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CHEMICAL EFFECTS

Reduction of Pesticide Toxicity Under Field-Relevant Conditions? The Interaction of Titanium Dioxide Nanoparticles, Ultraviolet, and Natural Organic Matter

2020-11

In surface waters, the illumination of photoactive engineered nanomaterials (ENMs) with ultraviolet (UV) light triggers the formation of reactive intermediates, consequently altering the ecotoxicological potential of co-occurring organic micropollutants including pesticides due to catalytic degradation. Simultaneously, omnipresent natural organic matter (NOM) adsorbs onto ENM surfaces, altering the ENM surface properties. Also, NOM absorbs light, reducing the photo(cata)lytic transformation of pesticides. Interactions between these environmental factors impact 1) directly the ecotoxicity of photoactive ENMs, and 2) indirectly the degradation of pesticides. We assessed the impact of field-relevant UV radiation (up to 2.6 W UVA/m²), NOM (4 mg TOC/L), and photoactive ENM (nTiO₂, 50 µg/L) on the acute toxicity of 6 pesticides in *Daphnia magna*. We selected azoxystrobin, dimethoate, malathion, parathion, permethrin, and pirimicarb because of their varying photo- and hydrolytic stabilities. Increasing UVA alone partially reduced pesticide toxicity, seemingly due to enhanced degradation. Even at 50 µg/L, nano-sized titanium dioxide (nTiO₂) reduced but also increased pesticide toxicity (depending on the applied pesticide), which is attributable to 1) more efficient degradation and potentially 2) photocatalytically induced formation of toxic by-products. Natural organic matter 1) partially reduced pesticide toxicity, not evidently accompanied by enhanced pesticide degradation, but also 2) inhibited pesticide degradation, effectively increasing the pesticide toxicity. Predicting the ecotoxicological potential of pesticides based on their interaction with UV light or interaction with NOM was hardly possible, which was even more difficult in the presence of nTiO₂. *Environ Toxicol Chem* 2020;39:2237-2246. © 2020 The Authors. Environmental Toxicology and Chemistry published by Wiley Periodicals LLC on behalf of SETAC.

Authors: Simon Lüderwald, Frederik Meyer, Verena Gerstle, Lisa Friedrichs, Katrin Rolfing, Verena C Schreiner, Nikita Bakanov, Ralf Schulz, Mirco Bundschuh

Full Source: *Environmental toxicology and chemistry* 2020 Nov;39(11):2237-2246. doi: 10.1002/etc.4851.

In surface waters, the illumination of photoactive engineered nanomaterials (ENMs) with ultraviolet (UV) light triggers the formation of reactive intermediates, consequently altering the ecotoxicological potential of co-occurring organic micropollutants including pesticides due to catalytic degradation.

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Varying attenuation of trace organic chemicals in natural treatment systems - A review of key influential factors

2021-01-24

The removal of trace organic chemicals (TOrcs) from treated wastewater and impacted surface water through managed aquifer recharge (MAR) has been extensively studied under a variety of water quality and operating conditions and at various experimental scales. The primary mechanism thought to dictate removal over the long term is biodegradation by microorganisms present in the system. This review of removal percentages observed in biologically active filtration systems reported in the peer-reviewed literature may serve as the basis to identify future indicators for persistence, as well as variable and efficient removal in MAR systems. A noticeable variation in reported removal percentages (standard deviation above 30%) was observed for 24 of the 49 most commonly studied TOrcs. Such variations suggest a rather inconsistent capacity of biologically active filter systems to remove these TOrcs. Therefore, operational parameters such as the change in dissolved organic carbon (Δ DOC) during treatment, hydraulic retention time (HRT), filter material, and redox conditions were correlated to the associated TOrc removal percentages to determine whether a data-based relationship could be elucidated. Interestingly, 11 out of the 24 compounds demonstrated increased removal with increasing Δ DOC concentrations. Furthermore, 10 compounds exhibited a positive correlation with HRT. Based on the evaluated data, a minimum HRT of 0.5-1 day is recommended for removal of most compounds.

Authors: Josefine Filter, Veronika Zhiteneva, Carsten Vick, Aki Sebastian Ruhl, Martin Jekel, Uwe Hübner, Jörg E Drewes

Full Source: *Chemosphere* 2021 Jan 24;274:129774. doi: 10.1016/j.chemosphere.2021.129774.

ENVIRONMENTAL RESEARCH

Evaluation and optimization of blanket production from recycled polyethylene terephthalate based on the coordination of environment, economy, and society

2021-02-02

The recycling of waste polyethylene terephthalate (PET) is widely regarded as an eco-friendly and cost-effective technology and has been gradually developed into an important direction for the utilization of solid waste resources. However, the integrated evaluation research on this technology from the environmental, economic, and social aspects

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are still not in place. Based on the theory of collaborative entropy, this study constructs an integrated evaluation and optimization methodology system for the environmental, economic, and social impacts of blanket production from recycled PET, using environmental life cycle assessment, life cycle cost assessment, social life cycle assessment, and sensitivity analysis. The study assessed the environmental load, economic cost, and social impact of blanket production from recycled PET, and then identified the key processes through sensitivity analysis. In addition, the graphical method and the principle of collaborative entropy model are applied to evaluate two of the environmental load, economic cost, and social impact in the blanket production from recycled PET. The results of the two methods are consistent, which indicates that to carry out multi-objective integrated evaluation with collaborative entropy model have good reliability. Moreover, the quantified results of collaborative entropy showed that the key processes that affected the coordinated development of the environment, economy, and society were organic chemicals usage process, electricity generation process, and direct air emission process. Based on the "Reduce-Reuse-Recycle" theory and the position of key processes in the system, feasible optimization suggestions were proposed. The establishment of this methodology system could provide theoretical and practical references for other waste utilization industry.

Authors: Shu Tian, Hongrui Tang, Qingsong Wang, Xueliang Yuan, Qiao Ma, Mansen Wang

Full Source: The Science of the total environment 2021 Feb 2;772:145049. doi: 10.1016/j.scitotenv.2021.145049.

OCCUPATIONAL

Analysis of neurotransmitters associated with neuropsychiatric status in workers following lead exposure

2021-01

Objective: To explore the correlation between neuropsychiatric status and blood neurotransmitter in lead workers, and to provide theoretical basis for the prevention and treatment of lead workers.

Subjects and methods: The study applied cross-sectional survey, 74 occupational lead exposed workers in a battery factory in a city of Hebei province were selected as the lead exposed group, and 62 workers (non-lead workers) were selected as the control group. The occupational health symptoms questionnaire and health examination and POMS (Profile of Mood State, POMS) emotional test questionnaire were applied to investigate the nearly emotional status of the studied objects, ICP-MS

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was used to determine the blood lead level of all subjects, HPLC (High performance liquid chromatography, HPLC) was applied to determine the concentration of neurotransmitter in peripheral blood of all studied subjects, and all results were applied the Pearson's correlation analysis. Results: The blood lead concentration of the lead workers group (163.23 ± 40.77 ug/L) was significantly higher than that in the control group (43.62 ± 14.50 ug/L), and the difference was statistically significant. From the analysis of neuropsychiatric status, the neurological symptoms in the lead workers group were higher than that in the control group, among which the symptoms of sleep disturbance, dizziness, fatigue, numbness of limbs and dampness and coldness of limbs were more obvious. Among the symptoms of digestive system, the incidence of abdominal pain, abdominal distension, constipation and nausea and vomiting were higher. According to the POMS emotion questionnaire, the scores of 5 negative emotions and 1 positive emotion in the lead exposure group were higher than that in the control group, and the difference was statistically significant. Related to the control group, the concentration of neurotransmitters such as DA, 5-HT, GABA, Gly, Trp and Glu were statistically decreased, $p < 0.001$. There was a negative correlation between neurotransmitters in peripheral blood and blood lead levels in lead workers, among which 5-HT had the greatest correlation with lead levels ($r = -0.569$, $p < 0.001$). 5-HT and Trp were significantly correlated with tension-anxiety (T), depression-depression (D), anger-hostility (A), Vigor-hyperactivity (V), fatigue-inertia (F), and confusion-confusion (C). 5-HT, Trp and GABA were significantly correlated with the survey symptoms, among which, the sleep disorder, constipation and fatigue had most significantly positive correlation with 5-HT or Trp, r-value was respectively 0.373, 0.233 and 0.563.

Conclusions: Lead exposure not only causes the alteration of neuropsychiatric behavior of lead workers, but also changes gastrointestinal symptoms. Serotonin may be involved as the main neurotransmitter synthesized in intestinal, and the synthesis and metabolism may be regulated by intestinal flora.

Authors: X-J Chen, X Wang, S-J Meng, L-J Zhang, L Wu, F-Y Cao, Y-S Zhang

Full Source: European review for medical and pharmacological sciences 2021 Jan;25(2):880-889. doi: 10.26355/eurrev_202101_24656.

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Low-level exposure to lead dust in unusual work schedules and hematologic, renal, and hepatic parameters

2021-02-09

Background: Many workers are exposed to lead dust in lead-zinc mines. Exposure to this heavy toxic metal and its compounds can cause irreversible adverse health effects. Objective: To assess possible hematotoxic, nephrotoxic, and hepatotoxic potentials of low levels of lead in a group of mine workers exposed to this heavy metal in an unusual work schedule.

Methods: A total of 73 exposed and 70 non-exposed employees were interviewed. Demographic data, and occupational and medical history of the employees were obtained by questionnaires. Air monitoring was performed to determine the workers' time-weighted average (TWA) exposure to lead dust. The threshold limit value (TLV) for lead was adjusted for unusual work schedules according to the model developed by the University of Montreal and the Institute de Recherche en Sante et en Securite du Travail (IRSST). Blood samples were collected for complete blood count, liver and kidney function tests. Data were analyzed using version 21.0 of the SPSS software.

Results: The TWA exposure of workers was 24 µg/m³. On average, the worker's exposure to lead dust did not exceed the 8-h OSHA and ACGIH TLV-TWA of 50 µg/m³. Significant associations were found only between exposure to lead and platelet count, red cell distribution width, total protein, and albumin.

Conclusions: Exposure to low levels of lead dust in unusual work schedules was not associated with overt hematotoxicity, hepatotoxicity or nephrotoxicity. However, mild, sub-clinical, pre-pathologic significant changes were noted in some blood parameters of the exposed employees as compared with their referent counterparts.

Authors: Fateme Kooshki, Masoud Neghab, Esmaeel Soleimani, Jafar Hasanzadeh

Full Source: Toxicology and applied pharmacology 2021 Feb 9;115448. doi: 10.1016/j.taap.2021.115448.

Occupational Exposure to Electromagnetic Fields and Health Surveillance According to the European Directive 2013/35/EU

2021-02-10

In the European Union, health surveillance (HS) of electromagnetic fields (EMF)-exposed workers is mandatory according to the Directive

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2013/35/EU, aimed at the prevention of known direct biophysical effects and indirect EMF's effects. Long-term effects are not addressed in the Directive as the evidence of a causal relationship is considered inadequate. Objectives of HS are the prevention or early detection of EMF adverse effects, but scant evidence is hitherto available on the specific procedures. A first issue is that no specific laboratory tests or medical investigations have been demonstrated as useful for exposure monitoring and/or prevention of the effects. Another problem is the existence of workers at particular risk (WPR), i.e., subjects with specific conditions inducing an increased susceptibility to the EMF-related risk (e.g., workers with active medical devices or other conditions); exposures within the occupational exposure limit values (ELVs) are usually adequately protective against EMF's effects, but lower exposures can possibly induce a health risk in WPR. Consequently, the HS of EMF-exposed workers according to the EU Directive should be aimed at the early detection and monitoring of the recognized adverse effects, as well as an early identification of WPR for the adoption of adequate preventive measures.

Authors: Alberto Modenese, Fabriziomaria Gobba

Full Source: International journal of environmental research and public health 2021 Feb 10;18(4):1730. doi: 10.3390/ijerph18041730.

Is Chronic Exposure to Raw Water a Possible Risk Factor for Amyotrophic Lateral Sclerosis? A Pilot Case-Control Study

2021-02-05

Background: The etiopathogenesis of amyotrophic lateral sclerosis (ALS) is still largely unknown.

Methods: We performed a case-control study (33 cases and 35 controls) in Umbria, Italy. We investigated associations between common lifestyle, clinical factors, as well as environmental exposures potentially implicated with ALS onset. Face-to-face interviews were carried out. All cases were recruited and diagnosed according to El Escorial criteria. Case-control comparisons were made for educational and residential status, occupational exposures, and clinical and lifestyle factors prior to cases' dates of diagnosis.

Results: Our results showed an increased risk of ALS for subjects chronically exposed to raw water use (odds ratio (OR) = 6.55, 95% confidence interval (CI): 2.24-19.12). Garden activities showed a tight association with ALS as well, very likely as a consequence of chronic raw water exposure. Indeed, we could exclude an impact for pesticides, as no significant differences were observed in pesticide exposure in the two groups interviewed. However, cases were more often exposed to fertilizers.

Background: Many workers are exposed to lead dust in lead-zinc mines.

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After adjustment for age, sex, and heavy physical activities, exposure to raw water was still associated with increased ALS risk (OR = 4.74, 95% CI: 1.33-16.85).

Discussion: These findings suggest an association between ALS and exposure to raw water, which should be further investigated for the presence of chemicals interfering with nervous system functionality.

Authors: Giuseppe Stipa, Antonio Ancidoni, Monica Mazzola, Emanuela Testai, Enzo Funari, Cristina Spera, Cinzia Fanelli, Alessia Mancini, Nicola Vanacore

Full Source: Brain sciences 2021 Feb 5;11(2):193. doi: 10.3390/brainsci11020193.

PHARMACEUTICAL/TOXICOLOGY

Gestational Exposure to Phthalates and Social Responsiveness Scores in Children Using Quantile Regression: The EARLI and HOME Studies

2021-01-30

Linear regression is often used to estimate associations between chemical exposures and neurodevelopment at the mean of the outcome. However, the potential effect of chemicals may be greater among individuals at the 'tails' of outcome distributions. Here, we investigated distributional effects on the associations between gestational phthalate exposure and child Autism Spectrum Disorder (ASD)-related behaviors using quantile regression. We harmonized data from the Early Autism Risk Longitudinal Investigation (EARLI) (n = 140) Study, an enriched-risk cohort of mothers who had a child with ASD, and the Health Outcomes and Measures of the Environment (HOME) Study (n = 276), a general population cohort. We measured concentrations of 9 phthalate metabolites in urine samples collected twice during pregnancy. Caregivers reported children's ASD-related behaviors using the Social Responsiveness Scale (SRS) at age 3-8 years; higher scores indicate more ASD-related behaviors. In EARLI, associations between phthalate concentrations and SRS scores were predominately inverse or null across SRS score quantiles. In HOME, positive associations of mono-n-butyl phthalate, monobenzyl phthalate, mono-isobutyl phthalate, and di-2-ethylhexyl phthalate concentrations with SRS scores increased in strength from the median to 95th percentile of SRS scores. These results suggest associations between phthalate

Linear regression is often used to estimate associations between chemical exposures and neurodevelopment at the mean of the outcome.

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concentrations and SRS scores may be stronger in individuals with higher SRS scores.

Authors: Marisa A Patti, Craig Newschaffer, Melissa Eliot, Ghassan B Hamra, Aimin Chen, Lisa A Croen, M Daniele Fallin, Irva Hertz-Picciotto, Geetika Kalloo, Jane C Khoury, Bruce P Lanphear, Kristen Lyall, Kimberly Yolton, Joseph M Braun

Full Source: International journal of environmental research and public health 2021 Jan 30;18(3):1254. doi: 10.3390/ijerph18031254.

Exposure to perfluoroalkyl substances in early pregnancy and risk of sporadic first trimester miscarriage

2021-02-11

Many first trimester sporadic miscarriages are unexplained and the role of environmental exposures is unknown. The present aim was to study if levels of Perfluoroalkyl substances (PFASs) in early pregnancy are associated with unexplained, sporadic first trimester miscarriage. The study was performed within the Swedish SELMA pregnancy cohort. Seventy-eight women with non-recurrent first trimester miscarriage were included and 1449 women were available as live birth controls. Eight PFASs were measured in first trimester serum. A doubling of perfluorooctanoic acid (PFOA) exposure, corresponding to an inter-quartile increase, was associated with an odds ratio (95%CI) for miscarriage of 1.48 (1.09-2.01) when adjusting for parity, age and smoking. Analyses per quartiles of PFOA exposure indicated a monotonic dose response association with miscarriage. A similar, but not significant, pattern was observed for perfluorononanoic acid (PFNA). For other PFAS, there were no associations with miscarriage. We have previously shown associations between early pregnancy PFAS exposures and preeclampsia, as well as lower birth weight. Now we report an association between PFOA and miscarriage within the same cohort, which may suggest shared but unknown mechanisms. The study can only represent a period of early placentation and clinical pregnancy loss during the second half of the first trimester.

Authors: Sverre Wikström, Ghada Hussein, Annika Lingroth Karlsson, Christian H Lindh, Carl-Gustaf Bornehag

Full Source: Scientific reports 2021 Feb 11;11(1):3568. doi: 10.1038/s41598-021-82748-6.

Parabens for which the molecules contain hydrolytic and ionizable groups, are emerging pollutants due to their ubiquity in the environment. However, lack of pKa and second-order base-catalyzed hydrolysis kinetics (kB) values limits their environmental persistence assessment. Herein, six

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parabens were selected as reference compounds for which the pKa and kB values were measured experimentally. A semiempirical quantum chemical (QC) method was selected to calculate pKa of the parabens, and density functional theory (DFT) methods were selected to calculate kB for neutral and anionic forms of the parabens, by comparing the QC-calculated and determined values. Combining the QC-calculated and experimental pKa and kB values, quantitative structure-activity relationships with determination coefficients (R²) being 0.947 and 0.842 for the pKa and kB models, respectively, were developed, which were validated and could be employed to efficiently fill the kB and pKa data gaps of parabens within applicability domains. The base-catalyzed hydrolysis half-lives were estimated to range from 6 h to 1.52 × 10⁶ years (pH 7-9, 25 °C), further necessitating the in silico models due to the tedious and onerous experimental determination, and the huge number of hydrolyzable and ionizable chemicals that may be released into the environment.

Authors: Tong Xu, Jingwen Chen, Xi Chen, Huaijun Xie, Zhongyu Wang, Deming Xia, Weihao Tang, Hong-Bin Xie

Full Source: Environmental science & technology 2021 Feb 10. doi: 10.1021/acs.est.0c06891.

Changes in the levels of headspace volatiles, including acetaldehyde and formaldehyde, in red and white wine following light irradiation

2021-02-13

The effects of fluorescence light irradiation on the changes in the levels of volatiles, especially acetaldehyde and formaldehyde, were determined in red and white wines. Three different red or white wine brands were mixed and subjected to light irradiation for 5 days. Generally, the levels of total volatiles in white wine were higher than those in red wine and decreased during light irradiation. The level of 1,1,6-trimethyl-1,2-dihydronaphthalene, an aromatic compound commonly found in aging wine, decreased significantly following light irradiation ($p < 0.05$), whereas those of acetaldehyde and formaldehyde increased significantly in white wine ($p < 0.05$). Furthermore, the formaldehyde content in white wine was higher than that in red wine. Thus, light irradiation promotes the decomposition of major volatiles to a greater degree in white wine than in red wine. This implies that white wine may require more attention and caution against light exposure than red wine. PRACTICAL APPLICATION: Red and white wines are two globally consumed alcoholic beverages; several factors influence their quality. This study evaluates the effects of light irradiation on the profiles of headspace volatiles, such as

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formaldehyde and acetaldehydes, which are harmful chemicals. Generally, the levels of total headspace volatiles decreased during storage, while those of acetaldehyde and formaldehyde increased markedly in white wine. This increase in aldehyde levels suggests that wines should not be exposed to light irradiation. The results of this study will help wine producers, distributors, and consumers maintain wines with low contents of acetaldehyde and formaldehyde.

Authors: Se Hyeok Kim, Hyun Jeong Jung, Jae Hwan Lee

Full Source: Journal of food science 2021 Feb 13. doi: 10.1111/1750-3841.15642.

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