CHEMWATCH

# Bulletin Board

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## CHEMICAL EFFECTS

### Aquatic toxicity and fate of styrene oligomers in the environment

2023-09-20
Styrene oligomers (SOs) are ubiquitous contaminants that appear in the environment, sometimes to significant extent (see section 3.1). Despite the ongoing international debate on the human health risks posed by SOs, to the best of my knowledge, there are no studies on the aquatic toxicity and environmental fates (biodegradation and atmospheric degradation) of SOs in the environment. This study is to predict the aquatic toxicity and environmental fate of SOs by using the US EPA EPI suite program as an in-silico method. For better understanding, the risks and fates of SOs are compared with those of the well-known bisphenol A (BPA) and styrene monomer (SM or styrene). As a result of this study, SOs are predicted to be relatively more toxic than BPA and SM to aquatic and terrestrial organisms in the freshwater, marine, and terrestrial environments. In particular, the biodegradability of SOs is predicted to be relatively very slow in the environment, and most SOs are more likely to be effectively decomposed by hydroxyl radicals than by ozone in the atmosphere. As a result, this study can contribute to motivating understanding of the aquatic toxicity and fate of ubiquitous SOs in the environment.
Authors: Bum Gun Kwon
Full Source: Ecotoxicology and environmental safety 2023 Sep 20;265:115462. doi: 10.1016/j.ecoenv.2023.115462.

### Advanced electrocatalytic redox processes for environmental remediation of halogenated organic water pollutants

2023-09-22
Halogenated organic compounds are widespread, and decades of heavy use have resulted in global bioaccumulation and contamination of the environment, including water sources. Here, we introduce the most common halogenated organic water pollutants, their classification by type of halogen (fluorine, chlorine, or bromine), important policies and regulations, main applications, and environmental and human health risks. Remediation techniques are outlined with particular emphasis on carbon-halogen bond strengths. Aqueous advanced redox processes are discussed, highlighting mechanistic details, including electrochemical oxidations and reductions of the water-oxygen system,

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and thermodynamic potentials, protonation states, and lifetimes of radicals and reactive oxygen species in aqueous electrolytes at different pH conditions. The state of the art of aqueous advanced redox processes for brominated, chlorinated, and fluorinated organic compounds is presented, along with reported mechanisms for aqueous destruction of select PFAS (per- and polyfluoroalkyl substances). Future research directions for aqueous electrocatalytic destruction of organohalogens are identified, emphasizing the crucial need for developing a quantitative mechanistic understanding of degradation pathways, the improvement of analytical detection methods for organohalogens and transient species during advanced redox processes, and the development of new catalysts and processes that are globally scalable.
Authors: Madeleine K Wilsey, Teona Taseska, Ziyi Meng, Wanqing Yu, Astrid M Müller
Full Source: Chemical communications (Cambridge, England) 2023 Sep 22. doi: 10.1039/d3cc03176d.

## ENVIRONMENTAL RESEARCH

### Exposure to environmental airborne particulate matter caused wide-ranged transcriptional changes and accelerated Alzheimer's-related pathology: A mouse study

2023-09-20
Air pollution poses a significant threat to human health, though a clear understanding of its mechanism remains elusive. In this study, we sought to better understand the effects of various sized particulate matter from polluted air on Alzheimer's disease (AD) development using an AD mouse model. We exposed transgenic Alzheimer's mice in their prodromic stage to different sized particulate matter (PM), with filtered clean air as control. After 3 or 6 months of exposure, mouse brains were harvested and analyzed. RNA-seq analysis showed that various PM have differential effects on the brain transcriptome, and these effects seemed to correlate with PM size. Many genes and pathways were affected after PM exposure. Among them, we found a strong activation in mRNA Nonsense Mediated Decay pathway, an inhibition in pathways related to transcription, neurogenesis and survival signaling as well as angiogenesis, and a dramatic downregulation of collagens. Although we did not detect any extracellular Aβ plaques, immunostaining revealed that both intracellular Aβ1-42 and phospho-Tau levels were increased in various PM exposure conditions compared to the clean air control. NanoString GeoMx

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analysis demonstrated a remarkable activation of immune responses in the PM exposed mouse brain. Surprisingly, our data also indicated a strong activation of various tumor suppressors including RB1, CDKN1A/p21 and CDKN2A/p16. Collectively, our data demonstrated that exposure to airborne PM caused a profound transcriptional dysregulation and accelerated Alzheimer's-related pathology.

Authors: Liron L Israel, Oliver Braubach, Ekaterina S Shatalova, Oksana Chepurna, Sachin Sharma, Dmytro Klymyshyn, Anna Galstyan, Antonella Chiechi, Alysia Cox, David Herman, Bishop Bliss, Irene Hasen, Amanda Ting, Rebecca Arechavala, Michael T Kleinman, Rameshwar Patil, Eggehard Holler, Julia Y Ljubimova, Maya Koronyo-Hamaoui, Tao Sun, Keith L Black

Full Source: Neurobiology of disease 2023 Sep 20;106307. doi: 10.1016/j.nbd.2023.106307.

## Aerobic physical exercise modifies prostate tumoral environment

2023-09-21

Exercise is recognized for its potential role in reducing the risk of certain cancers. However, the molecular mechanisms behind this risk reduction are not fully understood. Here, we hypothesized that aerobic physical exercise induces cancer attenuating effects through the modulation of oxidative stress and inflammation. To test this hypothesis, twenty male Sprague Dawley rats with chemically induced prostate tumors were divided into two groups: Prostate cancer (PC) in the absence and presence of exercise (PC + Ex). Rats in the PC + Ex group performed exercises on a treadmill for 8 weeks, 5 sessions per week, at an intensity of 60 % of maximum capacity. Weight and feed efficiency, Ki-67, apoptosis, prostatic inflammation, and markers of oxidative stress were analyzed. We found that aerobic physical exercise significantly decreased prostate cell proliferation ($p < 0.05$) across modulation, tumor size, and prostate weight. The PC + Ex group also significantly reduced anti-apoptosis protein expression ($p < 0.05$) and increased pro-apoptotic protein expression. Furthermore, physical exercise increased enzymatic antioxidant defenses in the prostate, plasma, and whole blood. Moreover, PC + Ex reduced lipid peroxidation and protein carbonyl levels ($p < 0.05$). In the prostate, there was an increase in anti-inflammatory cytokines (IL-10), and a reduction in pro-inflammatory cytokines (IL-6, TNF-α, and NF-κB) after 8 weeks of physical exercise. In conclusion, we found that aerobic physical exercise is a functional, beneficial, and applicable approach to control PC progression, because it modifies the systemic environment, including the regulation of glucose and circulating lipids. This modification of the cancer cells environment has anti-inflammatory and antioxidant effects that attenuate tumor growth.

Exercise is recognized for its potential role in reducing the risk of certain cancers.

Authors: Allice Santos Cruz Veras, Rafael Ribeiro Correia, Victor Rogério Garcia Batista, Maria Eduarda de Almeida Tavares, Rafael Jesus Gonçalves Rubira, Gabriela Alice Fiais, Inês Cristina Giometti, Antonio Hernandes Chaves-Neto, Giovana Rampazzo Teixeira

Full Source: Life sciences 2023 Sep 21;122097. doi: 10.1016/j.lfs.2023.122097.

## Physicochemical properties of environmental media can affect the adsorption of arsenic (As) by microplastics

2023-09-21

Microplastics are emerging pollutants that can adsorb heavy metals and threaten human health through food chain. Recently, there has been increasing interest in understanding the adsorption behavior of heavy metals by microplastics in farmland soil. In particular, arsenic (As), as a carcinogen, has the potential to be adsorbed by soil microplastics. However, the mechanisms and controlling factors of As adsorption by microplastics in farmland soil under natural conditions are still unknown. Here, microplastics and As were respectively added to farmland soils with different physicochemical properties from twelve provinces of China for adsorption experiment. We performed surface analysis of microplastics, quantified As accumulation through quasi-first-order kinetic equation and developed regression models to screen the factors controlling As adsorption. The results showed that the adsorption of As by soil microplastics was a chemical process accompanied by the loss of electrons from oxygen-containing functional groups. Soil cation exchange capacity (CEC) was the main factor controlling the adsorption rate, while soil organic matter (SOM), total nitrogen (TN) and CEC mainly influenced the equilibrium adsorption capacity. This is the first report on microplastic-As adsorption in natural soil, which allows deeper insights into risk assessment, prediction and control of microplastic-As pollution in agricultural soil.

Microplastics are emerging pollutants that can adsorb heavy metals and threaten human health through food chain.

Authors: Hanwen Chen, Xin Zhang, Chuning Ji, Wenxuan Deng, Guang Yang, Zhipeng Hao, Baodong Chen

Full Source: Environmental pollution (Barking, Essex : 1987) 2023 Sep 21;122592. doi: 10.1016/j.envpol.2023.122592.

## PHARMACEUTICAL/TOXICOLOGY

### Nanobubbles in water and wastewater treatment systems: Small bubbles making big difference

2023-09-11

Since the discovery of nanobubbles (NBs) in 1994, NBs have been attracting growing attention for their fascinating properties and have been studied for application in various environmental fields, including water and wastewater treatment. However, despite the intensive research efforts on NBs' fundamental properties, especially in the past five years, controversies and disagreements in the published literature have hindered their practical implementation. So far, reviews of NB research have mainly focused on NBs' role in specific treatment processes or general applications, highlighting proof-of-concept and success stories primarily at the laboratory scale. As such, there lacks a rigorous review that authenticates NBs' potential beyond the bench scale. This review aims to provide a comprehensive and up-to-date analysis of the recent progress in NB research in the field of water and wastewater treatment at different scales, along with identifying and discussing the challenges and prospects of the technology. Herein, we systematically analyze (1) the fundamental properties of NBs and their relevancy to water treatment processes, (2) recent advances in NB applications for various treatment processes beyond the lab scale, including over 20 pilot and full-scale case studies, (3) a preliminary economic consideration of NB-integrated treatment processes (the case of NB-flotation), and (4) existing controversies in NBs research and the outlook for future research. This review is organized with the aim to provide readers with a step-by-step understanding of the subject matter while highlighting key insights as well as knowledge gaps requiring research to advance the use of NBs in the wastewater treatment industry.

Authors: Mingyi Jia, Muhammad Usman Farid, Jehad A Kharraz, Nallapaneni Manoj Kumar, Shauhrat S Chopra, Am Jang, John Chew, Samir Kumar Khanal, Guanghao Chen, Alicia Kyoungjin An

Full Source: Water research 2023 Sep 11;245:120613. doi: 10.1016/j.watres.2023.120613.

Since the discovery of nanobubbles (NBs) in 1994, NBs have been attracting growing attention for their fascinating properties and have been studied for application in various environmental fields, including water and wastewater treatment.



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### Chemical recycling of plastic wastes with alkaline earth metal oxides: A review

2023-09-21

Plastics have been widely used in daily life and industries due to their low cost and high durability, leading to huge production of plastics and tens of millions of plastic wastes every year. Chemical recycling can recycle contaminated and degraded plastics (that mechanical recycling cannot deal with) to obtain value-added products, which potentially solve the environmental problems caused by plastics and realize a circular economy. Alkaline earth metal oxides, as a category of cost-effective and multi-functional materials, have been widely used in chemical recycling of common plastics, acting as three roles: catalyst, template, and absorbent. Among five commercial plastics, polyethylene terephthalate is suitable for pyrolysis and solvolysis. Polyethylene and polypropylene, which are ideal precursors for synthesis of carbon nanotubes, could be combined with biomass for co-pyrolysis. Polyvinyl chloride needs to be pretreated to reduce chloride content prior to pyrolysis. Depolymerization of polystyrene into monomers is attractive. This review summarized the chemical recycling approaches of commercial plastics and the strategies with alkali earth metal oxides for the development of efficient recycling processes. It will aid understanding of the advances and challenges in the field and promote the future research.

Authors: Shaoqin Chen, Yun Hang Hu

Full Source: The Science of the total environment 2023 Sep 21;167251. doi: 10.1016/j.scitotenv.2023.167251.

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Authors: Hanwen Chen, Xin Zhang, Chuning Ji, Wenxuan Deng, Guang Yang, Zhipeng Hao, Baodong Chen

Full Source: Environmental pollution (Barking, Essex : 1987) 2023 Sep 21;122592. doi: 10.1016/j.envpol.2023.122592.

## OCCUPATIONAL

### Bystander chemical exposures and injuries associated with nearby plastic sewer pipe manufacture: public health practice and lessons

2022-11

Cured-in-place pipes (CIPPs) are plastic liners manufactured inside existing damaged sanitary sewer, storm sewer, and water pipes that extend the service life of host pipes. This process often is conducted in neighborhoods and near roadways. Before, during, and after plastic manufacture, waste materials that include volatile materials are released into the air. Emissions from this manufacturing process can affect outdoor air quality and indoor air quality for buildings connected to the sewer system. We identified key issues and solicited stakeholder feedback to estimate and manage public health risks of CIPP-generated chemical air pollution. A work group representing 13 U.S. agencies and public health associations provided feedback and prioritized public health issues for action. To mitigate potential public and occupational health risks, additional testing and public health educational efforts were recommended. An improved understanding of CIPP chemical exposure pathways, as well as stakeholder needs and interests, is essential.

Authors: Yoorae Noh, Jonathan H Shannahan, Anna G Hoover, Kelly G Pennell, Mark H Weir, Andrew J Whelton

Full Source: Journal of environmental health 2022 Nov;85(4):22-31.

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### US drinking water quality: exposure risk profiles for seven legacy and emerging contaminants

2023-09-22

Background: Advances in drinking water infrastructure and treatment throughout the 20th and early 21st century dramatically improved water reliability and quality in the United States (US) and other parts of the world. However, numerous chemical contaminants from a range of anthropogenic and natural sources continue to pose chronic health concerns, even in countries with established drinking water regulations, such as the US.

Objective/methods: In this review, we summarize exposure risk profiles and health effects for seven legacy and emerging drinking water contaminants or contaminant groups: arsenic, disinfection by-products, fracking-related substances, lead, nitrate, per- and polyfluorinated alkyl substances (PFAS) and uranium. We begin with an overview of US public water systems, and US and global drinking water regulation. We end with a summary of cross-cutting challenges that burden US drinking water systems: aging and deteriorated water infrastructure, vulnerabilities for children in school and childcare facilities, climate change, disparities in access to safe and reliable drinking water, uneven enforcement of drinking water standards, inadequate health assessments, large numbers of chemicals within a class, a preponderance of small water systems, and issues facing US Indigenous communities.

Results: Research and data on US drinking water contamination show that exposure profiles, health risks, and water quality reliability issues vary widely across populations, geographically and by contaminant. Factors include water source, local and regional features, aging water infrastructure, industrial or commercial activities, and social determinants. Understanding the risk profiles of different drinking water contaminants is necessary for anticipating local and general problems, ascertaining the state of drinking water resources, and developing mitigation strategies.

Impact statement: Drinking water contamination is widespread, even in the US. Exposure risk profiles vary by contaminant. Understanding the risk profiles of different drinking water contaminants is necessary for anticipating local and general public health problems, ascertaining the state of drinking water resources, and developing mitigation strategies.

Authors: Ronnie Levin, Cristina M Villanueva, Daniel Beene, Angie L Cradock, Carolina Donat-Vargas, Johnnye Lewis, Irene Martinez-Morata,

Background: Advances in drinking water infrastructure and treatment throughout the 20th and early 21st century dramatically improved water reliability and quality in the United States (US) and other parts of the world.

Darya Minovi, Anne E Nigra, Erik D Olson, Laurel A Schaider, Mary H Ward, Nicole C Deziel
Full Source: Journal of exposure science & environmental epidemiology 2023 Sep 22. doi: 10.1038/s41370-023-00597-z.