

## Toxicological evaluation of exhaust emissions from light-duty vehicles using different fuel alternatives in sub-freezing conditions

**Background:** Emissions from road traffic are under constant discussion since they pose a major threat to human health despite the increasingly strict emission targets and regulations. Although the new passenger car regulations have been very effective in reducing the particulate matter (PM) emissions, the aged car fleet in some EU countries remains a substantial source of PM emissions. Moreover, toxicity of PM emissions from multiple new types of bio-based fuels remain uncertain and different driving conditions such as the sub-zero running temperature has been shown to affect the emissions. Overall, the current literature and experimental knowledge on the toxicology of these PM emissions and conditions is scarce.

**Methods:** In the present study, we show that exhaust gas PM from newly regulated passenger cars fueled by different fuels at sub-zero temperatures, induce toxicological responses in vitro. We used exhaust gas volume-based PM doses to give us better insight on the real-life exposure and included one older diesel car to estimate the effect of the new emissions regulations.

**Results:** In cars compliant with the new regulations, gasoline (E10) displayed the highest PM concentrations and toxicological responses, while the higher ethanol blend (E85) resulted in slightly lower exhaust gas PM concentrations and notably lower toxicological responses in comparison. Engines powered by modern diesel and compressed natural gas (CNG) yielded the lowest PM concentrations and toxicological responses.

**Conclusions:** The present study shows that toxicity of the exhaust gas PM varies depending on the fuels used. Additionally, concentration and toxicity of PM from an older diesel car were vastly higher, compared to contemporary vehicles, indicating the beneficial effects of the new emissions regulations.

### General information

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

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

## Pulmonary toxicity of Fe<sub>2</sub>O<sub>3</sub>, ZnFe<sub>2</sub>O<sub>4</sub>, NiFe<sub>2</sub>O<sub>4</sub> and NiZnFe<sub>4</sub>O<sub>8</sub> nanomaterials: Inflammation and DNA strand breaks

Exposure to metal oxide nanomaterials potentially occurs at the workplace. We investigated the toxicity of two Fe-oxides: Fe<sub>2</sub>O<sub>3</sub> nanoparticles and nanorods; and three MFe<sub>2</sub>O<sub>4</sub> spinels: NiZnFe<sub>4</sub>O<sub>8</sub>, ZnFe<sub>2</sub>O<sub>4</sub>, and NiFe<sub>2</sub>O<sub>4</sub> nanoparticles. Mice were dosed 14, 43 or 128 µg by intratracheal instillation. Recovery periods were 1, 3, or 28 days. Inflammation – neutrophil influx into bronchoalveolar lavage (BAL) fluid – occurred for Fe<sub>2</sub>O<sub>3</sub> rods (1 day), ZnFe<sub>2</sub>O<sub>4</sub> (1, 3 days), NiFe<sub>2</sub>O<sub>4</sub> (1, 3, 28 days), Fe<sub>2</sub>O<sub>3</sub> (28 days) and NiZnFe<sub>4</sub>O<sub>8</sub> (28 days). Conversion of mass-dose into specific surface-area-dose showed that inflammation correlated with deposited surface area and consequently, all these nanomaterials belong to the so-called low-solubility, low-toxicity class. Increased levels of DNA strand breaks were observed for both Fe<sub>2</sub>O<sub>3</sub> particles and rods, in BAL cells three days post-exposure. To our knowledge, this is, besides magnetite (Fe<sub>3</sub>O<sub>4</sub>), the first study of the pulmonary toxicity of MFe<sub>2</sub>O<sub>4</sub> spinel nanomaterials.

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Organisations: Materials Science and Environmental Engineering, Research group: Materials Characterization, National Research Centre for the Working Environment (NRCWE), Member of the German Center for Lung Research (DZL), German Research Center for Environmental Health, National Institute of Occupational Health, Risø Campus  
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### 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.

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Organisations: Materials Science and Environmental Engineering, Research group: Bio- and Circular Economy, University of La Coruña (UDC), UNESCO-IHE Institute for Water Education

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### Bibliographical note

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EXT="Lens, Piet N.L."

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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.

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

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INT=phys,"Wihersaari, Hugo"

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### Associations between indoor environmental quality in schools and symptom reporting in pupil-administered questionnaires

Background: The associations between indoor environmental quality (IEQ) in homes and symptom reporting of children have been extensively studied, but only few large-scale studies have been done in schools. We examined associations between expert-assessed IEQ in schools and pupils' reporting of different symptoms, and whether associations were stronger if participants relate symptoms to the school environment. Methods: The questionnaire survey was done in all primary and secondary schools in two areas of Helsinki, Finland. Primary school pupils (grade 3-6, n = 8775, 99 school-

buildings) and secondary school pupils (grade 7-9, n = 3410, 30 school-buildings) reported their symptoms. Symptoms were combined into respiratory, lower respiratory, eye, skin, and general symptom groups. Surveys were also done among the parents of the primary school pupils (grade 1-6, n = 3540, 88 school buildings), but results are reported only in the supplement due to the low response rate (20% in 2017 and 13% in 2018). The associations between IEQ and symptoms were analyzed using multilevel logistic regression analysis. Results: Several of the IEQ indicators were highly correlated and indicators were therefore mainly analyzed by combining them into a summary score and into latent classes. Dose-response associations were found between IEQ problems and higher reporting of respiratory and general symptoms among both primary and secondary school pupils. Some associations were also observed with lower respiratory and skin symptoms, but not with eye symptoms. The associations were somewhat stronger with symptoms related to the school environment compared to symptoms reported without such relation: For a unit change in IEQ summary score and respiratory symptoms in primary schools, odds ratios were 1.07 (95% CI 1.02-1.06) and 1.04 (95% CI 1.04-1.10), and in secondary schools 1.09 (95% CI 1.01-1.09) and 1.05 (95% CI 1.02-1.17), respectively. Conclusions: Expert-assessed IEQ problems in schools were associated with increased reporting of especially respiratory and general symptoms. The associations were only somewhat stronger in magnitude for symptoms reported in relation to the school environment compared to symptoms reported without such relation.

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Organisations: Civil Engineering, University of Helsinki Faculty of Medicine, Unit of Civil Engineering, National Public Health Institute

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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.

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

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### **Airport emission particles: Exposure characterization and toxicity following intratracheal instillation in mice**

Background: Little is known about the exposure levels and adverse health effects of occupational exposure to airplane emissions. Diesel exhaust particles are classified as carcinogenic to humans and jet engines produce potentially similar soot particles. Here, we evaluated the potential occupational exposure risk by analyzing particles from a non-commercial airfield and from the apron of a commercial airport. Toxicity of the collected particles was evaluated alongside NIST standard reference diesel exhaust particles (NIST2975) in terms of acute phase response, pulmonary inflammation, and genotoxicity after single intratracheal instillation in mice. Results: Particle exposure levels were up to  $1 \text{ mg/m}^3$  at the non-commercial airfield. Particulate matter from the non-commercial airfield air consisted of primary and aggregated soot particles, whereas commercial airport sampling resulted in a more heterogeneous mixture of organic compounds including salt, pollen and soot, reflecting the complex occupational exposure at an apron. The particle contents of polycyclic aromatic hydrocarbons and metals were similar to the content in NIST2975. Mice were exposed to doses 6, 18 and  $54 \mu\text{g}$  alongside carbon black (Printex 90) and NIST2975 and euthanized after 1, 28 or 90 days. Dose-dependent increases in total number of cells, neutrophils, and eosinophils in bronchoalveolar lavage fluid were observed on day 1 post-exposure for all particles. Lymphocytes were increased for all four particle types on 28 days post-exposure as well as for neutrophil influx for jet engine particles and carbon black nanoparticles. Increased Saa3 mRNA levels in lung tissue and increased SAA3 protein levels in plasma were observed on day 1 post-exposure. Increased levels of DNA strand breaks in bronchoalveolar lavage cells and liver tissue were observed for both particles, at single dose levels across doses and time points. Conclusions: Pulmonary exposure of mice to particles collected at two airports induced acute phase response, inflammation, and genotoxicity similar to standard diesel exhaust particles and carbon black nanoparticles, suggesting similar physicochemical properties and toxicity of jet engine particles and diesel exhaust particles. Given this resemblance as well as the dose-response relationship between diesel exhaust exposure and lung cancer, occupational exposure to jet engine emissions at the two airports should be minimized.

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### **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  $20^\circ\text{C}$  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 Se<sup>0</sup> 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

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Organisations: Chemistry and Bioengineering, Bhabha Atomic Research Centre, Montana State University (MSU), Hydraulic and Environmental Engineering (IHE) Inst. for Water Education

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### 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 36–40  $\mu\text{m}^2/\text{cm}^3$  measured close to the rooftop level of the street canyon, and further to 16–26  $\mu\text{m}^2/\text{cm}^3$  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.

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#### 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.

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

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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: 85015999251

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

### 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

### The possibility of decreasing 50-HZ electric field exposure near 400-kV power lines with arc flash personal protective equipment

Various guidelines for the protection of human beings against possible adverse effects resulting from exposure to electromagnetic fields (EMFs) have been published with a view towards continual improvement; therefore, decreasing exposure is an important research area. The aim of this study was to investigate the possibility of decreasing electric field exposure with arc flash rated personal protective equipment (PPE), which in this case was a set of coveralls, and to compare the measurement results to calculations using the helmet-mask measuring system. We collected the data under a 400-kV power line. The test person stood on isolated aluminum paper, and the current between the ground and the aluminum paper was measured. When the test subject wore the arc flash PPE, the current to the ground was only 9.5% of the current measured when wearing normal clothes, which represents a clear decrease in exposure.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, The Clinical Physiology and Neurophysiology Unit, The North Karelia Central Hospital and Honkalampi Centre, Fingrid Oyj

Contributors: Korpinen, L., Pirkkalainen, H., Heiskanen, T., Pääkkönen, R.

Publication date: 1 Oct 2016

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Environmental Research and Public Health

Volume: 13

Issue number: 10

Article number: 942

ISSN (Print): 1661-7827

Ratings:

Scopus rating (2016): CiteScore 3.1 SJR 0.853 SNIP 1.071

Original language: English

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

Keywords: Electric field, Exposure, Power lines

Electronic versions:

ijerph-13-00942

DOIs:

10.3390/ijerph13100942

URLs:

<http://urn.fi/URN:NBN:fi:tty-201610284666>

### Bibliographical note

EXT="Korpinen, Leena"

INT=elt,"Pääkkönen, Rauno"

Source: Scopus

Source ID: 84989225737

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

### Effect of particle size and dispersion status on cytotoxicity and genotoxicity of zinc oxide in human bronchial epithelial cells

Data available on the genotoxicity of zinc oxide (ZnO) nanoparticles (NPs) are controversial. Here, we examined the effects of particle size and dispersion status on the cytotoxicity and genotoxicity of nanosized and fine ZnO, in the

presence and absence of bovine serum albumin (BSA; 0.06%) in human bronchial epithelial BEAS-2B cells. Dynamic light scattering analysis showed the most homogenous dispersions in water alone for nanosized ZnO and in water with BSA for fine ZnO. After a 48-h treatment, both types of ZnO were cytotoxic within a similar, narrow dose range (1.5-3.0  $\mu\text{g}/\text{cm}^2$ ) and induced micronuclei at a near toxic dose range (1.25-1.75  $\mu\text{g}/\text{cm}^2$ ), both with and without BSA. In the comet assay, nanosized ZnO (1.25-1.5  $\mu\text{g}/\text{cm}^2$ ), in the absence of BSA, caused a statistically significant increase in DNA damage after 3-h and 6-h treatments, while fine ZnO did not. Our findings may be explained by better uptake or faster intracellular dissolution of nanosized ZnO without BSA during short treatments (3-6 h; the comet assay), with less differences between the two ZnO forms after longer treatments (>48 h; the in vitro micronucleus test). As ZnO is genotoxic within a narrow dose range partly overlapping with cytotoxic doses, small experimental differences e.g. in the dispersion of ZnO particles may have a substantial effect on the genotoxicity of the nominal doses added to the cell culture.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Materials Characterization, Nofer Institute of Occupational Medicine, University of Zaragoza, Finnish Institute of Occupational Health

Contributors: Roszak, J., Catalán, J., Järventaus, H., Lindberg, H. K., Suhonen, S., Vippola, M., Stepnik, M., Norppa, H.

Number of pages: 12

Pages: 7-18

Publication date: 1 Jul 2016

Peer-reviewed: Yes

#### Publication information

Journal: Mutation Research: Genetic Toxicology and Environmental Mutagenesis

Volume: 805

ISSN (Print): 1383-5718

Ratings:

Scopus rating (2016): CiteScore 4.5 SJR 0.927 SNIP 0.972

Original language: English

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

Keywords: DNA damage, Genotoxicity, Micronucleus, Nanoparticle, Zinc oxide

DOIs:

10.1016/j.mrgentox.2016.05.008

Source: Scopus

Source ID: 84973346011

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

### Possible influences of spark discharges on cardiac pacemakers

Exposure to spark discharges may occur beneath high voltage transmission lines when contact is initiated with a conductive object (such as a motor vehicle) with the spark discharge mediated by the ambient electric field from the line. The objective of this study was to assess whether such exposures could interfere with the normal functioning of implanted cardiac pacemakers (PMs). The experiment consisted of PMs implanted in a humanized phantom and then exposed to spark discharge through an upper extremity. A circuit was designed that produced spark discharges between two spherical electrodes fed to the phantom's left hand. The circuit was set to deliver a single discharge per half cycle (every 10 ms) about 10 ms in duration with a peak current of 1.2-1.3 A, thus simulating conditions under a 400kV power line operating at 50 Hz. Of 29 PMs acquired, all were tested in unipolar configuration and 20 in bipolar configuration with exposure consisting of 2 min of continuous exposure (one unit was exposed for 1 min). No interference was observed in bipolar configuration. One unit in unipolar configuration incorrectly identified ventricular extra systoles (more than 400 beats min<sup>-1</sup>) for 2 s. The use of unipolar configuration in new implants is extremely rare, thus further minimizing the risk of interference with the passage of time. Replication of this study and, if safety for human subjects can be assured, future testing of human subjects is also advisable.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Environmental Health, Fingrid Oyj, Department of Electrical and Computer Engineering, Kagawa National College of Technology, Tampere University Hospital, Finnish Institute of Occupational Health, SPAusNet, Electric Power Research Institute

Contributors: Korpinen, L., Kuisti, H., Tarao, H., Virtanen, V., Paakkönen, R., Dovan, T., Kavet, R.

Number of pages: 10

Pages: 1-10

Publication date: 2016

Peer-reviewed: Yes

### Publication information

Journal: Health Physics

Volume: 110

Issue number: 1

ISSN (Print): 0017-9078

Ratings:

Scopus rating (2016): CiteScore 2.1 SJR 0.555 SNIP 0.882

Original language: English

ASJC Scopus subject areas: Radiology Nuclear Medicine and imaging, Health, Toxicology and Mutagenesis, Epidemiology

Keywords: Electromagnetic Fields, Environmental Assessment, Exposure, Health Effects, Occupational

DOIs:

10.1097/HP.0000000000000373

Source: Scopus

Source ID: 84948454808

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 (nSe<sub>0</sub>) immobilized in pellets of *Phanerochaete chrysosporium*, to remove Zn from aqueous solutions was investigated. Fungal pellets containing nSe<sub>0</sub> (nSe<sub>0</sub>-pellets) showed to be better biosorbents as they removed more Zn (88.1 ± 5.3 %) compared to Se-free fungal pellets (56.2 ± 2.8 %) at pH 4.5 and an initial Zn concentration of 10 mg L<sup>-1</sup>. The enhanced sorption capacity of nSe<sub>0</sub>-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 nSe<sub>0</sub>-pellets fitted well to the pseudo-second order kinetic model (R<sup>2</sup> = 0.99), and the sorption isotherm was best represented by the Sips model (Langmuir-Freundlich) with heterogeneous factor n = 1 (R<sup>2</sup> = 0.99), which is equivalent to the Langmuir model. Operational advantages of fungal pelleted reactors and the Zn removal efficiencies achieved by nSe<sub>0</sub>-pellets under mild acidic conditions make nSe<sub>0</sub>-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

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

### **Scanner abdominal: Étude comparative de l'exposition patient en routine clinique sur des appareils avec et sans reconstruction itérative**

Objective: compare the dose delivered to patients and image quality in clinical routine to perform an abdominal CT scan with no iterative reconstruction techniques (IR) relative to an examination conducted on a scanner with IR. Materials and methods: this is a retrospective study of 30 patients who underwent two abdominal examinations: one on a 40-slice scanner (TDM40) without IR and another one on a 256-slice scanner with IR (TDM256). The patients, on medical follow-up for a chronic abdominal disease, had an exam on each scanner using the same protocol comprising an abdominopelvic time portal phase. The length of acquisition, the effective dose and the dose length product (DLP) as well as quantitative and qualitative assessments of the image were compared. Results: the average effective dose per examination was 17.3 mSv with the TDM40 (PDL: 1019 mGy.cm) against 11.1 mSv with the TDM256 (PDL: 654 mGy.cm), hence a reduction of 35.8% (p < 0.001). The length of acquisition and quantification were comparable in both groups. The qualitative assessment was slightly higher on the TDM40 but no examination was considered suboptimal. Conclusion: using a scanner equipped with IR significantly reduces the effective dose while maintaining image quality.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Lille University Hospital - CHRU, Univ Lille Nord de France

Contributors: Gomes, M., Leroy, C., Lemaire, S., Marmin, C., Mordon, S., Ernst, O.

Number of pages: 7

Pages: 35-41

Publication date: 2014

Peer-reviewed: Yes

### Publication information

Journal: Radioprotection

Volume: 49

Issue number: 1

ISSN (Print): 0033-8451

Ratings:

Scopus rating (2014): CiteScore 0.5 SJR 0.231 SNIP 0.332

Original language: French

ASJC Scopus subject areas: Nuclear Energy and Engineering, Renewable Energy, Sustainability and the Environment, Public Health, Environmental and Occupational Health, Waste Management and Disposal, Health, Toxicology and Mutagenesis, Safety, Risk, Reliability and Quality

Keywords: As low as reasonably achievable (ALARA), Computed tomography, Low doses, Patient dose, Radiation dose  
DOIs:

10.1051/radiopro/2013078

URLs:

<http://www.scopus.com/inward/record.url?scp=84905261404&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84905261404

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

### **Validation of exposure assessment and assessment of recruitment methods for a prospective cohort study of mobile phone users (COSMOS) in Finland: A pilot study**

Background: The aim of the study was to evaluate the agreement between self-reported and operator-derived estimates of call time based on a three-month monitoring period, as well as the consistency of mobile phone use over time. Alternative approaches to improve participation in a cohort study of mobile phone users were also compared. Methods: A total of 5,400 subjects were identified from network operators' subscriber databases for recruitment to the pilot study. Operator and questionnaire data were used to quantify mobile phone use. Operator data were available for a subset of the subjects for a three-month period in three consecutive years. We also evaluated the effect of the length of the questionnaire and one- or two-phase recruitment on participation. Results: The average response rate for both questionnaires and recruitment procedures was 12%. The response rate was not affected by the length of the questionnaire or the recruitment method. Operator data were available for 83% of the participants for 2007, the first study year. The agreement between self-reported and operator-derived call times decreased with the level of use among intermediate and heavy mobile phone users. During 2007-2009, mobile phone use increased fairly constantly over time. Conclusions: The agreement between self-reported mobile phone use and operator databases was moderate and overestimation of the call time by participants was common. A prospective cohort study would be feasible in Finland, although the potentially low participation rate would increase the resources required for recruitment.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Prostate cancer research center (PCRC), STUK - Radiation and Nuclear Safety Authority, Tampere School of Public Health

Contributors: Heinävaara, S., Tokola, K., Kurttio, P., Auvinen, A.

Publication date: 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: Environmental Health: A Global Access Science Source

Volume: 10

Issue number: 1

Article number: 14

Ratings:

Scopus rating (2011): CiteScore 3.9 SJR 1.301 SNIP 1.265

Original language: English

ASJC Scopus subject areas: Health, Toxicology and Mutagenesis, Public Health, Environmental and Occupational Health, Medicine(all)

DOIs:

10.1186/1476-069X-10-14

URLs:

<http://www.scopus.com/inward/record.url?scp=79952321418&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79952321418

Research output: Contribution to journal › Article › 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> from biodegradation. The results of the aeration study suggest that the role of atmospheric CO<sub>2</sub> 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

### 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, NH<sub>4</sub>-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

### Mutation spectra in Salmonella of analogues of MX: Implications of chemical structure for mutational mechanisms

We determined the mutation spectra in Salmonella of four chlorinated butenoic acid analogues (BA-1 through BA-4) of the drinking water mutagen 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) and compared the results with those generated previously by us for MX and a related compound, MCF. We then considered relationships between the properties of mutagenic potency and mutational specificity for these six chlorinated butenoic acid analogues. In TA98, the



three most potent mutagens, BA-3, BA-4, MX, and the organic extract, all induced large percentages of complex frameshifts (33- 67%), which distinguish these agents from any other class of compound studied previously. In TA100, which has only GC sites for mutation recovery, >71% of the mutations induced by all of the agents were GC→TA transversions. The availability of both GC and TA sites for mutation in TA104 resulted in greater distinctions in mutational specificity than in TA100. MX targeted GC sites almost exclusively (98%); the structurally similar BA-4 and BA-2 produced mutations at similar frequencies at both GC and AT sites; and the structurally similar BA-3 and BA-1 induced most mutations at AT sites (69%). Thus, large variations in structural properties influencing relative mutagenic potency appeared to be distinct from the more localized similar structural features influencing mutagenic specificity in TA104. Among a set of physicochemical properties examined for the six butenoic acids, a significant correlation was found between pK(a) and mutagenic potency in TA100, even when the unionized fraction of the activity dose was considered. In addition, a correlation in CLOGP for BA-1 to BA-4 suggested a role for bioavailability in determining mutagenic potency. These results illustrate the potential value of structural analyses for exploring the relationship between chemical structure and mutational mechanisms. To our knowledge, this is the first study in which such analyses have been applied to structural analogues for which both mutagenic potency and mutation spectra data were available.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Division of Pharmaceutical Chemistry, University of North Carolina at Charlotte, Computer Science Department, Environ. Carcinogenesis Div. (MD-68), US Environmental Protection Agency, Dept. of Food and Nutrition Science, Kyoto Women's University, Dept. of Environ. Sci. and Eng., University of Helsinki

Contributors: Demarini, D. M., Landi, S., Ohe, T., Shaughnessy, D. T., Franzén, R., Richard, A. M.

Number of pages: 15

Pages: 51-65

Publication date: 20 Sep 2000

Peer-reviewed: Yes

### Publication information

Journal: Mutation Research: Fundamental and Molecular Mechanisms of Mutagenesis

Volume: 453

Issue number: 1

ISSN (Print): 1386-1964

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Scopus rating (2000): SJR 0.962 SNIP 0.932

Original language: English

ASJC Scopus subject areas: Molecular Biology, Health, Toxicology and Mutagenesis

Keywords: Mutation spectra, MX analogues, Salmonella

DOIs:

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Source: Scopus

Source ID: 0034692550

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

### Mutation spectra of the drinking water mutagen 3-chloro-4-methyl-5-hydroxy-2(5H)-furanone (MCF) in Salmonella TA100 and TA104: Comparison to MX

The chlorinated drinking water mutagen 3-chloro-4-methyl-5-hydroxy-2(5H)-furanone (MCF) occurs at concentrations similar to or greater than that of the related furanone 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX). MCF and MX differ structurally only by replacement of a 3-methyl in MCF with a 3-dichloromethyl in MX; yet, MCF is significantly less mutagenic than MX and produces different adducts when reacted with nucleosides or DNA. To explore further the effects that these structural differences might have on the biological activity of MCF and MX, we determined the mutation spectra of MCF in Salmonella strains TA100 and TA 104 and of MX in strain TA104; the spectrum of MX in TA100 had been determined previously. In TA100, which presents only GC targets for mutagenesis, MCF induced primarily (75%) GC → TA transversions, with most of the remaining revertants (20%) being GC → AT transitions. This spectrum was not significantly different from that of MX in TA100 (P = 0.07). In TA104, which presents both GC and AT targets, MCF induced a lower percentage (57%) of GC → TA transversions, with most of the remaining revertants (33%) being AT → TA transversions. In contrast, MX induced almost only (98%) GC → TA transversions in TA104, with the remaining revertants (2%) being AT → TA transversions. Thus, almost all (98%) of the MX mutations were targeted at GC sites in TA104, whereas only 63% of the MCF mutations were so targeted. These results are consistent with the published findings that MX: (1) forms an adduct on guanosine when reacted with guanosine, (2) induces apurinic sites in DNA, and (3) forms a minor adduct on adenosine when reacted with adenosine or DNA. The results are also consistent with evidence that MCF forms adenosine adducts when reacted with adenosine. Our results show that the replacement of the 4-methyl in MCF with a 4-dichloromethyl to form MX not only increases dramatically the mutagenic potency but also shifts significantly the mutagenic specificity from almost equal targeting of GC and AT sites by MCF to almost exclusive targeting of GC sites by MX.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Abo Akad Univ, Abo Akademi University, Dept Phys, Dept. of Environ. Sci. and Eng., University of North Carolina at Charlotte, Computer Science Department, Dept. of Food and Nutrition Science, Åbo Akademi University, Kyoto Women's University, Environ. Carcinogenesis Division, U.S. Environmental Protection Agency, Department of Organic Chemistry, University of Helsinki

Contributors: Shaughnessy, D. T., Ohe, T., Landi, S., Warren, S. H., Richard, A. M., Munter, T., Franzén, R., Kronberg, L., DeMarini, D. M.

Number of pages: 8

Pages: 106-113

Publication date: 2000

Peer-reviewed: Yes

### Publication information

Journal: Environmental and Molecular Mutagenesis

Volume: 35

Issue number: 2

ISSN (Print): 0893-6692

Ratings:

Scopus rating (2000): SJR 0.778 SNIP 0.977

Original language: English

ASJC Scopus subject areas: Genetics, Environmental Science(all), Environmental Chemistry, Health, Toxicology and Mutagenesis, Genetics(clinical), Toxicology

Keywords: MCF, Mutation spectra, MX, Salmonella

DOIs:

10.1002/(SICI)1098-2280(2000)35:2<106::AID-EM5>3.0.CO;2-U

URLs:

<http://www.scopus.com/inward/record.url?scp=0034023630&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 0034023630

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

### Genotoxic activity of chlorinated butenoic acids in *Salmonella typhimurium* strains TA98, TA100 and TA104

The mutagenic activities of several chlorinated butenoic acids, recently identified in chlorinated drinking waters, were determined by the *Salmonella* microsome assay. The *Salmonella typhimurium* tester strains TA98, TA100, and TA104 were used without S9 mix. The results from the investigation showed that (Z)-2-chloro-3-(dichloromethyl)-4-oxobutenoic acid (MX, in the open form) was the most potent mutagen of the compounds tested. However, a significant number of mutations was also induced by compounds with structural similarities to MX. In general, all the compounds, except the butenedioic acids, were mutagenic in the assays for both base-pair substitution strains (TA100, TA104) and for the frameshift strain TA98, with the highest mutagenic response observed in strain TA100. When the aldehyde group of MX and of 2-chloro-3-(chloromethyl)-4-oxobutenoic acid (CMCF, in the open form) was replaced by a dichloromethyl group, the mutagenic response in strains TA98 and TA104 changed. We concluded that a frame-shift mutation occurred because of the replacement. The increase of the TA104 mutagenicity suggested that adenosine could be the target for these types of compounds. Further evidence for such possibility were the modified adenosine adducts we could identify for some chlorinated butenoic acids. Copyright (C) 1998 Elsevier Science B.V.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Helsinki University, Department of Pharmacy, Natl. Inst. for Environ. Studies, National Institute of Public Health Japan

Contributors: Franzén, R., Goto, S., Tanabe, K., Morita, M.

Number of pages: 7

Pages: 31-37

Publication date: 1 Sep 1998

Peer-reviewed: Yes

### Publication information

Journal: Mutation Research: Genetic Toxicology and Environmental Mutagenesis

Volume: 417

Issue number: 1

ISSN (Print): 1383-5718

Original language: English

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

Keywords: Chlorinated butenedioic acid, Mutagenicity test, Salmonella typhimurium strain

DOIs:

10.1016/S1383-5718(98)00092-8

URLs:

<http://www.scopus.com/inward/record.url?scp=0031660926&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 0031660926

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

### Investigation of the adducts formed by reaction of butenedioic acids with adenosine

Several genotoxic butenedioic acids present in chlorine-disinfected drinking water were allowed to react with adenosine, guanosine, and cytidine in aqueous solution. HPLC analyses, with detection at 254 and 310 nm, showed that clearly detectable products were formed only in the reactions with adenosine. The major products from the reactions between either 2-chloro-3- methyl-2-butenedioic acid (ox-MCF) or 2-chloro-3-(chloromethyl)-2- butenedioic acid (ox-CMCF) and adenosine were the same. This substance was isolated by C18 column chromatography and characterized by UV absorbance, <sup>1</sup>H and <sup>13</sup>C NMR spectroscopy, and mass spectrometry. It was identified as 3-(β-D-ribofuranosyl)-7-carboxy-7-formyl-8-[9'-(β-D-ribofuranosyl)-N<sup>6</sup>- adenosinyl]-1,N<sup>6</sup>-ethanoadenosine (cfεA,A). The yields of cfεA,A in reactions performed at pH 7.4 and 37 °C were 0.7% and 0.3% with ox-MCF and ox-CMCF, respectively.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Natl. Inst. for Environ. Studies

Contributors: Franzén, R., Morita, M., Tanabe, K., Takagi, H., Shibata, Y.

Number of pages: 6

Pages: 1186-1191

Publication date: Oct 1997

Peer-reviewed: Yes

### Publication information

Journal: Chemical Research in Toxicology

Volume: 10

Issue number: 10

ISSN (Print): 0893-228X

Original language: English

ASJC Scopus subject areas: Drug Discovery, Organic Chemistry, Chemistry(all), Toxicology, Health, Toxicology and Mutagenesis

DOIs:

10.1021/tx970036d

URLs:

<http://www.scopus.com/inward/record.url?scp=0030778905&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 0030778905

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

### Mutational spectra of Salmonella typhimurium revertants induced by chlorohydroxyfuranones, byproducts of chlorine disinfection of drinking water

The base substitution specificities of 3-chloro-4-(dichloromethyl)-5- hydroxy-2(5H)-furanone (MX), 3-chloro-4-(chloromethyl)-5-hydroxy-2(SH)- furanone (CMCF), 3,4-dichloro-5-hydroxy-2(5H)-furanone (MCA), and chloromalonaldehyde (CMA), a putative breakdown product of MCA, were examined in the hisG46 gene and in the hisG428 gene of Salmonella typhimurium using allele specific oligonucleotide hybridization. Although the compounds are structurally closely related, they induced substantially different mutation spectra: MCA and CMA caused primarily GC → AT transitions in the hisG46 allele (target sequence CCC), in particular, at the second position of the codon in strain TA100. In TA100 the mutation spectrum of MCA was similar to that of CMA. The mutational specificity of MCA can be explained as a consequence of misincorporation opposite to cyclic ethene adducts identical to those formed by the carcinogen vinyl chloride. The spectra induced by MX and CMCF in TA100 were almost identical but distinctively different from the spectra of MCA and CMA. Both compounds induced primarily GC → TA transversions, in particular, at the second position of the codon, and to a lesser extent in the first position of the codon. An identical site bias is induced by carcinogens such as polycyclic aromatic hydrocarbons and heterocyclic amines as a consequence of formation of (noncyclic) guanosine adducts. In hisG428 (target sequence TAA) MX induced again primarily GC → TA transversions in Tyr tRNA genes (supC/M) and, to a lesser extent, intragenic AT → TA transversions (TAA → AAA). The possible involvement of guanosine and adenosine adducts in the mutational specificity of MX is addressed.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Der Technischen Universität Wien Fakultät für Elektrotechnik und Informationstechnik, Tumor Biology/Cancer Research Inst., University of Vienna, Åbo Akademi University  
Contributors: Knasmüller, S., Zöhrer, E., Kronberg, L., Kundi, M., Franzen, R., Schulte-Hermann, R.  
Number of pages: 8  
Pages: 374-381  
Publication date: 1996  
Peer-reviewed: Yes

#### Publication information

Journal: Chemical Research in Toxicology  
Volume: 9  
Issue number: 2  
ISSN (Print): 0893-228X  
Original language: English  
ASJC Scopus subject areas: Drug Discovery, Organic Chemistry, Chemistry(all), Toxicology, Health, Toxicology and Mutagenesis  
DOIs:  
10.1021/tx9500686  
Source: Scopus  
Source ID: 0029882809  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Induction of genotoxic effects by chlorohydroxyfuranones, byproducts of water disinfection, in *E. coli* K-12 cells recovered from various organs of mice

The genotoxic effects of three chlorohydroxyfuranones (CHF<sub>s</sub>), 3-chloro-4-(dichloromethyl)-5-hydroxy-2[5H]-furanone (MX), 3-chloro-4-(chloromethyl)-5-hydroxy-2[5H]furanone (CMCF) and 3,4-dichloro-5-hydroxy-2[5H]furanone (MCA), which are formed as byproducts of water disinfection with chlorine, were investigated in bacterial differential DNA repair assays *in vitro* and in animal-mediated assays *in vivo*. As indicators of DNA damage, *E. coli* K-12 strains were used that differ in their repair capacity (*uvrB/recA* vs. *uvr+/rec+*). Liquid incubation of the compounds without metabolic activation caused a pronounced reduction of the viability of the repair-deficient strain relative to the repair-proficient wild-type strain. The order of potency of genotoxic activity *in vitro* (dose range 0.004-10 µg/ml) was MX > CMCF > MCA. Addition of mouse S-9 mix or bovine serum albumin to the incubation mixtures resulted in an almost complete loss of the activity of all three test compounds. In the animal-mediated assays, mixtures of the indicator bacteria were injected intravenously into mice which were subsequently treated with the test compounds (200 mg/kg b.w.). Two hours later, the cells were recovered from various organs and the relative survival frequencies determined. Under these conditions, all three compounds caused pronounced genotoxic effects, MX and CMCF being stronger genotoxins than MCA. The strongest effects were consistently found in the gastrointestinal tract, but statistically significant DNA damage was also observed in indicator cells recovered from lungs, liver, spleen and kidneys. In a further experiment, the effects of lower doses of MX (4.3, 13 and 40 mg/kg) were investigated. In these experiments dose-dependent effects were measured in all organs. CMCF and MA caused only marginal effects at 40 mg/kg except in the stomach where approximately a 50% reduction of relative survival frequency was observed with CMCF. The results of these animal-mediated assays indicate that (i) all three CHF<sub>s</sub> cause genotoxic effects in the living animal, and (ii) the potencies of the three compounds observed under *in vivo* conditions are not commensurate with their extremely high activities measured *in vitro*. One possible explanation for the weaker responses observed in the animal-mediated assays might be that CHF<sub>s</sub> are inactivated by nonspecific protein binding.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Tumor Biology/Cancer Research Inst., Institute of Tumor Biology, Cancer Research, Åbo Akademi University  
Contributors: Fekadu, K., Parzefall, W., Kronberg, L., Franzen, R., Schulte-Hermann, R., Knasmüller, S.  
Number of pages: 8  
Pages: 317-324  
Publication date: 1994  
Peer-reviewed: Yes

#### Publication information

Journal: Environmental and Molecular Mutagenesis  
Volume: 24  
Issue number: 4  
ISSN (Print): 0893-6692  
Original language: English  
ASJC Scopus subject areas: Environmental Science(all), Environmental Chemistry, Genetics, Genetics(clinical), Toxicology, Health, Toxicology and Mutagenesis

Keywords: Bacterial host mediated assay, Mucochloric acid, MX

DOIs:

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Source: Scopus

Source ID: 0028618759

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

### **Low-dose ionising radiation and cardiovascular diseases - Strategies for molecular epidemiological studies in Europe**

It is well established that high-dose ionising radiation causes cardiovascular diseases. In contrast, the evidence for a causal relationship between long-term risk of cardiovascular diseases after moderate doses (0.5-5. Gy) is suggestive and weak after low doses (

#### **General information**

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Prostate cancer research center (PCRC), Federal Office for Radiation Protection, STUK - Radiation and Nuclear Safety Authority, CREAL, Centre for Research in Environmental Epidemiology, Universitat Pompeu Fabra (UPF) and CIBER Epidemiologia y Salud Publica (CIBERESP), Centre de Recherche en Cancérologie de Lyon, UMR Inserm 1052, CNRS 5286, IRSN Institut de Radioprotection et de Surete Nucleaire, National Cancer Institute, German Research Center for Environmental Health, PHE, Netherlands Cancer Institute

Contributors: Kreuzer, M., Auvinen, A., Cardis, E., Hall, J., Jourdain, J. R., Laurier, D., Little, M. P., Peters, A., Raj, K., Russell, N. S., Tapio, S., Zhang, W., Gomolka, M.

Number of pages: 11

Pages: 90-100

Publication date: 1 Apr 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: MUTATION RESEARCH: REVIEWS IN MUTATION RESEARCH

Volume: 764

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Ratings:

Scopus rating (2015): CiteScore 10.6 SJR 2.651 SNIP 1.954

Original language: English

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

Keywords: Biomarker, Cardiovascular diseases, Epidemiology, Ionising radiation, Pathogenesis

DOIs:

10.1016/j.mrrev.2015.03.002

URLs:

<http://www.scopus.com/inward/record.url?scp=84930045539&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84930045539

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

#### Airport emission particles: Exposure characterization and toxicity following intratracheal instillation in mice

##### General information

Publication status: Published

MoE publication type: Not Eligible

Organisations: Physics, Research group: The Instrumentation, Emissions, and Atmospheric Aerosols Group, Research area: Aerosol Physics, National Research Centre for the Working Environment, Risø Campus, FORCE Technology, Työterveyslaitos

Contributors: Bendtsen, K. M., Brostrøm, A., Koivisto, A. J., Koponen, I., Berthing, T., Bertram, N., Kling, K. I., Dal Maso, M., Kangasniemi, O., Poikkimäki, M., Loeschner, K., Clausen, P. A., Wolff, H., Jensen, K. A., Saber, A. T., Vogel, U.

Publication date: 6 Nov 2019

Peer-reviewed: Unknown

Event: Paper presented at Annual meeting 2019 in Danish Society for Pharmacology and Toxicology, Sønderborg, Denmark.

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

Keywords: Airport, Exposure risk, Jet engine emission, Jet engine particle, Occupational exposure

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

#### 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