CHEMWATCH

# Bulletin Board

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MAY. 10, 2024

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## CHEMICAL EFFECTS

### Advanced applications of hydroxyapatite nanocomposite materials for heavy metals and organic pollutants removal by adsorption and photocatalytic degradation: A review

2024-05-03

This comprehensive review delves into the forefront of scientific exploration, focusing on hydroxyapatite-based nanocomposites (HANCs) and their transformative role in the adsorption of heavy metals (HMs) and organic pollutants (OPs). Nanoscale properties, including high surface area and porous structure, contribute to the enhanced adsorption capabilities of HANCs. The nanocomposites' reactive sites facilitate efficient contaminant interactions, resulting in improved kinetics and capacities. HANCs exhibit selective adsorption properties, showcasing the ability to discriminate between different contaminants. The eco-friendly synthesis methods and potential for recyclability position the HANCs as environmentally friendly solutions for adsorption processes. The review acknowledges the dynamic nature of the field, which is characterized by continuous innovation and a robust focus on ongoing research endeavors. The paper highlights the HANCs' selective adsorption capabilities of various HMs and OPs through various interactions, including hydrogen and electrostatic bonding. These materials are also used for aquatic pollutants' photocatalytic degradation, where reactive hydroxyl radicals are generated to oxidize organic pollutants quickly. Future perspectives explore novel compositions, fabrication methods, and applications, driving the evolution of HANCs for improved adsorption performance. This review provides a comprehensive synthesis of the state-of-the-art HANCs, offering insights into their diverse applications, sustainability aspects, and pivotal role in advancing adsorption technologies for HMs and OPs.

Authors: Youssef Miyah, Noureddine El Messaoudi, Mohammed Benjelloun, Yaser Acikbas, Zeynep Mine Şenol, Zeynep Ciğeroğlu, Eduardo Alberto Lopez-Maldonado

Full Source: Chemosphere 2024 May 3:142236. doi: 10.1016/j.chemosphere.2024.142236.

This comprehensive review delves into the forefront of scientific exploration, focusing on hydroxyapatite-based nanocomposites (HANCs) and their transformative role in the adsorption of heavy metals (HMs) and organic pollutants (OPs).

### Marine degradation and ecotoxicity of conventional, recycled and compostable plastic bags

2024-05-02

Plastic bags are currently a major component of marine litter, causing aesthetical nuisance, and undesirable effects on marine fauna that ingest them or are entangled. Plastic litter also rises concern on the ecotoxicological effects due to the potential toxicity of the chemical additives leached in aquatic environments. Conventional plastic bags are made of polyethylene, either from first use or recycled, but but regulations restricting single-use plastics and limiting lightweight carrier bags (<50 µm thickness) have fostered the replacement of thin PE bags by compostable materials advertised as safer for the environment. In this study, we assess the degradation of commercially available plastic bags in marine conditions at two scales: aquariums (60 days) and outdoors flow-through mesocosm (120 days). Strength at break point and other tensile strength parameters were used as ecologically relevant endpoints to track mechanical degradation. Ecotoxicity has been assessed along the incubation period using the sensitive Paracentrotus lividus embryo test. Whereas PE bags did not substantially lose their mechanical properties within the 60 d aquarium exposures, compostable bags showed remarkable weight loss and tensile strength decay, some of them fragmenting in the aquarium after 3 to 4 weeks. Sediment pore water inoculum promoted a more rapid degradation of compostable bags, while nutrient addition pattern did not affect the degradation rate. Longer-term mesocosms exposures supported these findings, as well as pointed out the influence of the microbial processes on the degradation efficiency of compostable/bioplastic bags. Compostable materials, in contrast toPE, showed moderate toxicity on sea-urchin larvae, partially associated to degradation of these materials, but the environmental implications of these findings remain to be assessed. These methods proved to be useful to classify plastic materials, according to their degradability in marine conditions, in a remarkably shorter time than current standard tests and promote new materials safer for the marine fauna.

Authors: Sara López-Ibáñez, Jakob Quade, Angelika Wlodarczyk, María-José Abad, Ricardo Beiras

Full Source: Environmental pollution (Barking, Essex : 1987) 2024 May 2:124096. doi: 10.1016/j.envpol.2024.124096.

### Development of an Automated Morphometric Approach to Assess Vascular Outcomes following Exposure to Environmental Chemicals in Zebrafish

2024-05

Background: Disruptions in vascular formation attributable to chemical insults is a pivotal risk factor or potential etiology of developmental defects and various disease settings. Among the thousands of chemicals threatening human health, the highly concerning groups prevalent in

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the environment and detected in biological monitoring in the general population ought to be prioritized because of their high exposure risks. However, the impacts of a large number of environmental chemicals on vasculature are far from understood. The angioarchitecture complexity and technical limitations make it challenging to analyze the entire vasculature efficiently and identify subtle changes through a high-throughput in vivo assay.
Objectives: We aimed to develop an automated morphometric approach for the vascular profile and assess the vascular morphology of health-concerning environmental chemicals.
Methods: High-resolution images of the entire vasculature in Tg(fli1a:eGFP) zebrafish were collected using a high-content imaging platform. We established a deep learning-based quantitative framework, ECA-ResXUnet, combined with MATLAB to segment the vascular networks and extract features. Vessel scores based on the rates of morphological changes were calculated to rank vascular toxicity. Potential biomarkers were identified by vessel-endothelium-gene-disease integrative analysis.
Results: Whole-trunk blood vessels and the cerebral vasculature in larvae exposed to 150 representative chemicals were automatically segmented as comparable to human-level accuracy, with sensitivity and specificity of 95.56% and 95.81%, respectively. Chemical treatments led to heterogeneous vascular patterns manifested by 31 architecture indexes, and the common cardinal vein (CCV) was the most affected vessel. The antipsychotic medicine haloperidol, flame retardant 2,2-bis(chloromethyl) trimethylenebis[bis(2-chloroethyl) phosphate], and tert-butylphenyl diphenyl phosphate ranked as the top three in vessel scores. Pesticides accounted for the largest group, with a vessel score of ≥1, characterized by a remarkable inhibition of subintestinal venous plexus and delayed development of CCV. Multiple-concentration evaluation of nine per- and polyfluoroalkyl substances (PFAS) indicated a low-concentration effect on vascular impairment and a positive association between carbon chain length and benchmark concentration. Target vessel-directed single-cell RNA sequencing of fli1a+ cells from larvae treated with λ-cyhalothrin, perfluorohexanesulfonic acid, or benzylbutyl phthalate, along with vessel-endothelium-gene-disease integrative analysis, uncovered potential associations with vascular disorders and identified biomarker candidates.
Discussion: This study provides a novel paradigm for phenotype-driven screenings of vascular-disrupting chemicals by converging morphological and transcriptomic profiles at a high-resolution level, serving as a powerful tool for large-scale toxicity tests. Our approach and the high-quality morphometric data facilitate the precise evaluation of vascular effects caused by environmental chemicals. https://doi.org/10.1289/EHP13214.
Authors: Xiali Zhong, Junzhou Chen, Zhuyi Zhang, Qicheng Zhu, Di Ji, Weijian Ke, Congying Niu, Can Wang, Nan Zhao, Wenquan Chen, Kunkun Jia, Qian Liu, Maoyong Song, Chunqiao Liu, Yanhong Wei
Full Source: Environmental health perspectives 2024 May;132(5):57001. doi: 10.1289/EHP13214.

## ENVIRONMENTAL RESEARCH

### Presence of polycyclic aromatic hydrocarbons and persistent organochlorine pollutants in human Milk: Evaluating their levels, association with Total antioxidant capacity, and risk assessment

2024-05-03
Breastfeeding provides numerous health benefits for both infants and mothers, promoting optimal growth and development while offering protection against various illnesses and diseases. This study investigated the levels of polychlorinated biphenyls (PCB), organochlorine pesticides (OCP) and polycyclic aromatic hydrocarbons (PAH) in human milk sampled in Zadar (Croatia). The primary objectives were twofold: firstly, to evaluate the individual impact of each compound on the total antioxidant capacity (TAC) value, and secondly, to assess associated health risks. Notably, this study presents pioneering and preliminary insights into PAH levels in Croatian human milk, contributing to the limited research on PAH in breast milk worldwide. PCB and OCP levels in Croatian human milk were found to be relatively lower compared to worldwide data. Conversely, PAH levels were comparatively higher, albeit with lower detection frequencies. A negative correlation was established between organic contaminant levels and antioxidative capacity, suggesting a potential link between higher antioxidative potential and lower organic contaminant levels. Diagnostic ratio pointed towards traffic emissions as the primary source of the detected PAH. The presence of PAH suggests potential health risk, underscoring the need for further in-depth investigation.
Authors: Gordana Mendaš, Ivana Jakovljević, Snježana Herceg Romanić, Sanja Fingler, Gordana Jovanović, Marijana Matek Sarić, Gordana Pehnec, Aleksandar Popović, Dalibor Stanković
Full Source: The Science of the total environment 2024 May 3:172911. doi: 10.1016/j.scitotenv.2024.172911.

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## Co-composting of green waste and biogas waste: physical, chemical parameters and quality of ripe compound

2024-05-03

The impact of adding biogas waste (BW) to green waste (GW) composting to increase nitrogen supplementation and improve mature compost quality was investigated. Conducted over 90 days using static windrows, the experiment compared treatments with GW alone (T1) and GW supplemented with BW (T2 and T3). The results showed that the addition of BW increased temperatures, improved the C/N ratio, and expedited the stabilization process compared to T1. Furthermore, the addition of BW led to significant degradation of hemicellulose (up to 39.98%) and cellulose (up to 27.63%) compared to GW alone. Analysis of Fourier-transform infrared (FTIR) spectra revealed the presence of aromatic, phenolic, aliphatic, and polysaccharide structures in the compost, with BW supplementation enhancing these characteristics. Importantly, the germination index (GI) assessment indicated that the compounds produced were not toxic and instead exhibited stimulatory effects on seed germination. Overall, the findings suggest that supplementing GW composting with BW can enhance the quality and efficacy of the composting process, resulting in compost with desirable properties for agricultural use.

Authors: Mauricio Aparecido Bortoloti, Adriana Zemiani Challiol, Isabela Mangerino Bortoloti Sicchieri, Emília Kiyomi Kuroda, Fernando Fernandes

Full Source: Environmental science and pollution research international 2024 May 3. doi: 10.1007/s11356-024-33539-9.

The impact of adding biogas waste (BW) to green waste (GW) composting to increase nitrogen supplementation and improve mature compost quality was investigated.

# PHARMACEUTICAL/TOXICOLOGY

## Can on-site leachate treatment facilities effectively address the issue of perfluoroalkyl acids (PFAAs) in leachate?

2024-05-03

In recent decades, the presence of perfluoroalkyl acids (PFAAs) in municipal solid waste leachate has emerged as a growing concern. Research has focused on PFAA release and occurrence characteristics in landfill and waste-to-energy leachate, highlighting their significant impact when released into wastewater treatment plants. Given the extremely high loading rate faced by current on-site leachate treatment plants (LTPs), the objective of this study is to assess whether the current "anaerobic/aerobic (A/O) + membrane bioreactor (MBR) + nanofiltration (NF) + reverse osmosis (RO)" configuration is effective in PFAAs removal.



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Concentrations of raw and treated leachate in 10 on-site LTPs with same treatment configuration and varying landfill ages were measured, and a comprehensive mass flow analysis of each treatment process was conducted. The results indicate that A/O treatment has limited capacity for PFAA removal, while NF and RO processes reached 77.44 % and 94.30 % removal rates of ∑PFAAs concentration, respectively. Short-chain PFAAs (> 80 % detected frequency) primarily influenced the distribution and variations of PFAAs in leachate and tend to disperse in the water phase. Correlation analysis revealed the current on-site LTPs exhibit a more efficient removal capacity for long-chain PFAAs.

Authors: Chu Tang, Lingyue Zhang, Hongxin Li, Jianchao Wang, Xiaoming Wang, Dongbei Yue

Full Source: The Science of the total environment 2024 May 3:172982. doi: 10.1016/j.scitotenv.2024.172982.

## Oxidation of chromium( ): A potential risk of using chemical oxidation processes for the remediation of 2-chlorophenol contaminated soils

2024-05-03

Chemical oxidation processes are widely used for the remediation of organically contaminated soils, but their potential impact on variable-valence and toxic metals such as chromium (Cr) is often overlooked. In this study, we investigated the risk of Cr( ) oxidation in soils during the remediation of 2-chlorophenol (2-CP) contaminated soils using four different processes: Potassium permanganate (KMnO4), Modified Fenton (Fe2+/H2O2), Alkali-activated persulfate (S2O82-/OH-), and Fe2+-activated persulfate (S2O82-/Fe2+). Our results indicated that the KMnO4, Fe2+/H2O2, and S2O82-/Fe2+ processes progressively oxidized Cr(III) to Cr( ) during the 2-CP degradation. The KMnO4 process likely involved direct electron transfer, while the Fe2+/H2O2 and S2O82-/Fe2+ processes primarily relied on HO• and/or SO4•- for the Cr(III) oxidation. Notably, after 4 h of 2-CP degradation, the Cr(VI) content in the KMnO4 process surpassed China's 3.0 mg kg-1 risk screening threshold for Class I construction sites, and further exceeded the 5.7 mg kg-1 limit for Class II construction sites after 8 h. Conversely, the S2O82-/OH- process exhibited negligible oxidation of Cr(III), maintaining a low oxidation ratio of 0.13%, as highly alkaline conditions induced Cr(III) precipitation, reducing its exposure to free radicals. Cr(III) oxidation ratio was directly proportional to oxidant dosage, whereas the Fe2+/H2O2 process showed a different trend, influenced by the concentration of reductants. This study provides insights into the selection and optimization of chemical oxidation processes for

Chemical oxidation processes are widely used for the remediation of organically contaminated soils, but their potential impact on variable-valence and toxic metals such as chromium (Cr) is often overlooked.

soil remediation, emphasizing the imperative for thorough risk evaluation of Cr(III) oxidation before their application.
Authors: Jie Yu, Jiang Yu, Siwei Deng, Zhi Huang, Ze Wang, Weiwei Zhu, Xueling Zhou, Longyu Liu, Donghai Wu, Hanyi Zhang
Full Source: Journal of environmental management 2024 May 3:359:120973. doi: 10.1016/j.jenvman.2024.120973.

## OCCUPATIONAL

### Occupational radiation exposure among medical personnel in university and general hospitals in Japan

2024-05-06
Objective: This study aimed to compare the occupational radiation exposure of medical workers between general hospitals and university hospitals.
Methods: Radiation exposure data from three hospitals in Hiroshima city, including one university hospital and two general hospitals, were collected using personal dosimeters. Monthly radiation doses were analyzed, and the annual sum of radiation exposure dose was calculated for 538 subjects in general hospitals and 1224 subjects in the university hospital. To assess the impact of locality, additional data from Nagasaki University Hospital and Fukushima Medical University Hospital were included for comparative analysis. Professional affiliations, such as doctors, nurses, and radiological technologists, were considered in the evaluation.
Results: The study revealed slight but significant differences in radiation doses between general and university hospitals. In general hospitals, except for radiological technologists, a slightly higher radiation dose was observed compared to university hospitals. Despite the annual increase in the use of medical radiation, the majority of hospital workers in both settings adhered to safety guidelines, with occupational radiation exposure remaining below the limit of detection (LOD). Workers who involved in fluoroscopic procedure, whether at university or general hospitals, had higher radiation doses than those who did not.
Conclusion: The study's primary conclusion is that workers in general hospitals experience a slight but significantly higher radiation dose and a lower percentage below the LOD compared to university hospitals. The observed difference is attributed to the greater workload at general hospitals than at university hospitals, and also may be due to the different nature of university hospital and general hospital. University hospitals, characterized by greater academic orientation, tend to benefit from comprehensive support systems, specialized expertise, and advanced technology, leading to more structured and regulated radiation control. These findings provide a basis for targeted interventions, improved safety protocols.
Authors: Arman Nessipkhan, Naoki Matsuda, Noboru Takamura, Noboru Oriuchi, Hiroshi Ito, Masao Kiguchi, Kiyoto Nishihara, Takayuki Tamaru, Kazuo Awai, Takashi Kudo
Full Source: Japanese journal of radiology 2024 May 6. doi: 10.1007/s11604-024-01579-3.

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### Maternal-Fetal Exposure to Antibiotics: Levels, Mother-to-Child Transmission, and Potential Health Risks

2024-05-03
Due to its widespread applications in various fields, antibiotics are continuously released into the environment and ultimately enter the human body through diverse routes. Meanwhile, the unreasonable use of antibiotics can also lead to a series of adverse outcomes. Pregnant women and developing fetuses are more susceptible to the influence of external chemicals than adults. The evaluation of antibiotic exposure levels through questionnaire surveys or prescriptions in medical records and biomonitoring-based data shows that antibiotics are frequently prescribed and used by pregnant women around the world. Antibiotics may be transmitted from mothers to their offspring through different pathways, which then adversely affect the health of offspring. However, there has been no comprehensive review on antibiotic exposure and mother-to-child transmission in pregnant women so far. Herein, we summarized the exposure levels of antibiotics in pregnant women and fetuses, the exposure routes of antibiotics to pregnant women, and related influencing factors. In addition, we scrutinized the potential mechanisms and factors influencing the transfer of antibiotics from mother to fetus through placental transmission, and explored the adverse effects of maternal antibiotic exposure on fetal growth and development, neonatal gut microbiota, and subsequent childhood health. Given the widespread use of antibiotics and the health threats posed by their exposure, it is necessary to comprehensively track antibiotics in pregnant women and fetuses in the future, and more in-depth biological studies are needed to reveal and verify the mechanisms of mother-to-child transmission, which is crucial for accurately quantifying and evaluating fetal health status.
Authors: Shiyu Miao, Jia Yin, Shuang Liu, Qingqing Zhu, Chunyang Liao, Guibin Jiang
Full Source: Environmental science & technology 2024 May 3. doi: 10.1021/acs.est.4c02018.

Due to its widespread applications in various fields, antibiotics are continuously released into the environment and ultimately enter the human body through diverse routes.

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## Association between long-term exposure to fine particulate matter and its chemical constituents and premature death in individuals living with HIV/AIDS

2024-05-02

Long-term exposure to fine particulate matter (PM2.5) is associated with an increased total mortality. However, the association of PM2.5 with mortality in people living with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS, PLWHA) and the relationship between its constituents and adverse outcomes remain unknown. In this cohort study, 28,140 PLWHA were recruited from the HIV/AIDS Comprehensive Response Information Management System of the Hubei Provincial Centre for Disease Control and Prevention in China between 2001 and 2020. The annual PM2.5 chemical composition data, including sulfate (SO42-), nitrate (NO3-), ammonium (NH4+), black carbon (BC), and organic matter (OM), was extracted from the Tracking Air Pollution (TAP) dataset in China. A Cox proportional hazard model with time-varying exposure and time-to-event quantile-based generalized (g) computation was used to assess the associations between PM2.5 chemical constituents, and mortality in PLWHA. A multivariate Cox proportional hazard model estimated an excess hazard ratio (eHR) of 0.32% [95% confidence interval (CI): (0.01%, 0.64%)] for AIDS-related death (ARD), associated with 1 μg/m3 rise in PM2.5 exposure. An increase of 1 μg/m3 in NH4+ was associated with 5.13% [95% CI: (2.89%, 7.43%)] and 2.97% [95% CI: (1.52%, 4.44%)] increase in the risk of ARD and all-cause deaths (ACD), respectively. When estimated using survival-based quantile g-computation, the eHR for ARD with a joint change in a decile increase in all five components was 6.10% [95% CI: 3.77%, 8.48%)]. Long-term exposure to PM2.5 chemical composition, particularly NH4+ increased the risk of death in PLWHA. This study provides epidemiological evidence that SO42- and NH4+ increased the risk of ARD and that NH4+ increased the risk of ACD in PLWHA. Multi-constituent analyses further suggested that NH4+ may be a key component in increasing the risk of premature death in patients with HIV/AIDS. Individuals aged ≥65 with HIV/AIDS are more vulnerable to SO42-, and consequent ACD.

Authors: Shijie Zhu, Faxue Zhang, Xiaoxin Xie, Wei Zhu, Heng Tang, Dingyuan Zhao, Lianguo Ruan, Dejia Li

Full Source: Environmental pollution (Barking, Essex : 1987) 2024 May 2:124052. doi: 10.1016/j.envpol.2024.124052.

Long-term exposure to fine particulate matter (PM2.5) is associated with an increased total mortality.

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