CHEMWATCH

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CHEMICAL EFFECTS

Contribution of plastic solid components to volatile organic compounds formation during plastics combustion

2024-09-26

The combustion of plastic waste releases volatile organic compounds (VOCs) that are harmful to human health. However, information on the micro-mechanisms of VOC formation remains lacking. Here, the study hypothesized and verified the relationship between VOC formation and solid component degradation during plastics combustion. The VOCs released during plastics combustion exhibit characteristics such as low carbon content (nc< 10), volatility (9 μg m-3 < log10C0 < 11 μg m-3), and medium oxidation degree (-1.5 < OSC^{-} < -0.5). The dominant VOCs ketones/aldehydes/acids (33-43 %) may be attributed to the depolymerization of the polymer structure of plastics, the oxidation of C-O/CO groups, and the secondary cleavage of gaseous oxygen-containing macromolecules. The VOCs released from the combustion of polyethylene terephthalate (PET) and poly(butyleneadipate-co-terephthalate) (PBAT) contained more aromatics than polyethylene (PE) and polypropylene (PP). And the temperature response of aromatics released from PET and PBAT lagged other VOCs compared that of PP and PE. However, compared to biomass thermal conversion, combustion of plastics releases fewer aromatics and nitrogenous compounds. Collectively, this work shows that the formation mechanisms of VOCs contributed by the solid components during plastic combustion are similar for PET and PBAT due to their similar chemical structures. The proposed mechanism in this paper will provide insight into the control of contaminants during plastic combustion.

Authors: Xinglei Wang, Simeng Tang, Ling Ding, Xinran Qiu, Zhenming Zhang, Li Xu, Xujun Liang, Xianfei Huang, Xuetao Guo

Full Source: Journal of hazardous materials 2024 Sep 26:480:135977. doi: 10.1016/j.jhazmat.2024.135977.

The combustion of plastic waste releases volatile organic compounds (VOCs) that are harmful to human health.

Organic fertilizer significantly mitigates N2O emissions while increase contributed of comammox Nitrospira in paddy soils

2024-09-27

Nitrification is the dominant process for nitrous oxide (N2O) production under aerobic conditions, but the relative contribution of the autotrophic nitrifiers (the ammonia-oxidising archaea (AOA), the ammonia-oxidising bacteria (AOB) and the comammox) to this process is still unclear in some soil types. This is particularly the case in paddy soils under different fertilization regimes. We investigated active nitrifiers and their contribution to nitrification and N2O production in a range of unfertilized and fertilized paddy soils, using 13CO2-DNA based stable isotope probing (SIP) technique combined with a series of specific nitrification inhibitors, including acetylene (C2H2), 3, 4-dimethylpyrazole phosphate (DMPP) and 2-phenyl-4,4,5,5-tetramethylimidazoline-1-oxyl 3-oxide (PTIO). The soils had a long-term history of fertilizer application, including chemical fertilizer only, a mixture of chemical fertilizers (70 %) and chicken manure (30 %) or a mixture of rice straw and chemical fertilizers. 13CO2-DNA-SIP and Illumina MiSeq sequencing demonstrated that comammox clades A.1 and B were active nitrifiers in all fertilized paddy soils. Inhibitor experiment showed that AOB largely contributed to nitrification activity and N2O emission in all paddy soils, while comammox contribution was more significant than AOA. Fertilization considerably altered nitrifiers' relative contribution to nitrification activity and N2O emissions. Applying organic fertilizers significantly decreased the N2O emissions but increased the contribution of comammox to the process. These findings expand the functional ecological niche of comammox, revealing their nitrification role and N2O production in other ecosystems than oligotrophic habitats.

Authors: Han Sun, Youfa Li, Yating Xing, Dylan Bodington, Xing Huang, Chenxiao Ding, Tida Ge, Hongjie Di, Jianming Xu, Cécile Gubry-Rangin, Yong Li

Full Source: The Science of the total environment 2024 Sep 27:176578. doi: 10.1016/j.scitotenv.2024.176578.

Background: Studies on the combined effects of persistent and non-persistent endocrine-disrupting chemicals (EDCs) on puberty are insufficient.

Prenatal and childhood exposure to endocrine-disrupting chemicals and early thelarche in 8-year-old girls: A prospective study using Bayesian kernel regression

2024-09-27

Background: Studies on the combined effects of persistent and non-persistent endocrine-disrupting chemicals (EDCs) on puberty are insufficient. To date, no studies have analyzed breast development at age 8 years, a key criterion for determining precocious puberty. We investigated the relationship between prenatal or childhood exposure to EDC mixtures and early thelarche, defined as breast development before age 8 years in girls.

Methods: This prospective study included 211 girls with data on prenatal and 8-year-old exposure of cadmium (Cd), lead, mercury, bisphenol-A (BPA), 3-phenoxybenzoic acid, and three phthalate metabolites from the

Environment and Development of Children cohort. Prenatal exposure was assessed through samples from pregnant women at 14-27th weeks of gestation. Tanner staging was assessed by a pediatric endocrinologist. The relationship between single and mixed chemical exposures and outcomes was assessed using logistic regression, generalized additive models (GAM), and Bayesian kernel machine regression (BKMR) models.
Results: Early thelarche was observed in 42 (19.9%) girls at age 8 years. In the logistic regression models, the risk of early thelarche increased with increased exposure to Cd in their mothers (adjusted odds ratio [aOR] per interquartile range [IQR]=1.80, 95% confidence interval [CI] 1.23-2.65) but decreased with prenatal BPA exposure (aOR per IQR=0.57, 95% CI 0.35-0.92). None of the 8-year-old chemical exposures was associated with early thelarche. In the GAM, early thelarche was positively correlated with prenatal Cd and inversely associated with prenatal BPA exposure (p=0.004 for Cd and p=0.036 for BPA). In the BKMR models, an increase in log-transformed prenatal Cd concentrations from the 25th to 75th percentile was associated with an increase in the estimated probability of early thelarche at age 8 years (risk difference: 0.46 [95% credible interval: 0.04-0.88]) when other chemicals were set at their median values.
Conclusions: Considering the combined effects of persistent and non-persistent chemical mixtures, maternal Cd exposure during the second trimester may be associated with early thelarche in 8-year-old girls.
Authors: Yunsoo Choe, Kyoung-Nam Kim, Yun Jeong Lee, Johanna Inhyang Kim, Bung-Nyun Kim, Youn-Hee Lim, Yun-Chul Hong, Choong Ho Shin, Young Ah Lee
Full Source: Environmental research 2024 Sep 27:120056. doi: 10.1016/j.envres.2024.120056.

Background: Disability is a key marker of overall physical health in older adults and is often preceded by chronic disease.

ENVIRONMENTAL RESEARCH

Long-term air pollution exposure and incident physical disability in older US adults: a cohort study

2024-09-26
Background: Disability is a key marker of overall physical health in older adults and is often preceded by chronic disease. Although air pollution is a well recognised risk factor for multiple chronic diseases, its association with physical disability has not been well characterised. We investigated the associations of air pollutants with physical disability in a large cohort representative of older adults in the USA.
Methods: We used biennial data on incident activities of daily living (ADL) disability collected from respondents of the Health and Retirement

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Survey between 2000 and 2016. As part of the Environmental Predictors of Cognitive Health and Aging study, we estimated 10-year average PM2·5, PM10-2·5, nitrogen dioxide (NO2), and ozone (O3) concentrations at participant residences before each survey using spatiotemporal prediction models. We used a time-varying, weighted Cox model to estimate hazard ratios (HRs) for incident physical disability per interquartile increase of air pollution with detailed adjustments for confounders.
Findings: Among 15 411 respondents aged 65 years and older (mean age 70·2 [SD 6·5] years; 55% female, 45% male), 48% of respondents reported newly having ADL disability during a mean follow-up of 7·9 years (SD 4·7). In fully adjusted models, we found greater risks of ADL disability associated with higher concentrations of PM2·5 (HR 1·03 per 3·7 μg/m^3 [95% CI 0·99-1·08], p=0·16), PM10-2·5 (1·05 per 4·9 μg/m^3 [1·00-1·11], p=0·022), and NO2 (1·03 per 7·5 ppb [0·99-1·08]. p=0·064), although not all these associations were statistically significant. In contrast, O3 was associated with a lower risk of ADL disability (0·95 per 3·7 ppb [0·91-1·00], p=0·030). In a multi-pollutant model, associations were similar to the single-pollutant models for PM10-2·5 (1·05 per 4·9 μg/m^3 [1·00-1·11], p=0·041) and O3 (0·94 per 3·7 ppb [0·88-1·01], p=0·083).
Interpretation: Our findings suggest that air pollution might be an underappreciated risk factor for physical disability in later life, although additional research is needed.
Funding: National Institutes of Environmental Health Sciences and National Institute on Aging.
Authors: Jiaqi Gao, Carlos F Mendes de Leon, Boya Zhang, Jennifer Weuve, Kenneth M Langa, Jennifer D'Souza, Adam Szpiro, Jessica Faul, Joel D Kaufman, Richard Hirth, Sara D Adar
Full Source: The lancet. Healthy longevity 2024 Sep 26:100629. doi: 10.1016/j.lanhl.2024.07.012.

Oceans and rivers are predominant sinks, reservoirs, and carriers of plastic debris that are proposed to be long term sources of a variety of contaminants in the environments.

Beyond plastic pollution: Unveiling chemical release from plastic debris in river water and seawater using non-target screening

2024-09-24
Oceans and rivers are predominant sinks, reservoirs, and carriers of plastic debris that are proposed to be long term sources of a variety of contaminants in the environments. This research unveiled kinetics of chemical releases from plastic debris in freshwater and marine environment via artificial river water (ARW) and seawater (ASW) in combination of nontarget screening. Chemical leaching from PVC cord particles in the ARW and ASW basically followed the first order kinetics,

reaching pseudo-equilibrium in 30d and 14d, respectively, associated with both particle surface - water partitioning and inner-particle diffusion of chemicals. Dissolved organic carbon, finer size, and weathering of plastic particles might enhance whereas metal ions potentially hinder chemical releases from plastic debris in waters, respectively. Salinity and pH showed moderate effects on chemical leaching. In addition, chemicals' physiochemical properties might also affect their leaching behavior. Hundreds to thousands of chemicals would be released from plastic debris in days once entering waters, among which > 80% were unknown with rare or no information about eco-toxicity and environmental fate, posing unpredicted risks to the environment. Furthermore, new chemicals may keep being released with increasing weathering and extending retention time of plastics in waters, leading to increases in both numbers and complexities of released chemicals. Chemical leaching from plastics showed product-dependence and certain differences in freshwater and seawater. Large numbers of unknown chemicals potentially released from plastic debris in rivers, lakes, and oceans and subsequent environmental risks warrant in-depth research.

Authors: Xianzhi Peng, Xinling Li, Jing Zhou, Jianhua Tan, Guangshi Chen, Zewen Zhu, Tao Yang

Full Source: Water research 2024 Sep 24:267:122515. doi: 10.1016/j.watres.2024.122515.

PHARMACEUTICAL/TOXICOLOGY

Single-cell transcriptomics reveals e-cigarette vapor-induced airway epithelial remodeling and injury

2024-09-28

Background: In recent years, e-cigarettes have been used as alternatives among adult smokers. However, the impact of e-cigarette use on human bronchial epithelial (HBE) cells remains controversial.

Methods: We collected primary HBE cells of healthy nonsmokers and chronic obstructive pulmonary disease (COPD) smokers, and analyzed the impact of e- cigarette vapor extract (ECE) or cigarette smoke extract (CSE) on HBE cell differentiation and injury by single-cell RNA sequencing, immunostaining, HE staining, qPCR and ELISA. We obtained serum and sputum from healthy non- smokers, smokers and e-cigarette users, and analyzed cell injury markers and mucin proteins.

Results: ECE treatment led to a distinct differentiation program of ciliated cells and unique patterns of their cell-cell communications compared with CSE. ECE treatment caused increased Notch signaling strength in a ciliated cell subpopulation, and HBE cell remodeling and injury including hypoplasia of ciliated cells and club cells, and shorter cilia. ECE-induced hypoplasia of ciliated cells and shorter cilia were ameliorated by the Notch signaling inhibition.

Conclusions: This study reveals distinct characteristics in e-cigarette vapor-induced airway epithelial remodeling, pointing to Notch signaling pathway as a potential targeted intervention for e-cigarette vapor-caused ciliated cell differentiation defects and cilia injury. In addition, a decrease in SCGB1A1 proteins is associated with e- cigarette users, indicating a potential lung injury marker for e-cigarette users.

Background: In recent years, e-cigarettes have been used as alternatives among adult smokers.

Profoxydim in Focus: A Structural Examination of Herbicide Behavior in Gas and Aqueous Phases

2024-09-14

This study investigates the chemical structure of profoxydim, focusing on its E-isomer, the main commercial form. The research aimed to determine the predominant tautomeric forms under various environmental conditions. Using proton and carbon-13 NMR spectroscopy alongside theoretical modeling, we examined tautomers and their conformers in different solvents (MeOD, DMSO, CDCl3, benzene) to mimic gas and aqueous phases. The findings reveal that the enolic form dominates in the gas phase, while the ketonic form prevails in aqueous environments, providing key insights into the herbicide's environmental behavior. We also observed an isomeric transition from E to Z under acidic conditions, which could affect profoxydim's reactivity in natural environments. The theoretical calculations indicated that in acidic conditions, the E and Z forms are nearly degenerate, with the E form remaining dominant in neutral environments. Additionally, QSAR models assessed the toxicity of various tautomers, revealing significant differences that could impact bioactivity and environmental fate. This research offers crucial insights into the structural dynamics of profoxydim, contributing to cyclohexanedione chemistry and the development of more effective herbicides.

Authors: María Cobos-Escudero, Paula Pla, Álvaro Cervantes-Diaz, José Luis Alonso-Prados, Pilar Sandín-España, Manuel Alcamí, Al Mokhtar Lamsabhi

Full Source: Molecules (Basel, Switzerland) 2024 Sep 14;29(18):4371. doi: 10.3390/molecules29184371.

This study investigates the chemical structure of profoxydim, focusing on its E-isomer, the main commercial form.

OCCUPATIONAL

Transcriptomic and functional effects from a chemical mixture based on the exposure profile in Baltic Sea salmon, on metabolic and immune functions in zebrafish embryo

2024-09-24

The Baltic Sea is one of the world's most contaminated seas with long-standing adverse health status of its wildlife such as the Baltic Sea salmon, resulting in reduced fecundity and increased mortality. While adverse health effects have been reported among wild fish from the Baltic Sea, the toxicity mechanisms underlying these adversities, and the chemical effect drivers mediating them are poorly understood. To address this knowledge gap, we utilized the zebrafish (Danio rerio) embryo model to determine molecular and functional effects brought on by exposure to a technical mixture including 9 organohalogen compounds detected in serum from wild-caught Baltic Sea salmon. To align with the salmon exposure scenario, an internal dose regimen was opted to establish same relative proportions of the compounds in the zebrafish (whole body) as observed in the salmon serum. Through transcriptomic profiling, we identified dose-dependent effects on immune system and metabolism as two critical functions overlapping with adverse effects observed in wild fish from the Baltic Sea. We then determined likely effect drivers by comparing gene responses of the mixture with those of individual mixture components. Aligned with our transcriptome results, the number of total macrophages was reduced and the zebrafish's ability to respond to a tissue damage suppressed in a dose-dependent manner. This study brings forth a key advancement in delineating the impact of chemical pollutants on the health of wild fish in the Baltic Sea.

Authors: Carolina Vogs, Dennis Lindqvist, Sheung Wai Tang, Lydia Gugescu, Harri Alenius, Emma Wincent

Full Source: Environment international 2024 Sep 24:192:109018. doi: 10.1016/j.envint.2024.109018.

The Baltic Sea is one of the world's most contaminated seas with long-standing adverse health status of its wild-life such as the Baltic Sea salmon, resulting in reduced fecundity and increased mortality.

Exploring relationships between smoke exposure, housing characteristics, and preterm birth in California

2024-09-27

Pregnant people are vulnerable to air pollution exposure, including risk of preterm birth, low birth weight, and stillbirth. Understanding the infiltration of outdoor wildfire into a residential space is critical for the accurate assessment of wildfire smoke exposure and associated health effects in pregnant people. Relying on ambient measurements of wildfire smoke alone can result in exposure misclassification. In this study, we examine the role of physical housing characteristics in the relationship between smoke exposure and preterm birth. In particular, we examine the effect of home size, year of construction, cooling type, and renovation status, as effect modifiers in the relationship between smoke exposure during pregnancy and preterm birth from 2007-2015 in California. To do this, we combined data on home characteristics from the California Tax Assessor, birth outcomes from the California birth records database, and the number of smoke days for each pregnancy from NOAA's Administration's Hazard Mapping System (HMS). We estimated the association between smoke day exposures and odds of preterm birth using logistic regression models and stratified by air basin and housing characteristics. Our findings reveal that cooling type and renovation status are key factors modifying the smoke exposure-preterm birth relationship. Notably, we found elevated associations for people living in unrenovated homes, those using evaporative cooling systems, and those using central air conditioning units. While we observed elevated odds of preterm birth associated with increasing smoke day exposure for residents of large and new homes, this effect does not significantly differ across home size and age quartiles. This study highlights the need to further examine the relative roles of housing characteristics as well as factors not measured here including behavioral factors, time spent outdoors, window use, and occupational exposures in driving adverse birth outcomes related to wildfire smoke exposure.

Authors: Rachel Sklar, Sally Picciotto, Dan Meltzer, Dana E Goin, ShihMing Huang, Frederick Lurmann, Elizabeth Noth, Nathan Pavlovic, Rachel Morello-Frosch, Amy M Padula

Full Source: Environmental pollution (Barking, Essex: 1987) 2024 Sep 27:125022. doi: 10.1016/j.envpol.2024.125022.

Background: As one of the most common traffic-related pollut-ants, diesel exhaust (DE) confers high risk for cardiovascular and respiratory diseases.

Chronic diesel exhaust exposure induced pulmonary vascular remodeling a potential trajectory for traffic related pulmonary hypertension

2024-09-28

Background: As one of the most common traffic-related pollutants, diesel exhaust (DE) confers high risk for cardiovascular and respiratory diseases. However, its impact on pulmonary vessels is still unclear.
Methods: To explore the effects of DE exposure on pulmonary vascular remodeling, our study analyzed the number and volume of small pulmonary vessels in the diesel engine testers (the DET group) from

Luoyang Diesel Engine Factory and the controls (the non-DET group) from the local water company, using spirometry and carbon content in airway macrophage (CCAM) in sputum. And then we constructed a rat model of chronic DE exposure, in which 12 rats were divided into the DE group (6 rats with 16-week DE exposure) and the control group (6 rats with 16-week clean air exposure). During right heart catheterization, right ventricular systolic pressure (RVSP) was assessed by manometry. Macrophage migration inhibitory factor (MIF) in lung tissues and bronchoalveolar lavage fluid (BALF) were measured by qRT-PCR and ELISA, respectively. Histopathological analysis for cardiovascular remodeling was also performed.

Results: In DET cohort, the number and volume of small pulmonary vessels in CT were positively correlated with CCAM in sputum ($P<0.05$). Rat model revealed that chronic DE-exposed rats had elevated RVSP, along with increased wall thickness of pulmonary small vessels and right the ventricle. What's more, the MIF levels in BALF and lung tissues were higher in DE-exposed rats than the controls.

Conclusion: Apart from airway remodeling, DE also induces pulmonary vascular remodeling, which will lead to cardiopulmonary dysfunction.

Authors: Chaohui Mu, Qinghai Li, Yong Niu, Ting Hu, Yanting Li, Tao Wang, Xinjuan Yu, Yiqiao Lv, Huiling Tang, Jing Jiang, Haibin Xu, Yuxin Zheng, Wei Han

Full Source: Respiratory research 2024 Sep 28;25(1):348. doi: 10.1186/s12931-024-02976-y.