CHEMWATCH

Bulletin Board

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CHEMICAL EFFECTS

Toxicity and endocrine-disrupting potential of PM 2.5: Association with particulate polycyclic aromatic hydrocarbons, phthalate esters, and heavy metals

2021-10-12

The adverse effects of fine atmospheric particulate matter with aerodynamic diameters of ≤2.5 μm (PM2.5) are closely associated with particulate chemicals. In this study, PM2.5 samples were collected from highway and industry sites in Hangzhou, China, during the autumn and winter, and their cytotoxicity and pulmonary toxicity and endocrine-disrupting potential (EDP) were evaluated in vitro and in vivo; the particulate polycyclic aromatic hydrocarbons (PAHs), phthalate esters (PAEs), and heavy metals were then characterized. The toxicological results suggested that the PM2.5 from highway site induced higher cytotoxicity (cell viability inhibition, intracellular oxidative stress, and cell membrane injury) and pulmonary toxicity (inflammatory response (IR) and oxidative stress (OS)) than the samples from industry site, while the PM2.5 from industry site exhibited higher EDP (estrogenic and anti-androgenic activity). The cytotoxicity and pulmonary toxicity of PM2.5 in the winter were higher than those in the autumn, while no seasonal difference in the endocrine-disrupting potential was observed ($p > 0.05$). The Pearson correlation analysis between the biological effects and particulate chemicals revealed that the PM2.5-induced inflammatory response and oxidative stress were closely associated with the particulate PAHs and heavy metals (Pearson correlation coefficients: rIR, PAHs = 0.822-0.988, rIR, heavy metals = 0.895-0.971, rOS, PAHs = 0.843-0.986, and rOS, heavy metals = 0.887-0.933), while particulate di (2-ethylhexyl)phthalate (DEHP) substantially contributed to the EDP of PM2.5 (rEDP, DEHP = 0.981). This study indicated that the toxicity and EDP of PM2.5 could vary with the surrounding environment and season, which was closely associated with the variations of particulate chemicals. Further studies are needed to clarify the associations between the harmful effects of PM2.5 and other contributing factors.

Authors: Qinghua Zhou, Jinyuan Chen, Junfan Zhang, Feifei Zhou, Jingjing Zhao, Xiuzhen Wei, Kaiyun Zheng, Jian Wu, Bingjie Li, Bingjun Pan

Full Source: Environmental pollution (Barking, Essex : 1987) 2021 Oct 12;292(Pt A):118349. doi: 10.1016/j.envpol.2021.118349.

The adverse effects of fine atmospheric particulate matter with aerodynamic diameters of ≤2.5 μm (PM2.5) are closely associated with particulate chemicals.

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Technical
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Airborne Fumigants and Residual Chemicals in Shipping Containers Arriving in New Zealand

2021-10-18

Background: Airborne fumigants and other hazardous chemicals inside unopened shipping containers may pose a risk to workers handling containers.

Methods: Grab air samples from 490 sealed containers arriving in New Zealand were analysed for fumigants and other hazardous chemicals. We also collected grab air samples of 46 containers immediately upon opening and measured the total concentration of volatile organic compounds in real-time during ventilation. Additive Mixture Values (AMV) were calculated using the New Zealand Workplace Exposure standard (WES) and ACGIH Threshold Limit Values (TLV) of the 8-h, time-weighted average (TWA) exposure limit. Regression analyses assessed associations with container characteristics. Results: Fumigants were detectable in 11.4% of sealed containers, with ethylene oxide detected most frequently (4.7%), followed by methyl bromide (3.5%). Other chemicals, mainly formaldehyde, were detected more frequently (84.7%). Fumigants and other chemicals exceeded the WES/TLV in 6.7%/7.8%, and 7.8%/20.0% of all containers, respectively. Correspondingly, they more frequently exceeded '1' for the AMV-TLV compared to the AMV-WES (25.7% versus 7.8%). In samples taken upon opening of doors, fumigants were detected in both fumigated and non-fumigated containers, but detection frequencies and exceedances of the WES, TLV, and AMVs were generally higher in fumigated containers. Detection frequencies for other chemicals were similar in fumigated and non-fumigated containers, and only formaldehyde exceeded both the WES and TLV in both container groups. Volatile compounds in container air reduced rapidly during ventilation. Some cargo types (tyres; personal hygiene, beauty and medical products; stone and ceramics; metal and glass; and pet food) and countries of origin (China) were associated with elevated airborne chemical and fumigant concentrations.

Conclusion: Airborne chemicals in sealed containers frequently exceed exposure limits, both in fumigated and non-fumigated containers, and may contribute to short-term peak exposures of workers unloading or inspecting containers.

Authors: Ruth Hinz, Andrea 't Mannetje, Bill Glass, Dave McLean, Jeroen Douwes

Full Source: Annals of work exposures and health 2021 Oct 18;wxab090. doi: 10.1093/annweh/wxab090.

Background: Airborne fumigants and other hazardous chemicals inside unopened shipping containers may pose a risk to workers handling containers.
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Reduced cytotoxicity of polyethyleneimine by covalent modification of antioxidant and its application to microalgal transformation

2021-10-13

The conversion of carbon dioxide into valuable chemicals is an effective strategy for combating augmented concentrations of carbon dioxide in the environment. Microalgae photosynthetically produce valuable chemicals that are used as biofuels, sources for industrial materials, medicinal leads, and food additives. Thus, improvements in microalgal technology via genetic engineering may prove to be promising for the tailored production of novel metabolites. For the transformation of microalgae, nucleic acids such as plasmid DNA (pDNA) are delivered into the cells using physical and mechanical techniques, such as electroporation, bombardment with DNA-coated microprojectiles, and vortexing with glass beads. However, owing to the electrostatic repulsion between negatively charged cell walls and nucleic acids, the delivery of nucleic acids into the microalgal cells is challenging. To solve this issue, in this study, we investigated microalgal transformation via electroporation using polyplexes with linear polyethyleneimine (LPEI) and pDNA. However, the high toxicity of LPEI decreased the transformation efficiency in Chlamydomonas reinhardtii cells. We revealed that the toxicity of LPEI was due to oxidative stress resulting from the cellular uptake of LPEI. To suppress the toxicity of LPEI, an antioxidant, 2,2,6,6-tetramethylpiperidine-1-oxyl (TEMPO), was covalently conjugated with LPEI; the conjugate was named as TEMPO-LPEI. Interestingly, with a cellular uptake tendency similar to that of LPEI, TEMPO-LPEI dramatically decreased oxidative stress and cytotoxicity. Electroporation using polyplexes of TEMPO-LPEI and pDNA enhanced the transformation efficiency, compared to those treated with bare pDNA and polyplexes of LPEI/pDNA. This result indicates that polycations conjugated with antioxidants could be useful in facilitating microalgal transformation.

Authors: Toru Yoshitomi, Haruka Karita, Natsumi Mori-Moriyama, Naoki Sato, Keitaro Yoshimoto

Full Source: Science and technology of advanced materials 2021 Oct 13;22(1):864-874. doi: 10.1080/14686996.2021.1978273.

The conversion of carbon dioxide into valuable chemicals is an effective strategy for combating augmented concentrations of carbon dioxide in the environment.

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Innovation in regulatory approaches for endocrine disrupting chemicals: The journey to risk assessment modernization in Canada

2021-10-16

Globally, regulatory authorities grapple with the challenge of assessing the hazards and risks to human and ecosystem health that may result from exposure to chemicals that disrupt the normal functioning of endocrine systems. Rapidly increasing number of chemicals in commerce, coupled with the reliance on traditional, costly animal experiments - often with limited sensitivity to many important mechanisms of endocrine disruption,- for hazard characterization, presents ongoing challenges for chemical regulation. The consequence is a limited number of chemicals for which there is sufficient data to assess if there is endocrine toxicity and hence few chemicals with thorough hazard characterization. To address this challenge, regulatory assessment of endocrine disrupting chemicals (EDCs) is benefiting from a revolution in toxicology that focuses on New Approach Methodologies (NAMs) to more rapidly identify, prioritize, and assess the potential risks from exposure to chemicals using novel, more efficient, and more mechanistically driven methodologies and tools. Incorporated into the Integrated Approaches to Testing and Assessment (IATA) and guided by conceptual frameworks such as Adverse Outcome Pathways (AOPs), emerging approaches focus initially on molecular interactions between the test chemical and potentially vulnerable biological systems instead of the need for animal toxicity data. These new toxicity testing methods can be complemented with in silico and computational toxicology approaches, including those that predict chemical kinetics. Coupled with exposure data, these will inform risk-based decision-making approaches. Canada is part of a global network collaborating on building confidence in the use of NAMs for regulatory assessment of EDCs. Herein, we review the current approaches to EDC regulation globally (mainly from the perspective of human health), and provide a perspective on how the advances for regulatory testing and assessment can be applied and discuss the promises and challenges faced in adopting these novel approaches to minimize risks due to EDC exposure in Canada, and our world.

Authors: T S Barton-Maclaren, M Wade, N Basu, S Bayen, J Grundy, V Marlatt, R Moore, L Parent, J Parrott, P Grigorova, J Pinsonnault-Cooper, V S Langlois

Full Source: Environmental research 2021 Oct 16;112225. doi: 10.1016/j.envres.2021.112225.

Globally, regulatory authorities grapple with the challenge of assessing the hazards and risks to human and ecosystem health that may result from exposure to chemicals that disrupt the normal functioning of endocrine systems.

ENVIRONMENTAL RESEARCH

Traffic-related air pollution associated pulmonary pathophysiologic changes and cardiac injury in elderly patients with COPD

2021-10-09

Traffic-related air pollution (TRAP) has shown enormous environmental toxicity, but its cardiorespiratory health impact on chronic obstructive pulmonary disease (COPD) has been less studied. We followed a panel of 45 COPD patients with 4 repeated clinical visits across 14 months in a traffic-predominated urban area of Beijing, China, with concurrent measurements of TRAP metrics (fine particulate matter, black carbon, oxides of nitrogen and carbon monoxide). Linear mixed-effect models were performed to evaluate the associations and potential pathways linking traffic pollution to indicators of spirometry, cardiac injury, inflammation and oxidative stress. We observed that interquartile range increases in moving averages of TRAP exposures at prior up to 7 days were associated with significant reductions in large and small airway functions, namely decreases in forced vital capacity of 3.1-9.3% and forced expiratory flow 25-75% of 5.9-16.4%. Higher TRAP levels were also associated with worsening of biomarkers relevant to lung injury (hepatocyte growth factor and surfactant protein D) and cardiac injury (high-sensitivity cardiac troponin I, B-type natriuretic peptide and soluble ST2), as well as enhanced airway/systemic inflammation and oxidative stress. Mediation analyses showed that TRAP exposures may prompt cardiac injury, possibly via worsening pulmonary pathophysiology. These findings highlight the importance of traffic pollution control priority in urban areas.

Authors: Tong Wang, Hongbing Xu, Yutong Zhu, Xiaoyan Sun, Jie Chen, Beibei Liu, Qian Zhao, Yi Zhang, Lingyan Liu, Jiakun Fang, Yunfei Xie, Shuo Liu, Rongshan Wu, Xiaoming Song, Bei He, Wei Huang

Full Source: Journal of hazardous materials 2021 Oct 9;424(Pt B):127463. doi: 10.1016/j.jhazmat.2021.127463.

Traffic-related air pollution (TRAP) has shown enormous environmental toxicity, but its cardiorespiratory health impact on chronic obstructive pulmonary disease (COPD) has been less studied.

Recent progress in cytometric technologies and their applications in ecotoxicology and environmental risk assessment

2021-10-15

Environmental toxicology focuses on identifying and predicting impact of potentially toxic anthropogenic chemicals on biosphere at various levels of biological organization. Presently there is a significant drive to gain deeper understanding of cellular and sub-cellular mechanisms of ecotoxicity. Most notable is increased focus on elucidation of cellular-response networks, interactomes, and greater implementation of cell-based biotests using high-throughput procedures, while at the same time decreasing the reliance on standard animal models used in ecotoxicity testing. This is aimed at discovery and interpretation of molecular pathways of ecotoxicity at large scale. In this regard, the applications of cytometry are perhaps one of the most fundamental prospective analytical tools for the next generation and high-throughput ecotoxicology research. The diversity of this modern technology spans flow, laser-scanning, imaging, and more recently, Raman as well as mass cytometry. The cornerstone advantages of cytometry include the possibility of multi-parameter measurements, gating and rapid analysis. Cytometry overcomes, thus, limitations of traditional bulk techniques such as spectrophotometry or gel-based techniques that average the results from pooled cell populations or small model organisms. Novel technologies such as cell imaging in flow, laser scanning cytometry, as well as mass cytometry provide innovative and tremendously powerful capabilities to analyze cells, tissues as well as to perform in situ analysis of small model organisms. In this review, we outline cytometry as a tremendously diverse field that is still vastly underutilized and often largely unknown in environmental sciences. The main motivation of this work is to highlight the potential and wide-reaching applications of cytometry in ecotoxicology, guide environmental scientists in the technological aspects as well as popularize its broader adoption in environmental risk assessment.

Authors: Donald Wlodkowic, Aleksandra Czerw, Beata Karakiewicz, Andrzej Deptała

Full Source: Cytometry. Part A : the journal of the International Society for Analytical Cytology 2021 Oct 15. doi: 10.1002/cyto.a.24508.

Extractive membrane bioreactor to detoxify industrial/hazardous landfill leachate and facilitate resource recovery

2021-10-12

Landfill leachate is a highly polluted and toxic waste stream harmful to the environment and human health, its biological treatment, even if challenging, offers the opportunity of recovering valuable resources. In this study, we propose the application of an extractive membrane bioreactor equipped with a polymeric tubing, made of Hytrel, as an innovative device able to remove specific organic toxic compounds of the leachate and, at the same time, to produce an effluent rich in valuable chemicals suitable for recovery. The leachate treatment consists in a

Landfill leachate is a highly polluted and toxic waste stream harmful to the environment and human health, its biological treatment, even if challenging, offers the opportunity of recovering valuable resources.

two-step process: the extraction of specific toxic compounds through the polymeric tubing based on the affinity with the polymer, and their subsequent biodegradation in controlled conditions in the bulk phase of the extractive membrane bioreactor, thus avoiding the direct contact of the microbial consortium with the toxic leachate. Three synthetic streams simulating leachates produced by landfills of typical industrial/hazardous waste, mixed municipal and industrial solid waste, and oil shale industry waste, whose toxic fraction is mainly constituted by phenolic compounds, have been tested. Successful performance was achieved in all the tested conditions, with high removal (≥98%) and biodegradation efficiencies (89-95%) of the toxic compounds. No mass transfer limitations across the tubing occurred during the operation and a marginal accumulation (in the range of 4-7%) into the polymer has been observed. Furthermore, volatile fatty acids and inorganic compounds contained in the leachates were fully recovered in the treated effluent. Feasibility study confirmed the applicability of the proposed bioreactor as a powerful technology able to achieve high toxic removal efficiency in leachate treatment and facilitate resource recovery.

Authors: Domenica Mosca Angelucci, Enrica Donati, M Concetta Tomei
Full Source: The Science of the total environment 2021 Oct 12;150892. doi: 10.1016/j.scitotenv.2021.150892.

OCCUPATIONAL

Association between Haematological Parameters and Exposure to a Mixture of Organophosphate and Neonicotinoid Insecticides among Male Farmworkers in Northern Thailand

2021-10-15

Exposure to insecticides may result in various health problems.

Exposure to insecticides may result in various health problems. This study investigated the association between haematological parameters and exposure to a mixture of organophosphate (OP) and neonicotinoid (NEO) insecticides among male farmworkers in Fang district, Chiang Mai province, northern Thailand. Concentrations of urinary dialkylphosphates, non-specific metabolites of OPs, and NEOs and their metabolites and haematological parameters were measured in 143 male farmworkers. The Bayesian kernel machine regression model was employed to evaluate the associations. Exposure to a mixture of insecticides was significantly associated with the mean corpuscular haemoglobin concentration (MCHC) when the concentrations of all the compounds and their metabolites were at the 60th percentile or higher compared with the 50th percentile. Furthermore, exposure to clothianidin (CLO) showed a decreasing association with MCHC when all the other insecticides were at their mean concentrations. CLO was the most likely compound to reduce MCHC, and this was confirmed by sensitivity analysis. These findings suggest that exposure to NEO insecticides, especially CLO, affects the haematological status relating to haemoglobin parameters.

Authors: Neeranuch Suwannarin, Tippawan Prapamontol, Tomohiko Isobe, Yukiko Nishihama, Ampica Mangklabruks, Tawiwan Pantasri, Somporn Chantara, Warangkana Naksen, Shoji F Nakayama
Full Source: International journal of environmental research and public health 2021 Oct 15;18(20):10849. doi: 10.3390/ijerph182010849.

Occupational Contact Dermatitis in Employees of Large-Scale Narcotic Crop Farms of Ethiopia: Prevalence and Risk Factors. A Self-Reported Study Using the Nordic Occupational Skin Questionnaire

2021-10-07

Background: Occupational skin diseases are the second leading occupational disease, accounting for almost 25% of all missed workdays.

Background: Occupational skin diseases are the second leading occupational disease, accounting for almost 25% of all missed workdays. Occupational contact dermatitis (OCD) accounts for 70% to 90% of all skin disorders in the workplace. Only a few occupational epidemiology studies have looked into the prevalence and risk factors of occupation-induced dermatitis among narcotic crop farm workers around the world. Related studies in Ethiopia are even fewer.
Methods: A cross-sectional survey was conducted in the Dirashe district of Southern Ethiopia from March 23 to April 12, 2021. Data was collected using a standardized interviewer-administered questionnaire. The history of contact dermatitis was determined using the standardized Nordic Occupational Skin Questionnaire version 2002 (NOSQ-2002). A total of 578 farm laborers took part in the study, which was conducted using a systematic random sampling. Descriptive statistics and multivariable regression were used to characterize the data and identify factors associated with occupational contact dermatitis.
Result: The prevalence of self-reported occupational contact dermatitis in the past 12 months among workers of large-scale Khat farms was (AOR: 67.80%, 95% CI [61.00, 76.23]). In the multivariable regression, being older (AOR: 5.51, 95% CI [1.79, 7.24]), working as a bundle binder (AOR: 5.74, 95% CI [2.12, 15.55]), not wearing personal protective equipment (PPE) (AOR: 2.50, 95% CI [1.64, 3.81]), and having poor knowledge of pesticides

use, storage, and disposal methods (AOR: 2.50, 95% CI [1.64, 3.81]) were associated with occupational contact dermatitis.
Conclusion: Contact dermatitis caused by work is very common among Khat farm laborers. Measures to promote safe practices and reduce exposure to hazards, such as removing expired and/or banned chemicals, purchasing alternative pesticides that meet legislative requirements, job rotation and routine training of staff on safe practices, increasing safety signage, and performing risk assessments, as well as improving the quantity and quality of institutional protective equipment supplies may thus contribute to the enhancement of safe work practices.
Authors: Aiggan Tamene
Full Source: Environmental health insights 2021 Oct 7;15:11786302211048378. doi: 10.1177/11786302211048378.

PHARAMACEUTICAL/TOXICOLOGY

Per- and polyfluoroalkyl substances, epigenetic age and DNA methylation: a cross-sectional study of firefighters

2021-10

Background: Per- and polyfluoroalkyl substances (PFASs) are persistent chemicals that firefighters encounter. Epigenetic modifications, including DNA methylation, could serve as PFASs toxicity biomarkers. Methods: With a sample size of 197 firefighters, we quantified the serum concentrations of nine PFASs, blood leukocyte DNA methylation and epigenetic age indicators via the EPIC array. We examined the associations between PFASs with epigenetic age, site- and region-specific DNA methylation, adjusting for confounders. Results: Perfluorohexane sulfonate, perfluorooctanoate (PFOA) and the sum of branched isomers of perfluorooctane sulfonate (Sm-PFOS) were associated with accelerated epigenetic age. Branched PFOA, linear PFOS, perfluorononanoate, perfluorodecanoate and perfluoroundecanoate were associated with differentially methylated loci and regions. Conclusion: PFASs concentrations are associated with accelerated epigenetic age and locus-specific DNA methylation. The implications for PFASs toxicity merit further investigation.

Background: Per- and polyfluoroalkyl substances (PFASs) are persistent chemicals that firefighters encounter.

Authors: Jaclyn M Goodrich, Miriam M Calkins, Alberto J Caban-Martinez, Todd Stueckle, Casey Grant, Antonia M Calafat, Amy Nematollahi, Alesia M Jung, Judith M Graber, Timothy Jenkins, Angela L Slitt, Alisa Dewald, Julianne Cook Botelho, Shawn Beitel, Sally Littau, John Gulotta, Darin Wallentine, Jeff Hughes, Charles Popp, Jefferey L Burgess
Full Source: Epigenomics 2021 Oct;13(20):1619-1636. doi: 10.2217/epi-2021-0225.