engineering, Safety, Risk, Reliability and Quality, Pollution, Industrial and Manufacturing Engineering

DOIs:

10.4271/2013-24-0167

URLs:

<http://www.scopus.com/inward/record.url?scp=84890368457&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84890368457

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Application of the pegasor particle sensor for the measurement of mass and particle number emissions

The Pegasor Particle Sensor (PPS) is a small and lightweight sensor that can be used directly in raw exhaust to provide the mass and number concentration of exhaust aerosol. Its operation principle is based on the electrical charging of exhaust aerosol and determination of particle concentration by measuring the charge accumulated on the particles. In this paper we have applied the PPS in a variety of vehicle exhaust configurations to evaluate its performance characteristics. First, the output signal of the instrument was calibrated with diesel exhaust to deliver either the mass or the number concentration of exhaust aerosol. Linear response with the soot mass concentration measured by a Photo Acoustic Soot Sensor and number concentration measured by an Electrical Low Pressure Impactor was established. Based on this calibration, the instrument was then used to measure particle concentrations at levels produced by a gasoline direct injection vehicle and diesel exhaust filtered by particle filters of variable efficiency. Hence, the complete range of concentrations and particle characteristics typically encountered in automotive exhaust has been examined. The results show that the PPS signal can provide a repeatable measurement of aerosol concentration in the exhaust of current vehicles, offering a very good correlation both to the mass and number of particles, as measured by existing techniques.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Pegasor Oy

Contributors: Ntziachristos, L., Amanatidis, S., Samaras, Z., Janka, K., Tikkanen, J.

Publication date: 2013

### Host publication information

Title of host publication: SAE 2013 World Congress and Exhibition

Volume: 2

Publisher: SAE International

ASJC Scopus subject areas: Automotive Engineering, Safety, Risk, Reliability and Quality, Pollution, Industrial and Manufacturing Engineering

DOIs:

10.4271/2013-01-1561

URLs:

<http://www.scopus.com/inward/record.url?scp=84940293852&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84940293852

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Use of a catalytic stripper as an alternative to the original PMP measurement protocol

The Particle Measurement Programme (PMP) developed an exhaust particle number measurement protocol that has been adopted by current light duty vehicle emission regulations in Europe. This includes thermal treatment of the exhaust aerosol to isolate solid particles only and a number counting device with a lower cutpoint of 23 nm to avoid measurement of smaller particles that may affect the repeatability of the measurement. In this paper, we examine a potential alternative to the PMP system, where the thermal treatment is replaced by a catalytic stripper (CS). This offers oxidation and not just evaporation of the volatile components. Alternative sampling systems, either fulfilling the PMP recommendations or utilizing a CS, have been explored in terms of their volatile particle removal efficiency. Tests have been conducted on

diesel exhaust, diesel equipped with DPF and gasoline direct injection emissions. The results showed that the CS offers similar performance characteristics to the PMP when tested on diesel exhaust. In tests with the gasoline vehicle, the CS has been shown of leading to lower particle concentrations than the PMP, indicating that a larger number of particles can be removed as volatiles. Moreover, steady speed tests at 120 kph revealed that the PMP protocol was not sufficient in removing particles below 10 nm, which were completely eliminated when the CS was positioned downstream of an evaporation tube. The results of the study once more confirm the robustness of the PMP protocol for diesel exhaust sampling but also suggest that more analysis is needed before extending the protocol to other vehicle types and/or particle sizes.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Urban circular bioeconomy (UrCirBio), Aristotle University of Thessaloniki, AVL List GmbH

Contributors: Ntziachristos, L., Amanatidis, S., Samaras, Z., Giechaskiel, B., Bergmann, A.

Publication date: 2013

#### Host publication information

Title of host publication: SAE 2013 World Congress and Exhibition

Volume: 2

Publisher: SAE International

ASJC Scopus subject areas: Automotive Engineering, Safety, Risk, Reliability and Quality, Pollution, Industrial and Manufacturing Engineering

DOIs:

10.4271/2013-01-1563

URLs:

<http://www.scopus.com/inward/record.url?scp=84940267604&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84940267604

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Thermophilic anaerobic digestion of pulp and paper mill primary sludge and co-digestion of primary and secondary sludge

Anaerobic digestion of pulp and paper mill primary sludge and co-digestion of primary and secondary sludge were studied for the first time in semi-continuously fed continuously stirred tank reactors (CSTR) in thermophilic conditions. Additionally, in batch experiments, methane potentials of 210 and 230 m<sup>3</sup>CH<sub>4</sub>/t volatile solids (VS)<sub>added</sub> were obtained for primary, and 50 and 100 m<sup>3</sup>CH<sub>4</sub>/tVS<sub>added</sub> for secondary sludge at 35 °C and 55 °C, respectively. Anaerobic digestion of primary sludge was shown to be feasible with organic loading rates (OLR) of 1-1.4 kgVS/m<sup>3</sup>d and hydraulic retention times (HRT) of 16-32 d resulting in methane yields of 190-240 m<sup>3</sup>CH<sub>4</sub>/tVS<sub>fed</sub>. Also the highest tested OLR of 2 kgVS/m<sup>3</sup>d and the shortest HRT of 14-16 d could be feasible, if pH stability is confirmed. Co-digestion of primary and secondary sludge with an OLR of 1 kgVS/m<sup>3</sup>d and HRTs of 25-31 d resulted in methane yields of 150-170 m<sup>3</sup>CH<sub>4</sub>/tVS<sub>fed</sub>. In the digestion processes, cellulose and hemicellulose degraded while lignin did not. pH adjustment and nitrogen deficiency needs to be considered when planning anaerobic digestion of pulp and paper mill wastewater sludges. © 2012 Elsevier Ltd.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Tampere University of Technology, Department of Chemistry and Bioengineering, Urban circular bioeconomy (UrCirBio), Jyväskylän yliopisto, University of Jyväskylä

Contributors: Bayr, S., Rintala, J.

Number of pages: 8

Pages: 4713-4720

Publication date: 1 Oct 2012

Peer-reviewed: Yes

#### Publication information

Journal: Water Research

Volume: 46

Issue number: 15

ISSN (Print): 0043-1354

Ratings:

Scopus rating (2012): CiteScore 8.1 SJR 2.914 SNIP 2.442

Original language: English

ASJC Scopus subject areas: Water Science and Technology, Waste Management and Disposal, Pollution, Ecological Modelling

Keywords: ADF, ADL, Anaerobic digestion, CSTR, FM, HRT, Methane, NDF, OLR, Primary sludge, Pulp and paper mill, SCOD, Secondary sludge, Thermophilic, TKN, TS, VFA, VS

DOIs:

10.1016/j.watres.2012.06.033

URLs:

<http://www.scopus.com/inward/record.url?scp=84864052991&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

Contribution: organisation=keb bio,FACT1=1

Source: researchoutputwizard

Source ID: 3899

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

### Exhaust particle sensor for OBD application

Efforts to develop a sensor for on-board diagnostics (OBD) of diesel vehicles are intensive as diesel particulate filters (DPFs) have become widespread around the world. This study presents a novel sensor that has been successfully tested for OBD diagnosis of damaged DPFs. The sensor is based on the "escaping current" technique. Based on this, a sample of exhaust gas is charged by a corona-ionized flow and is pumped by an ejector dilutor built in the sensor's construction. While the majority of ions return to the grounded sensor's body, a small quantity is lost with the charged particles exiting the sensor. This "escaping current" is a measurement of the particle concentration in the exhaust gas. Such a sensor has been developed and tested in real-exhaust of a diesel car and a diesel engine. The sensor provides high resolution (1 Hz, 0.3 s response time) and high sensitivity superseding OBD requirements. The sensor was used on an engine to monitor the efficiency of damaged DPFs. The signal was found to perform similar to the smokemeter, a widespread instrument used for routine testing in automotive laboratories. The sensor was then installed in the exhaust of a vehicle to test the DPF efficiency of a well operating and a damaged DPF over a transient test. The sensor was found to be sensitive enough to clearly detect a defected from a well-operating particle filter even at levels as low as  $6 \text{ mg km}^{-1}$ . This study demonstrates that a soot sensor based on the escaping current technique has the potential to be used for OBD and DPF control on forthcoming light duty and heavy duty diesel vehicles.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Urban circular bioeconomy (UrCirBio), Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Pegasor Oy

Contributors: Ntziachristos, L., Fragkiadoulakis, P., Samaras, Z., Janka, K., Tikkanen, J.

Publication date: 2011

### Host publication information

Title of host publication: SAE 2011 World Congress and Exhibition

ASJC Scopus subject areas: Automotive Engineering, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Pollution

DOIs:

10.4271/2011-01-0626

URLs:

<http://www.scopus.com/inward/record.url?scp=79959825725&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79959825725

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

### Weathering of gasification and grate bottom ash in anaerobic conditions

The effect of anaerobic conditions on weathering of gasification and grate bottom ash were studied in laboratory lysimeters. The two parallel lysimeters containing the same ash were run in anaerobic conditions for 322 days, after which one was aerated for 132 days. The lysimeters were watered throughout the study and the quality of leachates and changes in the binding of elements into ash were observed. The results show that organic carbon content and initial moisture of ashes are the key parameters affecting the weathering of ashes. In the grate ash the biodegradation of organic carbon produced enough  $\text{CO}_2$  to regulate pH. In contrast the dry gasification ash, containing little organic carbon, was not carbonated under anaerobic conditions and the pH decreased only after aeration was started. During the aeration the  $\text{CO}_2$  absorption capacity was not reached, indicating that intense aeration would be needed to fully carbonate gasification ash. The results indicate that in common weathering practice the main emissions-reducing processes are leaching and carbonation due to  $\text{CO}_2$  from biodegradation. The results of the aeration study suggest that the role of atmospheric  $\text{CO}_2$  in the weathering process was insignificant.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Sivula, L., Ilander, A., Väisänen, A., Rintala, J.  
Number of pages: 8  
Pages: 344-351  
Publication date: 15 Feb 2010  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Hazardous Materials

Volume: 174

Issue number: 1-3

ISSN (Print): 0304-3894

Ratings:

Scopus rating (2010): SJR 1.677 SNIP 1.706

Original language: English

ASJC Scopus subject areas: Health, Toxicology and Mutagenesis, Pollution, Waste Management and Disposal, Environmental Chemistry, Environmental Engineering

Keywords: Aeration, Anaerobic, Carbonation, Gasification ash, Weathering

DOIs:

10.1016/j.jhazmat.2009.09.056

Source: Scopus

Source ID: 71849087952

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

#### The mechanism of the oxidation of benzyl alcohol by iron(III)nitrate: Conventional versus microwave heating

The mechanism of the oxidation of benzyl alcohol with iron(III)nitrate nonahydrate under conventional and under microwave heating conditions has been investigated and the reaction conditions have been optimized. A series of redox reactions leads to the formation of benzaldehyde and other products. Direct comparison between conventional and microwave heating revealed identical conversions profiles. Mastering the microwave induced heat, absence of a real microwave effect and byproduct formation are the major factors to advise a traditional batch-wise way of process development to a larger scale.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Eindhoven University of Technology, Laboratory of Macromolecular and Organic Chemistry, DSM Research

Contributors: Dressen, M. H. C. L., Stumpel, J. E., Van De Kruijs, B. H. P., Meuldijk, J., Vekemans, J. A. J. M., Hulshof, L. A.

Number of pages: 5

Pages: 60-64

Publication date: 2009

Peer-reviewed: Yes

#### Publication information

Journal: Green Chemistry

Volume: 11

Issue number: 1

ISSN (Print): 1463-9262

Ratings:

Scopus rating (2009): SJR 2.088 SNIP 1.738

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution

DOIs:

10.1039/b813030b

URLs:

<http://www.scopus.com/inward/record.url?scp=58149280111&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Stumpel, Jelle"

Source: Scopus

Source ID: 58149280111

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

### **Internal leachate quality in a municipal solid waste landfill: Vertical, horizontal and temporal variation and impacts of leachate recirculation**

The aim of this study was to monitor and characterise internal leachate quality at a Finnish municipal solid waste landfill (Lahti, Kujala, in operation for approximately 50 years) to provide information about its horizontal and vertical variation as well as effects of leachate recirculation on leachate quality. The study area (approximately 4 h) of the landfill had 14 monitoring wells for leachate quality monitoring over a 2-year period. The leachate was monitored for COD, BOD, TKN,  $\text{NH}_4\text{-N}$ , Cl, pH and electric conductivity. The results showed high horizontal and vertical variability in leachate quality between monitoring wells, indicating that age and properties of waste, local conditions (e.g., water table) and degradation and dilution processes have a marked effect on local leachate quality. The mean COD values (642-8037 mg/l) and mean BOD/COD ratios (0.08-0.17) from the different monitoring wells were typical of landfills in the methanogenic phase of degradation. The leachate in the monitoring wells was notably more concentrated than the leachate effluent used for leachate recirculation. In the landfill as a whole the effects of the leachate recirculation on leachate quality, although difficult to distinguish from those caused by other factors, appeared to be minor during the study period.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

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

Number of pages: 7

Pages: 601-607

Publication date: 30 Dec 2008

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Hazardous Materials

Volume: 160

Issue number: 2-3

ISSN (Print): 0304-3894

Ratings:

Scopus rating (2008): SJR 1.25 SNIP 1.522

Original language: English

ASJC Scopus subject areas: Health, Toxicology and Mutagenesis, Pollution, Waste Management and Disposal, Environmental Chemistry, Environmental Engineering

Keywords: Landfill, Leachate, Nitrogen, Organic matter, Sampling

DOIs:

10.1016/j.jhazmat.2008.03.081

Source: Scopus

Source ID: 54549090158

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

### **Methane oxidation in a boreal climate in an experimental landfill cover composed from mechanically-biologically treated waste**

The present study evaluated microbial methane ( $\text{CH}_4$ ) oxidation in a boreally located outdoor landfill lysimeter (volume  $112 \text{ m}^3$ , height 3.9 m) filled with mechanically-biologically treated waste (MBT residual) and containing a cover layer made from the same MBT residual. The calculations based on gas emission and pore gas measurements showed that, between April and October 2005, a significant proportion (> 96%) of the methane produced ( $< 23 \text{ l CH}_4 \text{ m}^{-2} \text{ d}^{-1}$ ) in the lysimeter was oxidized. Methane was oxidized mainly at the depths of 35-75 cm, as indicated by the upward decrease both in the methane concentration and in the methane-to-carbon dioxide ratio in the pore gas. Lower methane oxidation ( $< 0.8 \text{ CH}_4 \text{ m}^{-2} \text{ d}^{-1}$ ; this was < 22% of the methane produced) was observed only during the coldest time of the year (January 2006), apparently due to the fall in temperature at the depths of 25-70 cm (from 9-25 °C during April to October to 2-9 °C in January). Unexpectedly, the highest methane oxidation potential (MOP) was observed in samples from the top layer where exposure to methane was low. Overall, the results show that MBT residual is a suitable support medium for methane oxidation in landfill covers in field conditions in a boreal climate.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

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

Number of pages: 17

Pages: 67-83

Publication date: 15 Dec 2008

Peer-reviewed: Yes

### Publication information

Journal: Science of the Total Environment

Volume: 407

Issue number: 1

ISSN (Print): 0048-9697

Ratings:

Scopus rating (2008): SJR 1.461 SNIP 1.489

Original language: English

ASJC Scopus subject areas: Environmental Chemistry, Pollution, Waste Management and Disposal, Environmental Engineering

Keywords: Greenhouse gases, Landfill gas, Low temperature, Mechanical-biological treatment, Methane oxidation, Municipal solid waste

DOIs:

10.1016/j.scitotenv.2008.08.016

Source: Scopus

Source ID: 56249090340

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

### Detailed internal characterisation of two Finnish landfills by waste sampling

The aim of this study was to characterise the internal structure and composition of landfilled waste at two Finnish landfills to provide information for active and post-landfill operations. The two sites, Ämmässuo and Kujala, have been in operation for 17 and 48 years, respectively. Waste was sampled (total 68 samples) and analysed for total solids (TS), volatile solids (VS), total Kjeldahl nitrogen (TKN), biological methane potential (BMP) and leaching of organic material (determined as chemical oxygen demand, COD) and ammonium nitrogen ( $\text{NH}_4\text{-N}$ ). The results showed high vertical and horizontal variability, which indicated that both the waste composition and state of degradation varied greatly in both landfills. Ämmässuo was characterised by 2- to 4-fold higher BMP,  $\text{NH}_4\text{-N}$  and COD leaching than Kujala. Moreover, the ratio of VS to TS was higher at Ämmässuo, while TS content was lower. The highest mean BMPs (68 and 44  $\text{m}^3/\text{t}$  TS), TKN content (4.6 and 5.2 kg/t dry weight) and VS/TS ratio (65% and 59%) were observed in the middle and top layers; and the lowest mean BMP (21 and 8  $\text{m}^3/\text{t}$  TS), TKN content (2.4 kg/t dry weight, in both landfills) and VS/TS ratio (55% and 16% in Ämmässuo and Kujala, respectively) in the bottom layers. In conclusion, waste sampling is a feasible way of characterising the landfill body, despite the high variation observed and the fact that the minimum number and size of samples cannot easily be generalized to other landfills due to different methods of waste management and different landfilling histories.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

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

Number of pages: 13

Pages: 151-163

Publication date: 2008

Peer-reviewed: Yes

### Publication information

Journal: Waste Management

Volume: 28

Issue number: 1

ISSN (Print): 0956-053X

Ratings:

Scopus rating (2008): SJR 1.375 SNIP 2.162

Original language: English

ASJC Scopus subject areas: Geotechnical Engineering and Engineering Geology, Management, Monitoring, Policy and Law, Pollution, Waste Management and Disposal

DOIs:

10.1016/j.wasman.2007.01.003

Source: Scopus

Source ID: 35548944982

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

### Landfill gas upgrading with countercurrent water wash

A pilot-scale countercurrent absorption process for upgrading landfill gas to produce vehicle fuel was studied using absorption and desorption units and water as absorbent. The height-to-diameter ratio of the absorption column used was 3:1 instead of the more conventionally used 20:1 ratio, and a higher pressure was used along with a lower water flow rate. The effects of pressure (10-30 bar) and water and gas flow-ratios on the upgrading process were studied. Methane

content in the product gas increased to near or above 90% with both gas flows (50 and 100 l/min) used at over 20 bar pressure with 10 l/min water flow and at 30 bar pressure with 5 l/min water flow. Carbon dioxide content with these upgrading parameters ranged from 3.2% to 4.8%. The remaining fraction of the product gas was nitrogen (from 6% to 7%), while hydrogen sulphide was removed to below the detection limit with all of the upgrading parameters used. The methane content of exhaust gas increased with increasing pressure. In conclusion, the pilot-scale gas upgrading process studied here appears to be able to produce gas with high energy content (>90% methane), apparently suitable as vehicle fuel, from landfill gas.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Jyväskylän yliopisto, University of Jyväskylä  
Contributors: Rasi, S., Läntelä, J., Veijanen, A., Rintala, J.  
Number of pages: 7  
Pages: 1528-1534  
Publication date: 2008  
Peer-reviewed: Yes

### Publication information

Journal: Waste Management  
Volume: 28  
Issue number: 9  
ISSN (Print): 0956-053X  
Ratings:  
Scopus rating (2008): SJR 1.375 SNIP 2.162  
Original language: English  
ASJC Scopus subject areas: Geotechnical Engineering and Engineering Geology, Management, Monitoring, Policy and Law, Pollution, Waste Management and Disposal  
DOIs:  
10.1016/j.wasman.2007.03.032  
Source: Scopus  
Source ID: 45849134565  
Research output: Contribution to journal › Article › Scientific › peer-review

### Mechanically-biologically treated municipal solid waste as a support medium for microbial methane oxidation to mitigate landfill greenhouse emissions

The residual fraction of mechanically-biologically treated municipal solid waste (MBT residual) was studied in the laboratory to evaluate its suitability and environmental compatibility as a support medium in methane (CH<sub>4</sub>) oxidative biocovers for the mitigation of greenhouse gas emissions from landfills. Two MBT residuals with 5 and 12 months total (aerobic) biological stabilisation times were used in the study. MBT residual appeared to be a favourable medium for CH<sub>4</sub> oxidation as indicated by its area-based CH<sub>4</sub> oxidation rates (12.2-82.3 g CH<sub>4</sub> m<sup>-2</sup> d<sup>-1</sup> at 2-25 °C; determined in CH<sub>4</sub>-sparged columns). The CH<sub>4</sub> oxidation potential (determined in batch assays) of the MBT residuals increased during the 124 d column experiment, from <1.6 to a maximum of 104 μg CH<sub>4</sub> g<sub>dw</sub><sup>-1</sup> h<sup>-1</sup> (dw = dry weight) at 5 °C and 578 μg CH<sub>4</sub> g<sub>dw</sub><sup>-1</sup> h<sup>-1</sup> at 23 °C. Nitrous oxide (N<sub>2</sub>O) production in MBT residual (<15 μg N<sub>2</sub>O kg<sub>dw</sub><sup>-1</sup> d<sup>-1</sup> in the CH<sub>4</sub> oxidative columns) was at the lower end of the range of N<sub>2</sub>O emissions reported for landfills and non-landfill soils, and insignificant as a greenhouse gas source. Also, anaerobic gas production (25.6 l kg<sub>dw</sub><sup>-1</sup> during 217 d) in batch assays was low, indicating biological stability of the MBT residual. The electrical conductivities (140-250 mS m<sup>-1</sup>), as well as the concentrations of zinc (3.0 mg l<sup>-1</sup>), copper (0.5 mg l<sup>-1</sup>), arsenic (0.3 mg l<sup>-1</sup>), nickel (0.1 mg l<sup>-1</sup>) and lead (0.1 mg l<sup>-1</sup>) in MBT residual eluates from a leaching test (EN-12457-4) with a liquid/solid (L/S) ratio of 10:1, suggest a potential for leachate pollutant emissions which should be considered in plans to utilise MBT residual. In conclusion, the laboratory experiments suggest that MBT residual can be utilised as a support medium for CH<sub>4</sub> oxidation, even at low temperatures, to mitigate greenhouse gas emissions from landfills.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Jyväskylän yliopisto, University of Jyväskylä  
Contributors: Einola, J. K. M., Karhu, A. E., Rintala, J. A.  
Number of pages: 15  
Pages: 97-111  
Publication date: 2008  
Peer-reviewed: Yes

### Publication information

Journal: Waste Management



Volume: 28  
Issue number: 1  
ISSN (Print): 0956-053X  
Ratings:

Scopus rating (2008): SJR 1.375 SNIP 2.162

Original language: English

ASJC Scopus subject areas: Geotechnical Engineering and Engineering Geology, Management, Monitoring, Policy and Law, Pollution, Waste Management and Disposal

DOIs:

10.1016/j.wasman.2007.01.002

Source: Scopus

Source ID: 35548991075

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

### **Landfill methane oxidation in engineered soil columns at low temperature**

Though engineered covers have been suggested for reducing landfill methane emissions via microbial methane oxidation, little is known about the covers' function at low temperature. This study aimed to determine the methane consumption rates of engineered soil columns at low temperature (4-12°C) and to identify soil characteristics that may enhance methane oxidation in the field. Engineered soils (30 cm thick) were mixtures of sewage sludge compost and de-inking waste, amended with sand (SDS soil) or bark chips (SDB soil). At 4-6°C, we achieved rates of 0.09 gCH<sub>4</sub> kgTS<sup>-1</sup> d<sup>-1</sup> (0.02 m<sup>3</sup> m<sup>-2</sup> d<sup>-1</sup>) and 0.06 gCH<sub>4</sub> kgTS<sup>-1</sup> d<sup>-1</sup> (0.009 m<sup>3</sup> m<sup>-2</sup> d<sup>-1</sup>) with SDS and SDB soils, respectively. With SDS, good movement and exchange of oxygen in porous soil moderated the slowdown of microbial activity so that the rate dropped only by half as temperature declined from 21-23°C to 4-6°C. In SDB, wet bark chips reduced the soil's air-filled porosity and intensified non-methanotrophic microbial activity, thus reducing the methane consumption rate at 4-6°C to one fourth of that at 21-23°C. In conclusion, soil characteristics such as air-filled porosity, water holding capacity, quantity and stabilization of organic amendments that affect the movement and exchange of oxygen are important variables in designing engineered covers for high methane oxidation at low temperature.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Jyväskylä, Jyväskylän yliopisto, Tritonet Ltd.

Contributors: Kettunen, R. H., Einola, J. K. M., Rintala, J. A.

Number of pages: 22

Pages: 313-334

Publication date: Nov 2006

Peer-reviewed: Yes

### **Publication information**

Journal: Water Air and Soil Pollution

Volume: 177

Issue number: 1-4

ISSN (Print): 0049-6979

Ratings:

Scopus rating (2006): SJR 0.574 SNIP 0.916

Original language: English

ASJC Scopus subject areas: Atmospheric Science, Pollution, Environmental Science(all), Environmental Chemistry, Water Science and Technology, Earth-Surface Processes

Keywords: Landfill cover, Low temperature, Methane oxidation, Organic amendments, Soil

DOIs:

10.1007/s11270-006-9176-0

Source: Scopus

Source ID: 33845511153

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

### **Anaerobic solubilisation of nitrogen from municipal solid waste (MSW)**

This paper reviews anaerobic solubilisation of nitrogen municipal solid waste (MSW) and the effect of current waste management practises on nitrogen release. The production and use of synthetically fixed nitrogen fertiliser in food production has more than doubled the flow of excessive nitrogenous material into the community and hence into the waste disposal system. This imbalance in the global nitrogen cycle has led to uncontrolled nitrogen emissions into the atmosphere and water systems. The nitrogen content of MSW is up to 4.0% of total solids (TS) and the proteins in MSW have a lower rate of degradation than cellulose. The proteins are hydrolysed through multiple stages into amino acids that are further fermented into volatile fatty acids, carbon dioxides, hydrogen gas, ammonium and reduced sulphur. Anaerobic digestion of MSW putrescibles could solubilise around 50% of the nitrogen. Thus, the anaerobic digestion of putrescibles may become an important method of increasing the rate of nitrogen recycling back to the ecosystem. A large proportion of

the nitrogen in MSW continues to end up in landfills; for example, in the EU countries around 2 million tonnes of nitrogen is disposed of annually this way. Nitrogen concentration in the leachates of existing landfills are likely to remain at a high level for decades to come. Under present waste management practices with a relatively low level of efficiency in the source segregation or mechanical sorting of putrescibles from grey waste and with a low level of control over landfill operating procedures, nitrogen solubilisation from landfilled waste will take at least a century.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Jyväskylä, Jyväskylän yliopisto, Metener Ltd

Contributors: Jokela, J. P. Y., Rintala, J. A.

Number of pages: 11

Pages: 67-77

Publication date: 2003

Peer-reviewed: Yes

#### Publication information

Journal: Reviews in Environmental Science and Bio-Technology

Volume: 2

Issue number: 1

ISSN (Print): 1569-1705

Ratings:

Scopus rating (2003): SJR 0.316 SNIP 0.349

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Applied Microbiology and Biotechnology, Waste Management and Disposal, Pollution

Keywords: Ammonia, Anaerobic digestion, Hydrolysis, Landfill, Leachate, Municipal solid waste, Nitrogen, Waste management

DOIs:

10.1023/B:RESB.0000022830.62176.36

Source: Scopus

Source ID: 36248984678

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

#### Thermophilic aerobic wastewater treatment, process performance, biomass characteristics, and effluent quality

Thermophilic aerobic wastewater treatment is reviewed. Thermophilic processes have been studied in laboratory and pilot-scale while full-scale applications are rare. The paper focuses on the microbiology of aerobic thermophiles, performance of the aerobic wastewater treatments, sludge yield, and alternatives to enhance performance of the thermophilic process. Thermophilic processes have been shown to operate under markedly high loading rates (30-180 kg COD m<sup>-3</sup>d<sup>-1</sup>).

Reported sludge production values under thermophilic conditions vary between 0.05 and 0.3 kg SS kg COD<sub>removed</sub>, which are about the same or lower than generally obtained in mesophilic processes. Compared to analogous mesophilic treatment, thermophilic treatment commonly suffers from poorer effluent quality, measured by lower total COD and filtrated (GF-A) COD removals. However, in the removal of soluble (bacterial membrane filtered) COD both mesophilic and thermophilic treatments have produced similar results. Sludge settleability in thermophilic processes have been reported to be better or poorer than in analogous mesophilic processes, although cases with better settling properties are rare. Combining thermophilic with mesophilic treatment or ultrafiltration may in some cases markedly improve effluent quality.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Jyväskylän yliopisto, University of Jyväskylä

Contributors: Suvilampi, J., Rintala, J.

Number of pages: 17

Pages: 35-51

Publication date: 2003

Peer-reviewed: Yes

#### Publication information

Journal: Reviews in Environmental Science and Bio-Technology

Volume: 2

Issue number: 1

ISSN (Print): 1569-1705

Ratings:

Scopus rating (2003): SJR 0.316 SNIP 0.349

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Applied Microbiology and Biotechnology, Waste Management and Disposal, Pollution

Keywords: Aerobic wastewater treatment, Process efficiency, Thermophilic

DOIs:

10.1023/B:RESB.0000022959.46025.9a

Source: Scopus

Source ID: 33646819182

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