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CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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CHEMICAL EFFECTS

Geospatial pattern of topsoil pollution and multi-endpoint toxicity in the petrochemical area of Augusta-Priolo (eastern Sicily, Italy)

2023-05-03

The present study was aimed at identifying geospatial patterns of pollutants including concentrations and toxicity as complex environmental mixtures, in topsoil samples close to petrochemical facilities in the heavily industrialized area of Augusta and Priolo in south-eastern Sicily (Italy). Elemental analysis of soil was conducted by ICP-MS for 23 metals and 16 rare earth elements (REEs). Organic analyses were primarily focused on polycyclic aromatic hydrocarbons (PAHs) (16 parent homologs) and total aliphatic hydrocarbons (C10 - C40). Topsoil samples were tested for toxicity in multiple bioassay models including: 1) developmental defects and cytogenetic anomalies in sea urchin *Sphaerechinus granularis* early life stages; 2) growth inhibition of diatom *Phaeodactylum tricornutum*; 3) mortality in nematode *Caenorhabditis elegans*; and 4) induction of mitotic abnormalities in onion *Allium cepa*. Samples collected at sites closest to defined petrochemical facilities were highest in select pollutants and correlated with biological effects in different toxicity endpoints. A noteworthy finding was the increased level of total REEs in sites closest to petrochemical facilities, suggesting their contributions to identifying petrochemical sources of pollutants to the environment. The combined data obtained in the different bioassays allowed exploration of geospatial patterns of effect in biota as a function of contaminant levels. In conclusion, this study provides consistent data of soil toxicity, metal and REE contamination at Augusta-Priolo sampling sites, and may provide an appropriate baseline for epidemiological studies on high incidences of congenital birth defects in the area and identification of at-risk localities.

Authors: Franca Tommasi, Daniel M Lyons, Giovanni Pagano, Rahime Oral, Philippe J Thomas, Kristin M Eccles, Serkan Tez, Maria Toscanesi, Antonella Giarra, Antonietta Siciliano, Nunzio Dipierro, Isidora Gjata, Marco Guida, Giovanni Libralato, Andrej Jaklin, Petra Burić, Ines Kovačić, Marco Trifuoggi
Full Source: Chemosphere 2023 May 3;138802. doi: 10.1016/j.chemosphere.2023.138802.

The present study was aimed at identifying geospatial patterns of pollutants including concentrations and toxicity as complex environmental mixtures, in topsoil samples close to petrochemical facilities in the heavily industrialized area of Augusta and Priolo in south-eastern Sicily (Italy).

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Alleviation of arsenic toxicity in pepper plants by aminolevulinic acid and heme through modulating its sequestration and distribution within cell organelles

2023-05-03

Aminolevulinic acid (ALA) is essential for chlorophyll and heme synthesis. However, whether heme interacts with ALA to elicit antioxidants in arsenic (As)-exposed plants is still unknown. ALA was applied daily to pepper plants for 3 days prior to beginning As stress (As-S). Then, As-S was initiated for 14 days by employing sodium hydrogen arsenate heptahydrate (0.1 mM AsV). Arsenic treatment decreased photosynthetic pigments (chl a by 38% and chl b by 28%), biomass by 24%, and heme by 47% content, but it elevated contents of malondialdehyde (MDA) by 3.3-fold, hydrogen peroxide (H₂O₂) by 2.3-fold, glutathione (GSH), methylglyoxal (MG), and phytochelatin (PCs) and electrolyte leakage (EL) by 2.3-fold along with enhanced subcellular As concentration in the pepper plant's roots and leaves. The supplementation of ALA to the As-S-pepper seedlings enhanced the amount of chlorophyll, heme content, and antioxidant enzyme activity as well as plant growth, while it reduced the levels of H₂O₂, MDA, and EL. ALA boosted GSH and phytochelates (PCs) in the As-S-seedlings by controlling As sequestration and rendering it harmless. The addition of ALA enhanced the amount of As that accumulated in the root vacuoles and reduced the poisonousness of the soluble As in the vacuoles. The ALA treatment facilitated the deposition and fixation of As in the vacuoles and cell walls, thereby reducing the transport of As to other cell organelles. This mechanism may have contributed to the observed decrease in As accumulation in the leaves. The administration of 0.5 mM hemin (H) (a source of heme) significantly enhanced ALA-induced arsenic stress tolerance. Hemopexin (Hx, 0.4 µg L⁻¹), a heme scavenger, was treated with the As-S plants along with ALA and ALA + H to observe if heme was a factor in ALA's increased As-S tolerance. Heme synthesis/accumulation in the pepper plants was reduced by Hx, which counteracted the positive effects of ALA. Supplementation of H along with ALA + Hx reversed the negative effects of Hx, demonstrating that heme is required for ALA-induced seedling As-S tolerance.

Authors: Cengiz Kaya, Muhammed Ashraf, Mohammed Nasser Alyemeni, Jörg Rinklebe, Parvaiz Ahmad
Full Source: Environmental pollution (Barking, Essex : 1987) 2023 May 3;121747. doi: 10.1016/j.envpol.2023.121747.

Aminolevulinic acid (ALA) is essential for chlorophyll and heme synthesis.

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Comparison of biomarkers of exposure among US adult smokers, users of electronic nicotine delivery systems, dual users and nonusers, 2018-2019

2023-05-05

The harm caused by cigarette smoking is overwhelmingly due to byproducts of tobacco combustion. Electronic Nicotine Delivery Systems (ENDS) provide nicotine to users without combustion, and may support tobacco harm reduction among cigarette smokers who would not otherwise quit in the near term. Analyses of Wave 5 of the Population Assessment of Tobacco and Health (PATH) Study compared biomarkers of exposure (BOE) levels for nicotine, 3 metals, 2 tobacco-specific nitrosamines and 14 smoking-related volatile organic compounds in 151 exclusive ENDS users, 1341 exclusive cigarette smokers, 115 dual users (cigarettes and ENDS), and 1846 past 30-day nonusers of tobacco, adjusting for demographics. Nicotine exposure in ENDS users and dual users did not significantly differ from smokers. Among ENDS users, 16 of 18 other BOEs were significantly lower than smokers'; 9 BOEs were not significantly different from nonusers. Among dual users smoking < 10 cigarettes/day, 15 of 18 non-nicotine BOEs were significantly lower than smokers', whereas in dual users smoking \geq 10 cigarettes per day none of the BOEs significantly differed from smokers'. In this representative sample of US adults, exclusive use of ENDS (vs. cigarette smoking) was associated with much lower exposures to many harmful chemicals associated with smoking-related disease. BOE levels in dual users were directly related to their cigarette consumption. These BOE data provide further evidence that ENDS expose users to substantially lower levels of toxicants than combustible cigarettes, confirming their potential for harm reduction.

Authors: Nathan M Holt, Saul Shiffman, Ryan A Black, Nicholas I Goldenson, Mark A Sembower, Michael J Oldham

Full Source: Scientific reports 2023 May 5;13(1):7297. doi: 10.1038/s41598-023-34427-x.

The harm caused by cigarette smoking is overwhelmingly due to byproducts of tobacco combustion.

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ENVIRONMENTAL RESEARCH

Occurrence of persistent and mobile chemicals and other contaminants of emerging concern in Spanish and Portuguese wastewater treatment plants, transnational river basins and coastal water

2023-05-03

This work investigated, during one year, the occurrence and fate of 52 contaminants of emerging concern (CECs) in transnational river basins and coastal areas of the North of Portugal and Galicia (NW Spain) and the wastewater treatment plants (WWTPs) discharging on these environments. The different CECs investigated included pharmaceuticals, personal care products, industrial chemicals, among others, of which ca. 90 % would fulfill the persistence, mobility and toxicity criteria proposed by the German Environmental Agency. The results showed the ubiquitous presence of these CECs and an incomplete removal of over 60 % of them with current conventional WWTPs. These findings highlight the requirement of a prominent and coordinated upgrade of WWTP treatments in order to meet the future European Union regulations on urban wastewater treatment and surface water quality. In fact, even some compounds exhibiting high removals, such as caffeine or xylene sulfonate, they were frequently detected in river and estuarine waters at the high ng L⁻¹ level. Thus, our preliminary risk assessment study concluded that 18 of the CECs presented a potential risk for the environment, being caffeine, sulphiride, perfluorooctanoic acid (PFOA), diclofenac, fipronil and perfluorobutanoic acid (PFBA) the most concerning ones. Yet, additional toxicity data as well as a more robust information on persistence and mobility of CECs are necessary for better estimating the magnitude of the problem and improve risk assessment. As an example, in the case of the antidiabetic metformin, recent research has revealed toxicity for model fish species at concentration levels below those found in the 40 % of the river water samples analyzed in this work.

Authors: Rosa Montes, Sandra Méndez, Julio Cobas, Nieves Carro, Teresa Neuparth, Nelson Alves, Miguel M Santos, José Benito Quintana, Rosario Rodil

Full Source: The Science of the total environment 2023 May 3;163737. doi: 10.1016/j.scitotenv.2023.163737.

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Microplastic pollution in lakeshore sediments: the first report on abundance and composition of Phewa Lake, Nepal

2023-05-05

Microplastic pollution in a freshwater environment has captured the attention of the scientific world in recent years. Microplastic is a new area of research in the freshwater of Nepal. Hence, the present study aims to examine the concentration, distribution, and characteristics of microplastic pollution in the sediments of Phewa Lake. Twenty sediment samples were collected from 10 sites to cover the vast area (5.762 km²) of the lake. The mean abundance of microplastic was 100.5 ± 58.6 items/kg dry weight. The average abundance of microplastics in five sections of the lake showed a significant difference (test statistics = 10.379, $p < 0.05$). Fibers (78.11%) dominated the sediments of Phewa Lake in all sampling sites. Transparent was the prominent color observed followed by red and altogether 70.65% of the microplastics detected were found at 0.2-1 mm size class. Fourier transform infrared spectroscopy (FTIR) analysis of visible microplastic particles (1-5 mm) confirmed polypropylene (PP) (42.86%) as the dominant polymer type followed by polyethylene (PE). This study can help to bridge the knowledge gap regarding the microplastic pollution in freshwater shoreline sediments of Nepal. Furthermore, these findings would create a new research area to explore the impact of plastic pollution which has been ignored in Phewa Lake.

Authors: Rajeshwori Malla-Pradhan, Khamphe Phoungthong, Thitipone Suwunwong, Tista Prasai Joshi, Bijay Lal Pradhan

Full Source: Environmental science and pollution research international 2023 May 5. doi: 10.1007/s11356-023-27315-4.

Examination of the environmental behavior of phosphogypsum with the application of lab-scale experiment

2023-05-04

Phosphogypsum (PG) is a reject of the phosphoric acid production process in phosphate fertilizer industries. The process results in the production of relatively large quantities of PG that it might cause serious environmental and human health concerns. The data of a laboratory investigation of PG are presented here. Lab-scale experiments with lysimeters were conducted in order to simulate and examine the environmental characteristics and the temporal behavior of PG leachates in terms of physicochemical characteristics and chemical composition. Based on the

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results, leachates from already deposited for many years PG or its mixture with marble powder, seemed to have better pH and conductivity values and lower elemental concentrations compared to leachates from freshly disposed PG. However, the leachates characteristics improve and stabilize in both cases after four days of irrigation or of 1080-1240 mm of rain. Most major elements were found to have minimal leachability, and the material satisfied the environmental limits for its disposal at landfills for inert and non-hazardous wastes.

Authors: Maria Pliaka, Georgios Gaidajis

Full Source: Journal of environmental science and health. Part A, Toxic/hazardous substances & environmental engineering 2023 May 4;1-9. doi: 10.1080/10934529.2023.2208994.

PHARMACEUTICAL/TOXICOLOGY

Incorporation of Fast-Elimination Chemicals in Hair Is Governed by Pharmacokinetics-Implications for Exposure Assessment

2023-05-05

Mechanisms governing chemicals' incorporation in hair are incompletely understood, and gaps remain to link the concentration of chemicals in hair to level of exposure and internal dose present in the body. This study assesses the relevance of hair analysis for the biomonitoring of exposure to fast-elimination compounds and investigates the role of pharmacokinetics (PK) in their incorporation in hair. Rats were administered with pesticides, bisphenols, phthalates, and DINCH over 2 months. Hairs were analyzed for 28 chemicals/metabolites to investigate correlations between their concentration in hair and the dose administered to the animals. Urine collected over 24 h after gavage was used to determine chemicals' PK and to investigate their influence on incorporation into hair by means of linear mixed models (LMMs). Eighteen chemicals presented a significant correlation between concentration in hair and level of exposure. In models combining all chemicals, agreement between concentration in hair predicted by LMM and experimental values was moderate ($R^2 = 0.19$) but significantly increased when PK were included in the models ($R^2 = 0.37$), and even more when chemical families were considered separately (e.g., $R^2 = 0.98$ for pesticides). This study shows that pharmacokinetics mediate

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Microplastic pollution in a freshwater environment has captured the attention of the scientific world in recent years.

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incorporation of chemicals in hair and suggests the relevance of hair for assessing exposure to fast-elimination chemicals.

Authors: François Fayès, Paul Palazzi, Florence Zeman, Emilie M Hardy, Charline Schaeffer, Christophe Rousselle, Claire Beausoleil, Brice M R Appenzeller

Full Source: Environmental science & technology 2023 May 5. doi: 10.1021/acs.est.2c06777.

OCCUPATIONAL

Benchmark dose estimation among benzene-exposed workers in China: Based on quantitative multi-endpoint genotoxicity assessments

2023-05-02

Based on previous exposure studies, benzene (BZ) has been classified as a human carcinogen and occupational exposure limit (OELs) to BZ has been set to be about 1 ppm around the world. However, health hazards have still been reported with exposure below the OEL. Thus, the OEL needs to be updated to reduce health risk. The overall aim of our study was therefore to generate new OEL for BZ via a benchmark dose (BMD) approach and based on quantitative and multi-endpoint genotoxicity assessments. Genotoxicities were determined using the novel human PIG-A gene mutation assay, the micronucleus (MN) test and the COMET assay in benzene-exposed workers. Among the 104 workers with below current OELs, they exhibited significantly higher PIG-A mutant frequencies (MFs) ($15.96 \pm 14.41 \times 10^{-6}$) and MN frequencies ($11.55 \pm 6.83\%$) than among the general subjects (PIG-A MFs: $5.45 \pm 4.56 \times 10^{-6}$, MN frequencies: $4.51 \pm 1.58\%$), but no difference in the COMET assay. A significant association was also observed between BZ exposures and PIG-A MFs and MN frequencies ($P < 0.001$). Our results indicate that health hazards were induced among workers with below OEL exposures. Based on results from the PIG-A and MN assays, the lower confidence limit of the BMD (BMDL) were calculated to be 8.71 mg/m³-year and 0.44 mg/m³-year, respectively. Based on these calculations, the OEL for BZ was determined

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to be lower than 0.07 ppm. This value can be considered by regulatory agencies to set new exposure limits and to better protect workers.

Authors: Yiyi Cao, Tongshuai Wang, Jing Xi, Wei Tian, Weiyang Liu, Yuan Sun, Wuzhong Liu, Xinyue You, Anqi Li, Guanghui Zhang, XinYu Zhang, Zhao-Lin Xia, Yang Luan

Full Source: Environmental pollution (Barking, Essex : 1987) 2023 May 2;121765. doi: 10.1016/j.envpol.2023.121765.

Safety culture and perception of warning signs of chemical hazards among hospital cleaning workers: a cross-sectional study

2023-05-04

Background: Due to the type of activities and the long-term exposure to chemicals, hospital cleaning workers require the necessary knowledge about the chemicals used and proper safety culture. This study aimed to evaluate the safety culture and perception of hospital cleaning workers' warning signs of chemical hazards.

Methods: This cross-sectional study was conducted in 2022 with the participation of 68 cleaning workers with the mean age \pm (SD) and work experience \pm (SD) of $36.19 \pm (7.619)$ and $9.21 \pm (5.462)$, respectively, in four selected Tehran hospitals in Iran. After ensuring the confidentiality of the received information and completing the demographic information checklist, each participant completed Global Harmonization System (GHS) sign perception and the safety culture questionnaires in this survey. Data were analyzed using regression and Pearson correlation tests.

Results: This study showed that the participant's correct perception in nine cases (81.8%) of presented GHS signs was lower than the ANSI Z535.3 standard. Among the investigated signs, "Flammable substances" and "Harmful to the environment" signs had the highest, and "Skin irritant" signs had the lowest correct perception. In addition, it was found that 55 people (80.9%) had an overall positive attitude toward the safety culture. The levels of "Work environment" (83.8%) and "Information exchange" (76.5%) had the highest and lowest positive scores for safety culture. Furthermore, there is a direct and significant relationship between the overall score of safety culture and the overall perception of the symptoms of GHS ($CC = 0.313, P = 0.009$).

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Conclusion: According to the obtained results, it is recommended to take the necessary measures to increase the employees' perception of the signs of chemical substances and improve their safety culture.

Authors: Younes Mehrifar, Soleiman Ramezanifar, Parvaneh Khazaei, Afsane Azimian, Elahe Khadiv, Ozra Dargahi-Gharehbagh, Ali Salehi Sahlabadi
Full Source: BMC public health 2023 May 4;23(1):817. doi: 10.1186/s12889-023-15726-4.

Occupational exposure to pesticides: DNA damage in horticulturist from Nativitas, Tlaxcala in Mexico

2023-05-03

Mexico is a country where agricultural activity is of great importance, but biomonitoring data are still scarce. With more intensive pesticides use per unit area/surface in horticultural productivity, there is a higher impact on environmental contamination and workers' health. Considering that exposure to various pesticide and pesticide mixtures represents an additional genotoxic risk, the appropriate characterization of exposure, confounding factors and the risk itself are very much needed. We compared genetic damage in 42 horticulturists and 46 unexposed controls (Nativitas, Tlaxcala) using alkaline comet (whole blood) and micronucleus (MN) test with nuclear abnormalities (NA) (buccal epithelial cells). Workers demonstrated significantly higher levels of damage (TI%= 14.02 ± 2.49 vs. 5.37 ± 0.46 ; MN= 10.14 ± 5.15 vs. 2.40 ± 0.20), with more than 90% of them not using protective clothing nor gloves during application. Combined DNA damage techniques and periodic monitoring together with educational programs for safe pesticide application is the best strategy to assess and prevent workers' health risks.

Authors: Sánchez-Alarcón Juana, Milić Mirta, Bonassi Stefano, Gómez-Arroyo Sandra, Cortés-Eslava Josefina, Flores-Márquez Ana Rosa, Valencia-Sánchez Rafael Alexander, Valencia-Quintana Rafael

Full Source: Environmental toxicology and pharmacology 2023 May 3;100:104141. doi: 10.1016/j.etap.2023.104141.

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