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CHEMICAL EFFECTS

Risk assessment of chemicals and their mixtures are hindered by scarcity and inconsistencies between different environmental exposure limits

2023-01-25

In chemical risk assessment, measured or modelled environmental concentrations are compared to environmental exposure limits (EELs), such as Predicted No Effects Concentrations (PNECs) or hazardous concentration for 5% of species (HC05) derived from species sensitivity distributions (SSDs). However, for many chemicals the EELs include large uncertainties or, in the worst case, the necessary data for their estimation are completely missing. This makes the assessment of chemical risks and any subsequent implementation of management strategies challenging. In this study we analyzed the uncertainty of EELs and its impact on chemical risk assessment. First, we compared three individual EEL datasets, two primarily based on experimental data and one based on computational predictions. The comparison demonstrates large disagreements between EEL data sources with experimentally derived EELs differing by more than seven orders of magnitude. In a case-study, based on the predicted emissions of 2000 chemicals, we showed that these uncertainties lead to significantly different risk assessment outcomes, including large differences in the magnitude of the total risk, risk driver identification, and the ranking of use categories as risk contributors. We also show that the large data-gaps in EEL datasets cannot be covered by commonly used computational approaches (QSARs). We conclude that an expanded framework for interpreting risk characterization outcomes is needed. We also argue that the large data-gaps present in ecotoxicological data need to be addressed in order to achieve the European zero pollution vision as the growing emphasis on ambient exposures will further increase the demand for accurate and well-established EELs.

Authors: M Gustavsson, S Sverker, T Backhaus, E Kristiansson

Full Source: Environmental research 2023 Jan 25;115372. doi: 10.1016/j.envres.2023.115372.

Chemical speciation determines combined cytotoxicity: Examples of biochar and arsenic/chromium

2023-01-23

As both electron donors and acceptors, biochars (BCs) may interact with multivalent metal ions in the environment, causing changes in ionic

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valence states and resulting in unknown combined toxicity. Therefore, we systematically investigated the interaction between BCs and Cr (Cr(III) & Cr(VI)) or As (As(III) & As(V)) and their combined cytotoxicity in human colorectal mucosal (FHC) cells. Our results suggest that the redox-induced valence state change is a critical factor in the combined cytotoxicity of BCs with Cr/As. Specifically, when Cr(VI) was adsorbed on BCs, 86.4 % of Cr(VI) was reduced to Cr(III). In contrast, As(III) was partially oxidized to As(V) with a ratio of 37.2 %, thus reaching a reaction equilibrium. Meanwhile, only As(V) was released in the cell, which could cause more As(III) to be oxidized. As both Cr(III) and As(V) are less toxic than their corresponding counterparts Cr(VI) and As(III), different redox interactions between BCs and Cr/As and release profiles between BCs and Cr/As together lead to reduced combined cytotoxicity of BP-BC-Cr(VI) and BP-BC-As(III). It suggests that the valence state changes of metal ions due to redox effects is one of the parameters to be focused on when studying the combined toxicity of complexes of BCs with different heavy metal ions.

Authors: Jian Liu, Yuting Wen, Yucong Mo, Weizhen Liu, Xiliang Yan, Hongyu Zhou, Bing Yan

Full Source: Journal of hazardous materials 2023 Jan 23;448:130855. doi: 10.1016/j.jhazmat.2023.130855.

ENVIRONMENTAL RESEARCH

Application of validated migration models for the risk assessment of styrene and acrylonitrile in ABS plastic toys

2023-01-25

With styrene and acrylonitrile in ABS plastic toys as examples, this paper introduces to the development of a systematic strategy for studying the chemical migration risk in toys. The approach, included the detection method, establishment of migration model, model verification, and the practical application of the model in risk assessment. First, simple and sensitive methods for detecting analyte residues and migration were developed by headspace GC-MS. Then, the migration models were established based on the migration data from 5 min to 168 h and verified using 11 ABS samples. The results showed that the predicted values of the models and the experimental values had a good fit (RMSE=0.10-8.72 %). Subsequently, the migration of analytes in 94 ABS toys was predicted with these models at specific migration times. The daily average exposure level to styrene and acrylonitrile were estimated for children (3 months to 3 years). At last, the migration models reasonably predicted that the cancer risk of styrene and acrylonitrile in ABS toys were 1.6×10^{-8} - $1.4 \times$

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10^{-6} and 3.1×10^{-8} - 1.6×10^{-6} , respectively. This research contributes to promote toy safety and child health by enriching migration models and risk assessments.

Authors: Zhijuan Wang, Hongyan Li, Tao Li, Qing Zhang, Yaqi Cai, Hua Bai, Qing Lv

Full Source: Ecotoxicology and environmental safety 2023 Jan 25;252:114570. doi: 10.1016/j.ecoenv.2023.114570.

Remediation and characterization of emerging and environmental pollutants from residential wastewater using a nature-based system

2023-01-28

The nature-based systems (NBS) are nature inspired, unflagging, efficient, and budget friendly ideas that evolved as ideal technologies for wastewater treatment. The present study deals with the purification of residential wastewater through the NBS, covering three seasons. The NBS embedded with the Canna lily effectively eliminated organic matter, nutrients, and heavy metals. Nearly 57.2-75.2% COD, 69.9-83.2% BOD, 73.4-90.6% TSS, 51.1-71.6% PO₄-P, 66.3-84.8% NH₄-N, 52-61.5% NO₃-N, and 68-70.6% NO₂-N removal were achieved. Heavy metals like Al, Cr, Mn, Fe, Ni, Cu, Zn, Mo, and Pb were removed, with a 98.25% reduction in the total bacterial count. The pollutant removal's kinetics was calculated using first-order kinetics. The mass removal rate of BOD was high in monsoon (22.3 g/m²/d), and COD was high in summer (36.4 g/m²/d). Organic compound removal (65.2%), including emerging pollutants, was observed by gas chromatography-mass spectrometry (GCMS) analysis of water and Canna samples. Wavelength dispersive X-ray fluorescence spectrometer (WDXRF) studied the elements and oxides retention by media and accumulation by the plant. The CHN content of the Canna and its morphological study was checked using the carbon CHNS analyzer and scanning electron microscope-energy dispersive X-ray (SEM-EDX), respectively. The performance of the NBS was validated using variance, correlation, and principal component analysis (PCA). This study shows the NBS effects on the remediation of environmental and emerging contaminants from residential wastewater and further use it for horticultural activities, thereby achieving sustainable development goals.

Authors: Monali Muduli, Meena Choudhary, Sanak Ray

Full Source: Environmental science and pollution research international 2023 Jan 28. doi: 10.1007/s11356-023-25553-0.

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Pollution and occupational protection of diesel particulate matter in underground space

2023-01-28

To address the diesel particulate matter pollution problem at the 12,306 continuous mining face of Shangwan coal mine, the spatial and temporal evolution law of diesel particulate matter generated at the three locations of the shuttle car head tunnel, contact alley, and support tunnel under the pressure-in ventilation condition of the double lane of the continuous mining face was studied by numerical simulation. The results show that the highest diesel particulate matter concentration at the shuttle car discharge is about 144.17 mg/m³, which seriously affects the health of miners. The highest diesel particulate matter concentration at the shuttle car tunnel is 52.58 mg/m³, and at the contact alley, the diesel particulate matter diffusion space is limited by the compression of the space inside the contact alley by the shuttle car machine body and the alley wall, which makes the diesel particulate matter accumulate here, forming a high diesel particulate matter concentration distribution area with a concentration value of 112.75 mg/m³. When supporting the roadway at the shuttle, diesel particulate matter accumulates in the range of X = 55 m ~ 60 m, Y = 0 m ~ 4 m, and Z = 23.4 m ~ 29.4 m. According to the degree of DPM pollution in different areas, different individual protective equipment is used to obtain different levels of pollution protection.

Authors: Yang Yang, Gang Zhou, Bingyou Jiang, Qi Wang, Yating Hu, Biao Sun

Full Source: Environmental science and pollution research international 2023 Jan 28. doi: 10.1007/s11356-023-25386-x.

An urgent health problem of indoor air pollution: results from a 15-years carbon monoxide poisoning observed study in Jinan City

2023-01-28

Carbon monoxide (CO) poisoning is a public health concern in developing countries especially in China with a high disease burden. We aimed to focus on non-occupational CO poisoning caused by household coal heating secular trends based on registry data in Jinan, China, and we aim to provide further evidence and suggestions for public health policy. We analyzed the occurrence and development trend and assess the spatial-temporal epidemiological characteristics of non-occupational CO poisoning caused by household coal heating in Jinan between 2007 and 2021. Among total of 6588 CO poisoning, 5616 cases (85.25%) and 180

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deaths caused by household coal heating was identified during study period. The cumulative incidence rate was 5.78 per 100,000 person-years and the mortality rate was 0.19 per 100,000 person-years. The incidence in urban areas (6.55 per 100,000 person-years) was higher than rural areas (5.04 per 100,000 person-years), and there was a statistical difference between urban and rural ($P < 0.001$) ($P < 0.001$). The poisoning time point mainly occurs in the sleep stage. In Jinan, socioeconomic status, accessibility to health services and rural status are determinants for CO poisoning incidence and mortality. Implementation of urban and rural central heating renovation is an effective way to further reduce the disease burden of CO poisoning in the future.

Authors: Mingjun Li, Bing Shan, Xiumiao Peng, Huiyun Chang, Liangliang Cui

Full Source: Scientific reports 2023 Jan 28;13(1):1619. doi: 10.1038/s41598-023-28683-0.

PHARMACEUTICAL/TOXICOLOGY

The impact of N-nitrosamine impurities on clinical drug development

2023-01-24

Over the past few years, an increasing number of commercially available drugs have been reported to contain N-nitrosamine impurities above acceptable intake limits. Consequent interruption or discontinuation of the manufacturing and distribution of several marketed drugs has culminated into shortages of marketed drugs, including the antidiabetic drug metformin and the potentially life-saving drug rifampin for the treatment of tuberculosis. Alarmingly, the clinical development of new investigational products has been complicated as well by the presence of N-nitrosamine impurities in batches of marketed drug. In particular, rifampin is a key clinical index drug employed in drug-drug interaction (DDI) studies, and as a result of nitrosamine impurities regulatory bodies no longer accept the administration of rifampin in DDI studies involving healthy subjects. Drug developers are now forced to look at alternative approaches for commonly employed perpetrators, which will be discussed in this review.

Authors: Sabina Paglialunga, Aernout van Haarst

Full Source: Journal of pharmaceutical sciences 2023 Jan 24;S0022-3549(23)00019-9. doi: 10.1016/j.xphs.2023.01.017.

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Associations of selenium exposure with blood lipids: Exploring mediating DNA methylation sites in general Chinese urban non-smokers

2023-01-26

Selenium (Se) is widely distributed in the total environment and people are commonly exposed to Se, while the potential effects and mechanisms of Se exposure on blood lipids have not been well established. This study aimed to assess the associations of urinary Se (SeU) with blood lipids and explore the potential mediating DNA methylation sites. We included 2844 non-smoke participants from the second follow-up (2017-2018) of the Wuhan-Zhuhai cohort (WHZH) in this study. SeU and blood lipids [i.e., total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL), and high-density lipoprotein cholesterol (HDL)] for all participants were determined. The associations of SeU with blood lipids were analyzed by generalized linear models. Then, we conducted the blood lipids related epigenome-wide association studies (EWAS) among 221 never smokers, and the mediation analysis was conducted to explore the potential mediating cytosine-phosphoguanine (CpG) sites in the above associations. In this study, the SeU concentration of the participants in this study was 1.40 (0.94, 2.08) $\mu\text{g}/\text{mmol Cr}$. The SeU was positively associated with TC and LDL, and not associated with TG and HDL. We found 131, 3, and 1 new CpG sites related to TC, HDL, and LDL, respectively. Mediation analyses found that the methylation of cg06964030 (within MIR1306) and cg15824094 (within PLCH2) significantly mediated the positive association between SeU and TC. In conclusion, high levels of Se exposure were associated with increased TC and LDL among non-smokers, and the methylation of MIR1306 and PLCH2 partly mediated Se-associated TC increase. These findings provide new insights into the effects and mechanisms of Se exposure on lipids metabolism and highlight the importance of controlling Se exposure and intake for preventing high blood lipids.

Authors: Xiuquan Nie, Ge Mu, Yanjun Guo, Shijie Yang, Xing Wang, Zi Ye, Qiyu Tan, Mengyi Wang, Min Zhou, Jixuan Ma, Weihong Chen

Full Source: The Science of the total environment 2023 Jan 26;869:161815. doi: 10.1016/j.scitotenv.2023.161815.

Selenium (Se) is widely distributed in the total environment and people are commonly exposed to Se, while the potential effects and mechanisms of Se exposure on blood lipids have not been well established.

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OCCUPATIONAL

Biomarkers for occupational manganese exposure

2023-01-27

Long-term inhalation exposure to manganese (Mn) metal or its inorganic compounds can result in manganism or subclinical neurofunctional deficits. Studies have described affected workers in Mn dioxide mining, Mn-containing ore crushing and milling facilities, manufacturing of dry-cell batteries, Mn steel and alloy production plants, and in welders. The objective of this study was to critically review existing evidence on the reliability of potential biomarkers of Mn exposure, specifically the relationship between inhalation exposure to Mn particulates in different occupational settings and Mn concentrations in blood and other biological fluids and tissues, with a particular focus on whole blood as a potentially useful medium for measuring internal tissue dose. We also examined available evidence on the relationship between Mn levels in blood and adverse clinical and subclinical neurotoxic outcomes. Three bibliographic databases were searched for relevant studies and identified references were screened by two independent reviewers. Of the 6338 unique references identified, 76 articles were retained for data abstraction. Findings indicate that the relationships between Mn in blood and both external Mn exposure indices and neurofunctional impairments are limited and inconsistent. Different sources of exposure to Mn compounds, heterogeneity in the methodological approaches, and inadequate reporting of essential information limited direct comparison of the reported findings. Among the Mn-exposure biomarkers considered in this review - including biomarkers in blood, plasma, serum, erythrocytes, urine, bone, toenails, fingernails, hair, saliva - biomarkers in whole blood may provide to be most useful in Mn biomonitoring and risk assessment.

Authors: Nataliya A Karyakina, Natalia Shilnikova, Nawal Farhat, Siva Ramoju, Brandon Cline, Franco Momoli, Donald Mattison, N Jensen, R Terrell, Daniel Krewski

Full Source: *Critical reviews in toxicology* 2023 Jan 27;1-28. doi: 10.1080/10408444.2022.2128718.

Review on distribution, fate, and management of potentially toxic elements in incinerated medical wastes

2023-01-23

Medical wastes include all solid and liquid wastes that are produced during the treatment, diagnosis, and immunisation of animals and

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humans. A significant proportion of medical waste is infectious, hazardous, radioactive, and contains potentially toxic elements (PTEs) (i.e., heavy metal (loids)). PTEs, including arsenic (As), cadmium (Cd), lead (Pb) and mercury (Hg), are mostly present in plastic, syringes, rubber, adhesive plaster, battery wastes of medical facilities in elemental form, as well as oxides, chlorides, and sulfates. Incineration and sterilisation are the most common technologies adopted for the safe management and disposal of medical wastes, which are primarily aimed at eliminating deadly pathogens. The ash materials derived from the incineration of hazardous medical wastes are generally disposed of in landfills after the solidification/stabilisation (S/S) process. In contrast, the ash materials derived from nonhazardous wastes are applied to the soil as a source of nutrients and soil amendment. The release of PTEs from medical waste ash material from landfill sites and soil application can result in ecotoxicity. The present study is a review paper that aims to critically review the dynamisms of PTEs in various environmental media after medical waste disposal, the environmental and health implications of their poor management, and the common misconceptions regarding medical waste.

Authors: Shiv Bolan, Lokesh P Padhye, Manish Kumar, Vasileios Antoniadis, Srinidhi Sridharan, Yuanyuan Tang, Narendra Singh, Choolaka Hewawasam, Meththika Vithanage, Lal Singh, Jörg Rinklebe, Hocheol Song, Kadambot H M Siddique, M B Kirkham, Hailong Wang, Nanthi Bolan
Full Source: *Environmental pollution (Barking, Essex : 1987)* 2023 Jan 23;321:121080. doi: 10.1016/j.envpol.2023.121080.

Long-term inhalation exposure to manganese (Mn) metal or its inorganic compounds can result in manganism or subclinical neurofunctional deficits.