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CHEMICAL EFFECTS

Changes in syntrophic microbial communities, EPS matrix, and gene-expression patterns in biofilm anode in response to silver nanoparticles exposure

2020-05-12

Understanding the toxic effect of silver nanoparticles (AgNPs) on various biological wastewater treatment systems is of significant interest to researchers. In recent years, microbial electrochemical technologies have opened up new opportunities for bioenergy and chemicals production from organic wastewater. However, the effects of AgNPs on microbial electrochemical systems are yet to be understood fully. Notably, no studies have investigated the impact of AgNPs on a microbial electrochemical system fed with a complex fermentable substrate. Here, we investigated the impact of AgNPs (50 mg/L) exposure to a biofilm anode in a microbial electrolysis cell (MEC) fed with glucose. The volumetric current density was 29 ± 2.0 A/m^3 before the AgNPs exposure, which decreased to 20 ± 2.2 A/m^3 after AgNPs exposure. The biofilms produced more extracellular polymeric substances (EPS) to cope with the AgNPs exposure, while carbohydrate to protein ratio in EPS considerably increased from 0.4 to 0.7. Scanning electron microscope (SEM) imaging also confirmed the marked excretion of EPS, forming a thick layer covering the anode biofilms after AgNPs injection. Transmission electron microscope (TEM) imaging showed that AgNPs still penetrated some microbial cells, which could explain the deterioration of MEC performance after AgNPs exposure. The relative expression level of the quorum signalling gene (LuxR) increased by 30%. Microbial community analyses suggested that various fermentative bacterial species (e.g., Bacteroides, Synergistaceae_vadinCA02, Dysgonomonas, etc.) were susceptible to AgNPs toxicity, which led to the disruption of their syntrophic partnership with electroactive bacteria. The abundance of some specific electroactive bacteria (e.g., Geobacter species) also decreased. Moreover, decreased relative expressions of various extracellular electron transfer associated genes (omcB, omcC, omcE, omcZ, omcS, and pilA) were observed. However, the members of family Enterobacteriaceae, known to perform a dual function of fermentation and anodic respiration, became dominant after biofilm

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anode exposed to AgNPs. Thus, EPS extraction provided partial protection against AgNPs exposure.

Authors: Basem S Zakaria, Bipro Ranjan Dhar
Full Source: The Science of the Total Environment. 2020 Sep 10;734:139395. doi: 10.1016/j.scitotenv.2020.139395. Epub 2020 May 12.

A novel In-Situ Toxicity Identification Evaluation (iTIE) system for determining which chemicals drive impairments at contaminated sites

2020-06-15

Human-dominated waterways contain thousands of chemicals. Determining which chemical is the most important stressor is important, yet very challenging. The U.S. EPA's Toxicity Identification Evaluation (TIE) procedure uses a series of chemical and physical manipulations to fractionate compounds within a matrix and systematically identify potential toxicants through laboratory bioassay testing. While this may provide useful information, it lacks ecological realism as it is subject to laboratory-related artifacts and is resource-intensive. The in-situ Toxicity Identification Evaluation (iTIE) technology was developed to improve this approach and has undergone a number of modifications over the past several years. The novel prototype 3 consists of an array of iTIE ambient water fractionation units. Each unit is connected to a peristaltic pumping system with an organism exposure chamber that receives water from a resin chamber to chemically fractionate test site water. Test organisms included freshwater and marine standard toxicity test species. Post-fractionation waters are collected for subsequent chemical analyses. Currently, the resins allow for separation of ammonia, metals, and non-polar organics and subsequent toxicity responses are compared between treatments and unfractionated, ambient exposures. The iTIE system was deployed to a depth of 3 m and evaluated in streams and marine harbors. Chemical analyses of water and iTIE chemical sorptive resins confirmed chemical groups causing lethal to sublethal responses. The system proved to be as sensitive or more so than the traditional Phase 1 TIE test and required almost half of the resources to complete. This iTIE prototype provides a robust technology that improves stressor-causality linkages and thereby supports strong evidence

Determining which chemical is the most important stressor is important, yet very challenging.

for ecological risk weight-of-evidence assessments. This article is protected by copyright. All rights reserved.
Authors: G Allen Burton Jr, Eduardo Cimino Cervi, Kathryn Meyer, August Steigmeyer, Edward Verhamme, Jennifer Daley, Michelle Hudson, Marienne Colvin, Gunther Rosen
Full Source: Environmental toxicology and chemistry. 2020 Jun 15. doi: 10.1002/etc.4799. Online ahead of print.

ENVIRONMENTAL RESEARCH

Applicability of conventional and non-conventional parameters for municipal landfill leachate characterization

2020-07-01

The disposal of municipal solid waste (MSW) in landfills generates leachate, a highly polluting liquid to the aquatic environment. Leachate composition become a challenge to choose the best treatment process. Then, detailed techniques to determine the organic content, in terms of refractability, composition, sources and biodegradability in landfill leachate can help to choose the appropriate treatment and improve landfill management. In this sense, the aim of this study is to apply conventional and non-conventional parameters through inert chemical oxygen demand (COD) analyses and spectroscopic techniques of fluorescence and UV-vis absorbance for the characterization of municipal landfill leachate. Results indicated that physicochemical characterization cannot provided enough detailed information about leachate composition, which becomes the treatment process fragile. Inert COD, besides have high time to execution (□30 days), presented additional information on potential of biological treatability in anaerobic conditions. Dissolved organic matter (DOM) characterization showed transitions between labile and refractory organic matter compounds. Moreover, the cost estimated showed that non-conventional parameters analysis have lower investment than conventional, being their implementation feasible. In conclusion, the synergy between conventional and non-conventional parameters, and the detailed information provided by inert COD and DOM characterization,

Leachate composition become a challenge to choose the best treatment process.

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shown a useful tool to the landfill management and, consequently, improving treatment process and its efficiency.
Authors: Ellen Caroline Baettker, Caroline Kozak, Heloise Garcia Knapik, Miguel Mansur Aisse
Full Source: Chemosphere. 2020 Jul;251:126414. doi: 10.1016/j.chemosphere.2020.126414. Epub 2020 Mar 6.

Selected antibodies and current-use pesticides in riverine runoff of an urbanized river system in association with anthropogenic stresses

2020-06-05

Antibiotics and current-use pesticides are ubiquitous in the environment. It is important to figure out their spatial distribution under the influences of anthropogenic activities and transport from rivers to coastal oceans. To address this knowledge gap, the present study conducted quarterly sampling in eight main runoff outlets of the Pearl River, South China, and obtained total concentrations of antibiotics and current-use pesticides at 24-296 ng L^{-1}. Higher total concentrations of these chemicals occurred in summer, attributed to seasonal consumption patterns and washout by rainfalls, respectively. The spatial distributions of target analytes were not significantly different between the eastern and western outlets with high and moderate urbanization levels, respectively. Approximately 16.4, 17.7, and 12.5 tons of antibiotics, organophosphorus pesticides, and neonicotinoids were discharged annually from the outlets to the South China Sea. These results suggested that usage amount and hydrology exhibited positive effects on the riverine inputs of the target chemicals. In addition, most target chemicals exhibited low risks to green algae, but erythromycin and parathion posed high ecological risks to aquatic organism (Daphnid and fish).
Authors: Xiang-Pu Zhang, Yu-Yu Zhang, Lei Mai, Liang-Ying Liu, Lian-Jun Bao, Eddy Y Zeng
Full Source: The Science of the Total Environment. 2020 Jun 5;739:140004. doi: 10.1016/j.scitotenv.2020.140004. Online ahead of print.

Higher total concentrations of these chemicals occurred in summer, attributed to seasonal consumption patterns and washout by rainfalls, respectively.

Screening-level estimates of environmental release rates, predicted exposures and toxic pressures of currently used chemicals

2020-06-15

This paper describes a procedure to quantify emissions of chemicals for environmental protection, assessment and management purposes. The procedure uses production and use volumes from registration dossiers and combines these with Specific Environmental Release Category (spERC) data. The procedure was applied in a case study. Emission estimations were made for chemicals registered under the EU chemicals regulations for industrial chemicals (REACH) and for the active ingredients of medicines and crop protection products. Emissions themselves cannot be validated. Instead, emission estimates were followed by multimedia fate modeling and mixture toxic pressure modeling to predict environmental concentrations (PECs) and toxic pressures for a typical European water body at steady state, which were compared to other such data. The results show that screening-level assessments could be performed, and yielded estimates of emissions, PECs and mixture toxic pressures of chemicals used in Europe. Steady-state PECs agreed fairly with measured concentrations. The mixture toxic pressure at steady state suggests the presence of effects in aquatic species assemblages, whereby few compounds dominate the predicted impact. This study shows that our screening-level emission estimation procedure is sufficiently accurate and precise to serve as a basis for assessment of chemical pollution in aquatic ecosystems at the scale of river catchments. Given a recognized societal need to develop methods for realistic, cumulative exposures, the emission assessment procedure can assist the prioritization of chemicals in safety policies (such as EU-REACH), where 'possibility to be used safely' needs to be demonstrated, and environmental quality policies (such as the EU Water Framework Directive), where 'good environmental quality' needs to be reached. This article is protected by copyright. All rights reserved.

Authors: Dik van de Meent, Dick de Zwart, Leo Posthuma

Full Source: Environmental Toxicology and Chemistry. 2020 Jun 15. doi: 10.1002/etc.4801. Online ahead of print.

The data gaps make the carcinogenic risk uncontrollable.

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PHARMACEUTICAL/TOXICOLOGY

Curation of cancer hallmark-based genes and pathways for in silico characterization of chemical carcinogenesis

2020-01-01

Exposure to toxic substances in the environment is one of the most important causes of cancer. However, the time-consuming process for the identification and characterization of carcinogens is not applicable to a huge amount of testing chemicals. The data gaps make the carcinogenic risk uncontrollable. An efficient and effective way of prioritizing chemicals of carcinogenic concern with interpretable mechanism information is highly desirable. This study presents a curation work for genes and pathways associated with 11 hallmarks of cancer (HOCs) reported by the Halifax Project. To demonstrate the usefulness of the curated HOC data, the interacting HOC genes and affected HOC pathways of chemicals of the three carcinogen lists from IARC, NTP and EPA were analyzed using the in silico toxicogenomics ChemDIS system. Results showed that a higher number of affected HOCs were observed for known carcinogens than the other chemicals. The curated HOC data is expected to be useful for prioritizing chemicals of carcinogenic concern. Database URL: The HOC database is available at https://github.com/hocdb-KMU-TMU/hocdb and the website of Database journal as Supplementary Data.

Authors: Peir-In Liang, Chia-Chi Wang, Hsien-Jen Cheng, Shan-Shan Wang, Ying-Chi Lin, Pinpin Lin, Chun-Eei Tung

Full Source: Database: the journal of biological databases and curation. 2020 Jan 1;2020:baaa045. doi: 10.1093/database/baaa045.

Significant exposures to exogenous N-EDCs may result from ingestion of foods such as soy-based diets, green tea, and sweet mustard.

Human exposure to Synthetic Endocrine Disrupting Chemicals (S-EDCs) is generally negligible as compared to natural compounds with higher or comparable endocrine activity. How to evaluate the risk of the S-EDCs?

2020-07-17

Theoretically, both synthetic endocrine-disrupting chemicals (S-EDCs) and natural (exogenous and endogenous) endocrine-disrupting chemicals (N-EDCs) can interact with endocrine receptors and disturb hormonal balance. However, compared to endogenous hormones, S-EDCs are only weak partial agonists with receptor affinities several orders of magnitude lower than S-EDCs. Thus, to elicit observable effects, S-EDCs require considerably higher concentrations to attain sufficient receptor

occupancy or to displace natural hormones and other endogenous ligands. Significant exposures to exogenous N-EDCs may result from ingestion of foods such as soy-based diets, green tea, and sweet mustard. While their potencies are lower as compared to natural endogenous hormones, they usually are considerably more potent than S-EDCs. Effects of exogenous N-EDCs on the endocrine system were observed at high dietary intakes. A causal relation between their mechanism of action and these effects is established and biologically plausible. In contrast, the assumption that the much lower human exposures to S-EDCs may induce observable endocrine effects is not plausible. Hence, it is not surprising that epidemiological studies searching for an association between S-EDC exposure and health effects have failed. Regarding testing for potential endocrine effects, a scientifically justified screen should use in vitro tests to compare potencies of S-EDCs with those of reference N-EDCs. When the potency of the S-EDC is similar or smaller than that of the N-EDC, further testing in laboratory animals and regulatory consequences are not warranted.

Authors: Herman Autrup, Frank A Barile, Sir Colin Berry, Bas J Blaauboer, Alan Boobis, Hermann Bolt, Christopher J Borgert, Wolfgang Dekant, Dnaiel Dietrich, Jose L Domingo, Gio Batta Gori, Helmut Greim, Jan Hengstler, Sam Kacew, Hans Marquardt, Olavi Pelkonen, Kai Savolainen, Pat Heslop-Harrison, Nico P Vermeulen
Full Source: Journal of toxicology and environmental health: part A. 2020 Jul 17;83(13-14):485-494. doi: 10.1080/15287394.2020.1756592. Epub 2020 Jun 18.

One such chemical is Dechlorane Plus, a flame retardant, that is now detected in humans and the environment.

Exposure to low doses of Dechlorane Plus promotes adipose tissue dysfunction and glucose intolerance in male mice

2020-06-18

The prevalence of type 2 diabetes (T2D) continues to increase worldwide. It is well established that genetic susceptibility, obesity, overnutrition and a sedentary life style are risk factors for the development of T2D. However, more recently, studies have also proposed links between exposure to endocrine-disrupting chemicals (EDCs) and altered glucose metabolism. Human exposure to environmental pollutants suspected to have endocrine disruptor activity is ubiquitous. One such chemical is Dechlorane Plus, a flame retardant, that is now detected in humans and the environment. Here we show that exposure of mice to low, environmentally relevant doses of Dechlorane Plus (DP), promoted glucose intolerance in mice fed high fat diet independent of weight gain. Further, DP had pronounced effects on the adipose tissue, where it induced the development of

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hypertrophied white adipose tissue (WAT), and increased serum levels of resistin, leptin, and plasminogen activator inhibitor-1. Further, DP exposure induced "whitening" of brown adipose tissue (BAT), and reduced BAT uncoupling protein 1 expression. Importantly, some of these effects occurred even when the mice were fed regular, low fat, diet. Finally, WAT adipogenic markers were reduced with DP treatment in the WAT. We also show that, DP directly inhibited insulin signalling in murine adipocytes and human primary subcutaneous adipocytes in vitro. Taken together, our results show that the exposure to low and environmentally relevant levels of DP may contribute to the development of T2D.

Authors: Endocrinology. 2020 Jun 18;bqaa096. doi: 10.1210/endocr/bqaa096. Online ahead of print.
Full Source:

OCCUPATIONAL

Occupational exposure top metals and solvents: allergy and airways diseases

2020-06-06

Purpose of review: Occupational allergic diseases (OAD) such as occupational contact dermatitis (OCD), occupational asthma (OA), and occupational rhinitis (OR) are the most prevalent occupational diseases in industrialized countries. The purpose of this review is to provide an update about the main occupational metal and solvent exposures related to allergy and airway diseases and to discuss newly defined causative agents and industries in this field.

Recent findings: Currently for over 400 causative agents for OA and OCD, several hundreds of agents for OR have been identified. Although many studies have reported an overall decline in OAD related to known agents after implementation of efficient and effective workplace preventive measures, the constant development of new products continuously introduces to the market potential unknown respiratory hazards. Workplace allergens are often high molecular weight (HMW) agents that are > 10 kDa molecular weight and capable of eliciting IgE sensitization. Sensitizing low molecular weight (LMW) agents are often reactive chemicals. Metals and solvents are two large causative agent groups related to OADs that mainly behave as LMW (< 10 kDa) sensitizers and/or irritants. Avoidance of causative exposures through control strategies is the primary prevention approach for OADs. These strategies must be applied and covered for all known and newly defined causative agents. This review aims to summarize current status of known occupational metal and

Currently for over 400 causative agents for OA and OCD, several hundreds of agents for OR have been identified.

solvent exposures related to allergy and airway diseases and to discuss newly defined causative agents and industries in this field.
Authors: Ozlem Kar Kurt, Nursen Basaran
Full Source: Current allergy and asthma reports. 2020 Jun 6;20(8):38. doi: 10.1007/s11882-020-00931-7.

Liver fibrosis associated with potential vinyl chloride and ethylene dichloride exposure from the petrochemical industry

2020-06-03
Background: The understanding of the relationship between exposure to carcinogenic vinyl chloride (VCM) and ethylene dichloride (EDC) and liver fibrosis is limited.
Objective: This study aimed to investigate the associations between the urinary metabolite levels of VCM and EDC and the risk of liver fibrosis in residents living near a petrochemical complex.
Methods: Our study comprised 447 adult residents of two townships with questionnaire survey and health examination near the largest petrochemical complex in central Taiwan. The urinary levels of thiodiglycolic acid (TdGA), the metabolite of VCM and EDC, were detected in study subjects. We utilized fibrosis-4 (FIB-4) as the noninvasive liver fibrosis index. Adjusted linear model was applied to evaluate the associations between the distance from the complex and the urinary TdGA levels. Adjusted logistic regression model was applied to evaluate the associations between the urinary TdGA levels and the risk of liver fibrosis.
Results: The study subjects living in the closer township had significant higher urinary TdGA levels than those living in the more distant township (269.6 ± 200.7 vs. 199.2 ± 164.7 μg/g creatinine) ($p < 0.001$). It showed that urinary TdGA levels were decreased 0.53-fold when the distances from the complex were increased 1-fold after adjusting for confounding factors. It demonstrated that the study subjects with the highest TdGA levels (>343.3 μg/g creatinine) had a higher risk of FIB-4>1.29 (OR = 2.09; 95% CI: 1.17, 3.78), and those with higher TdGA levels (232.7 to 343.3 μg/g creatinine) had a marginally higher risk of FIB-4>1.29 (OR = 1.65; 95% CI: 0.94, 2.90).
Conclusion: The residents living closer to the VCM/PVC plant in the petrochemical complex had higher urinary TdGA levels, which were associated with an increased risk of fibrosis. This confirmed that the EDC and VCM potentially emitted from the petrochemical industry may have an impact on the liver health of nearby residents.
Authors: Tzu-Hsuen Yuan, Jun-Lin Chen, Ruei-Hao SHie, Yen-Po Yeh, Yi-Hsuan Chen, Chang-Chuan Chan
Full Source: The Science of the Total Environment. 2020 Jun 3;739:139920. doi: 10.1016/j.scitotenv.2020.139920. Online ahead of print.

The urinary levels of thiodiglycolic acid (TdGA), the metabolite of VCM and EDC, were detected in study subjects.