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Technical

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CHEMICAL EFFECTS

Bioenergy Generation and Phenol Degradation through Microbial Fuel Cells Energized by Domestic Organic Waste

2023-05-26

Microbial fuel cells (MFCs) seem to have emerged in recent years to degrade the organic pollutants from wastewater. The current research also focused on phenol biodegradation using MFCs. According to the US Environmental Protection Agency (EPA), phenol is a priority pollutant to remediate due to its potential adverse effects on human health. At the same time, the present study focused on the weakness of MFCs, which is the low generation of electrons due to the organic substrate. The present study used rotten rice as an organic substrate to empower the MFC's functional capacity to degrade the phenol while simultaneously generating bioenergy. In 19 days of operation, the phenol degradation efficiency was 70% at a current density of 17.10 mA/m² and a voltage of 199 mV. The electrochemical analysis showed that the internal resistance was 312.58 Ω and the maximum specific capacitance value was 0.00020 F/g on day 30, which demonstrated mature biofilm production and its stability throughout the operation. The biofilm study and bacterial identification process revealed that the presence of conductive pili species (*Bacillus* genus) are the most dominant on the anode electrode. However, the present study also explained well the oxidation mechanism of rotten rice with phenol degradation. The most critical challenges for future recommendations are also enclosed in a separate section for the research community with concluding remarks.

Authors: Asim Ali Yaqoob, Nabil Al-Zaqri, Muhammad Alamzeb, Fida Hussain, Sang-Eun Oh, Khalid Umar

Full Source: *Molecules* (Basel, Switzerland) 2023 May 25;28(11):4349. doi: 10.3390/molecules28114349.

ENVIRONMENTAL RESEARCH

Distributed IoT Air Quality Measurement System for High-Risk Workplace Safety Enhancement

2023-05-25

The safety of an operator working in a hazardous environment is a recurring topic in the technical literature of recent years, especially for high-risk environments such as oil and gas plants, refineries, gas depots, or chemical industries. One of the highest risk factors is constituted by the

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presence of gaseous substances such as toxic compounds such as carbon monoxide and nitric oxides, particulate matter or indoors, in closed spaces, low oxygen concentration atmospheres, and high concentrations of CO₂ that can represent a risk for human health. In this context, there exist many monitoring systems for lots of specific applications where gas detection is required. In this paper, the authors present a distributed sensing system based on commercial sensors aimed at monitoring the presence of toxic compounds generated by a melting furnace with the aim of reliably detecting the insurgence of dangerous conditions for workers. The system is composed of two different sensor nodes and a gas analyzer, and it exploits commercial low-cost commercially available sensors.

Authors: Lorenzo Parri, Marco Tani, David Baldo, Stefano Parrino, Elia Landi, Marco Mugnaini, Ada Fort

Full Source: *Sensors* (Basel, Switzerland) 2023 May 25;23(11):5060. doi: 10.3390/s23115060.

An updated global overview of the manufacture and unintentional formation of polychlorinated naphthalenes (PCNs)

2023-06-07

This review updates information on the historical manufacture and unintentional production of polychlorinated naphthalenes (PCNs). The direct toxicity of PCNs as a result of occupational human exposure and through contaminated feed in livestock was recognised decades ago, making PCNs a precursor chemical for consideration in occupational medicine and occupational safety. This was confirmed by the listing of PCNs by the Stockholm Convention as a persistent organic pollutant in the environment, food, animals and humans. PCNs were manufactured globally between 1910–1980, but reliable data on the volumes produced or national outputs are scarce. A total figure for global production would be useful for the purposes of inventory and control and it is clear that combustion related sources such as waste incineration, industrial metallurgy and use of chlorine are current major sources of PCNs to the environment. The upper bound estimate of total global production has been put at 400,000 metric tons but the amounts (at least, many 10 s of tonnes) that are currently emitted unintentionally every year through industrial combustion processes should also be inventoried along with estimates for emissions from bush and forest fires. This would however require considerable national effort, financing and co-operation from source operators. The historical (1910-1970 s) production and resulting emissions through diffusive/evaporative releases through usage, are

Microbial fuel cells (MFCs) seem to have emerged in recent years to degrade the organic pollutants from wastewater.

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still reflected in documented occurrence and patterns of PCNs in human milk in Europe and other locations worldwide. More recently, PCN occurrence in human milk from Chinese provinces has been linked to local unintentional emissions from thermal processes.

Authors: Michał Klimczak, Guorui Liu, Awyn R Fernandes, Anna Kilanowicz, Jerzy Falandysz

Full Source: Journal of hazardous materials 2023 Jun 7;457:131786. doi: 10.1016/j.jhazmat.2023.131786.

Sunlight and marine weathering of poly(oxymethylene): Evolution of the physico-chemical properties

2023-06-09

Plastic pollution is now an environmental problem that affects all environmental compartments. The study of plastic degradation in terrestrial, marine and other freshwater environments is emerging. Research is mainly focused on plastic fragmentation into microplastics. In this contribution, an engineering polymer, poly(oxymethylene) (POM), was studied under different weathering conditions using physico-chemical characterization techniques. A POM homopolymer and a POM copolymer were characterized by electron microscopy, tensile tests, DSC, infrared spectroscopy and rheometry tests after climatic and marine weathering or artificial UV/water spray cycles. Natural climatic conditions were the most favorable for POM degradation, especially under solar UV, as evidenced by the strong fragmentation into microplastics when subjected to artificial UV cycles. The evolution of properties with exposure time was found to be non-linear under natural conditions, in contrast to artificial conditions. Two main stages of degradation were evidenced by the correlation between strain at break and carbonyl indices.

Authors: Lata Socalingame, Maialen Palazot, Mikael Kedzierski, Stéphane Bruzard

Full Source: Marine pollution bulletin 2023 Jun 9;193:115070. doi: 10.1016/j.marpolbul.2023.115070.

Performance and Mechanism of Chlorine Dioxide on BTEX Removal in Liquid and Indoor Air

2023-05-25

With the development of the chemical industry, benzene, toluene, ethylbenzene, and xylene (BTEX) have gradually become the major indoor air pollutants. Various gas treatment techniques are widely used to prevent the physical and mental health hazards of BTEX in semi-enclosed

Plastic pollution is now an environmental problem that affects all environmental compartments.

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spaces. Chlorine dioxide (ClO₂) is an alternative to chlorine as a secondary disinfectant with a strong oxidation ability, a wide range of action, and no carcinogenic effects. In addition, ClO₂ has a unique permeability which allows it to eliminate volatile contaminants from the source. However, little attention has been paid to the removal of BTEX by ClO₂, due to the difficulty of removing BTEX in semi-enclosed areas and the lack of testing methods for the reaction intermediates. Therefore, this study explored the performance of ClO₂ advanced oxidation technology on both liquid and gaseous benzene, toluene, o-xylene, and m-xylene. The results showed that ClO₂ was efficient in the removal of BTEX. The byproducts were detected by gas chromatography-mass spectrometry (GC-MS) and the reaction mechanism was speculated using the ab initio molecular orbital calculations method. The results demonstrated that ClO₂ could remove the BTEX from the water and the air without causing secondary pollution.

Authors: Anlong Wang, Yina Qiao, Yufan Zhang, Riya Jin, Jiaoqin Liu, Zengdi He, Mengye Jia, Jingshuai Gao, Chengjie Guo

Full Source: Molecules (Basel, Switzerland) 2023 May 25;28(11):4342. doi: 10.3390/molecules28114342.

PHARMACEUTICAL/TOXICOLOGY

Cancer incidence among workers in soft paper mills: A cohort study

2023-06-11

Objectives: To elucidate whether occupational exposure to soft paper dust increases the incidence of cancer.

Methods: We studied 7988 workers in Swedish soft paper mills from 1960 to 2008, of whom 3233 (2 187 men and 1046 women) had more than 10 years of employment. They were divided into high exposure (>5 mg/m³ for >1 year) or lower exposure to soft paper dust based on a validated job-exposure matrix. They were followed from 1960 to 2019, and person-years at risk were stratified according to gender, age, and calendar-year. The expected numbers of incident tumors were calculated using the Swedish population as the reference, and standardized incidence ratios (SIR) with 95% confidence intervals (95% CI) were assessed.

Results: Among high-exposure workers with more than 10 years of employment, there was an increased incidence of colon cancer (SIR 1.66, 95% CI 1.20-2.31), small intestine cancer (SIR 3.27, 95% CI 1.36-7.86), and thyroid gland cancer (SIR 2.68, 95% CI 1.11-6.43), as well as lung cancer (SIR 1.56, 95% CI 1.12-2.19). Among the lower-exposed workers there was an

Objectives: To elucidate whether occupational exposure to soft paper dust increases the incidence of cancer.

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increased incidence of connective tissue tumors (sarcomas) (SIR 2.26, 95% CI 1.13-4.51) and pleural mesothelioma (SIR 3.29, 95% CI 1.37-7.91).

Conclusion: Workers in soft paper mills with high exposure to soft paper dust have an increased incidence of large and small intestine tumors. Whether the increased risk is caused by paper dust exposure or some unknown associated factors is unclear. The increased incidence of pleural mesothelioma is probably linked to asbestos exposure. The reason for increased incidence of sarcomas is unknown.

Authors: Kjell Torén, Richard L Neitzel, Helena P Eriksson, Eva Andersson
Full Source: American journal of industrial medicine 2023 Jun 11. doi: 10.1002/ajim.23508.

Assessing the chemical composition, potential toxicity and cancer risk of airborne fine particulate matter (PM2.5) near a petrochemical industrial area

2023-06-07

In the vicinity of a petrochemical industrial region in São Paulo, Brazil, PM2.5-bound organic carbon (OC), elemental carbon (EC), polycyclic aromatic hydrocarbons (PAHs), nitro-PAHs, oxy-PAHs, hopanes, and inorganic species were evaluated. Oxidative potential (OP), burden (OB), and *Alivibrio fischeri* bioluminescence inhibition (AFBIA) assays were conducted to determine the potential health effects of exposure to these compounds. The PM2.5 mean concentration was $32.0 \pm 18.2 \mu\text{g}/\text{m}^3$, and benzo (a)pyrene was found to exceed recommended levels by at least four times. Secondary sources and vehicular emissions were indicated by nitro-PAHs, oxy-PAHs, and inorganic species. The OP and OB results revealed that secondary compounds favored antioxidant depletion. The AFBIA results showed that 64% of the samples were toxic. These findings emphasize the need to reduce the exposure risk and take measures to protect human health.

Authors: Sofia Caumo, Aleinnys B Yera, Célia Alves, Ismael Casotti Rienda, Nora Kováts, Katalin Hubai, Pérola de Castro Vasconcellos
Full Source: Environmental toxicology and pharmacology 2023 Jun 7;104170. doi: 10.1016/j.etap.2023.104170.

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OCCUPATIONAL

Work in nursing homes and occupational exposure to endotoxin and bacterial and fungal species

2023-06-10

Indoor microbial exposure may cause negative health effects. Only little is known about the occupational microbial exposure in nursing homes and the factors that influence the exposure. The exposure in nursing homes may be increased due to close contact with elderly persons who may carry infectious or antimicrobial-resistant microorganisms and due to handling of laundry, such as used clothing and bed linen. We investigated the microbial exposure in 5 nursing homes in Denmark, by use of personal bioaerosol samples from different groups of staff members taken during a typical working day, stationary bioaerosol measurements taken during various work tasks, sedimented dust samples, environmental surface swabs, and swabs from staff members' hands. From the samples, we explored bacterial and fungal concentrations and species composition, endotoxin levels, and antimicrobial resistance in *Aspergillus fumigatus* isolates. Microbial concentrations from personal exposure samples differed among professions, and geometric means (GM) were 2,159 cfu/m³ (84 to 1.5×10^5) for bacteria incubated on nutrient agar, 1,745 cfu/m³ (82 to 2.0×10^4) for bacteria cultivated on a *Staphylococcus* selective agar, and 16 cfu/m³ air for potential pathogenic fungi incubated at 37 °C (below detection limit to 257). Bacterial exposures were elevated during bed making. On surfaces, the highest bacterial concentrations were found on bed railings. The majority of bacterial species found were related to the human skin microflora, such as different *Staphylococcus* and *Corynebacterium* species. Endotoxin levels ranged from 0.02 to 59.0 EU/m³, with a GM of 1.5 EU/m³. Of 40 tested *A. fumigatus* isolates, we found one multiresistant isolate, which was resistant towards both itraconazole and voriconazole, and one isolate resistant towards amphotericin B. In conclusion, we give an overview of the general microbial exposure in nursing homes and show that microbial exposures are higher for staff with more care and nursing tasks compared with administrative staff.

Authors: Pil Uthaug Rasmussen, Katrine Uhrbrand, Margit W Frederiksen, Anne Mette Madsen

Full Source: Annals of work exposures and health 2023 Jun 10;wxad032. doi: 10.1093/annweh/wxad032.

Indoor microbial exposure may cause negative health effects.

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The Epidemiological Surveillance of Mesothelioma Mortality in Italy as a Tool for the Prevention of Asbestos Exposure

2023-05-25

As part of a surveillance plan active since the early 1990s, this study evaluates malignant mesothelioma (MM) mortality for the time-window 2010-2019 in Italy, a country that banned asbestos in 1992. National and regional mortality rates for MM, and municipal standardized mortality ratios (all mesotheliomas, pleural (MPM) and peritoneal (MPeM)), by gender and age group were calculated. A municipal clustering analysis was also performed. There were 15,446 deaths from MM (11,161 males, $3.8 \times 100,000$; 4285 females, $1.1 \times 100,000$), of which 12,496 were MPM and 661 were MPeM. In the study period, 266 people ≤ 50 years died from MM. A slightly decreasing rate among males since 2014 was observed. The areas at major risk hosted asbestos-cement plants, asbestos mines (chrysotile in Balangero), shipyards, petrochemical and chemical plants, and refineries. Female mortality excesses particularly were found in municipalities with a fluoro-edenite-contaminated mine (Biancavilla) and textile facilities. Excesses were also found in a region with the presence of natural asbestos fibres and in males living in two small islands. The Italian National Prevention Plan stated recommendations to eliminate asbestos exposures and to implement health surveillance and healthcare for people exposed to asbestos.

Authors: Lucia Fazzo, Giada Minelli, Marco De Santis, Emiliano Ceccarelli, Ivano Iavarone, Amerigo Zona

Full Source: International journal of environmental research and public health 2023 May 25;20(11):5957. doi: 10.3390/ijerph20115957.

Distributed IoT Air Quality Measurement System for High-Risk Workplace Safety Enhancement

2023-05-25

The safety of an operator working in a hazardous environment is a recurring topic in the technical literature of recent years, especially for high-risk environments such as oil and gas plants, refineries, gas depots, or chemical industries. One of the highest risk factors is constituted by the presence of gaseous substances such as toxic compounds such as carbon monoxide and nitric oxides, particulate matter or indoors, in closed spaces, low oxygen concentration atmospheres, and high concentrations of CO₂ that can represent a risk for human health. In this context, there exist many monitoring systems for lots of specific applications where gas detection is

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