Session E4: Emerging Contaminants in Urban Waters

Room A107-109
10:30 am – 12:00 pm

0080
E4-1

Occurrence and Transformation of Benzodiazepine Pharmaceuticals in the Environment

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Benzodiazepine derivatives are important drugs for treating anxiety, insomnia, agitation, seizures, muscle spasms, alcohol withdrawal and are used as premeds for anaesthesia. They are prescribed in large quantities globally and are potentially new emerging environmental contaminants. Unfortunately, a dearth of data exists concerning their occurrence, persistence and fate in the environment. This work addresses this by assessing the occurrence of selected benzodiazepine anxiolytics (diazepam, oxazepam and bromazepam) in waste and environmental waters and by identifying the stable transformation products formed during biodegradation and photodegradation experiments.

We investigated the occurrence of the selected benzodiazepine anxiolytics in Slovene rivers, hospital effluents and in wastewater treatment plant influents and effluents. The study reveals the presence of benzodiazepine derivatives in most samples with the highest amounts in hospital effluents: 111 ngL^{-1}, 158 ngL^{-1} and 72 ngL^{-1}, for diazepam, bromazepam and oxazepam, respectively. All three investigated compounds were also determined in Slovene rivers with median concentrations from 13 to 26 ngL^{-1}.

We also addressed the transformation products formed from benzodiazepine anxiolytics during environmental bio- or photo-degradation. In our study we propose eight diazepam and four oxazepam transformation products, which to our knowledge are reported for the first time. As virtually no information on the transformation of benzodiazepine derivatives is currently available, the proposed transformation products bring an important contribution to recognising their environmental fate. Hopefully, because of the increasing attention given to the determination of pharmaceutical transformation products in the literature and the development of identification tools in general, knowledge about the fate and effects of this particular group of pharmaceuticals in the environment will become more comprehensive.

Acknowledgements
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0261
E4-2

Reconnaissance Investigation of Emerging Contaminants in Effluent from Wastewater Treatment Plant and Stormwater Runoff in the Columbia River Basin

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In order to efficiently reduce toxic loading to the Columbia River basin, sources and pathways need to be identified. Little is known about the toxic loadings entering the system from wastewater treatment facilities and stormwater runoff. This study provides preliminary data on these sources and pathways throughout the basin. Nine cities were chosen in Oregon and Washington to provide diversity in location, arid eastside and wet westside characteristics, and population densities. Samples were collected from a wastewater treatment facility in each of the cities and analyzed for wastewater-indicator compounds, pharmaceuticals, PCBs, PBDEs, organochlorine and legacy compounds, currently used pesticides, mercury, and estrogenicity. Currently, these treatment facilities are required to sample their effluent to meet their permit requirements, which are very limited. Little is known about the environmental implications of emerging contaminants in these effluents. Results indicate that a majority of these compounds are present in the effluent and some at environmentally relevant concentrations. Although the grab samples were not time-integrated and the effluent is expected to change in nature throughout time, the continuous input of this number of compounds and at these concentrations may have implications on the receiving waters, the foodweb reliant on these waters, and the ecosystem as a whole.

The second component of the sampling effort was directed at characterizing stormwater runoff for a slightly different set of emerging contaminants-PCBs, PBDEs, organochlorine compounds, PAHs, metals, currently used pesticides, and oil and grease. Studies have shown that stormwater, most often untreated before entering the receiving waters, can deliver significant loadings of these compounds. Unlike effluent from wastewater treatment plants, stormwater runoff is sporadic and unpredictable, yet the sudden input of these contaminants has implications for the ecosystem. These two pathways are poorly understood in terms of their toxic contribution to the system, yet they act as integrators of human activities and offer an area where changes could be made to reduce harmful human effects on the environment.

0560
E4-3

Assessing the Extent and Magnitude of Sediment Contamination in Southern California by Two Chemicals of Emerging Concern

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Recently, investigators have identified the exposure of marine life to two constituents of emerging concern (CEC) in southern California: 1) pyrethroids, a current use pesticide that can be acutely toxic to non-target organisms; and 2) PBDEs, an industrial chemical that can bioaccumulate in marine organisms much like PCBs. However, managers know very little about the extent or magnitude of environmental contamination by pyrethroids or PBDEs. As part of the ongoing regional marine monitoring program collaborative in southern California, these two CECs were measured in sediments collected from 155 sites using a stratified-probabilistic study design. Strata included embayments and the open coast in order to assess if one habitat was at more risk than another. Total pyrethroid concentrations were detected in over a third of the southern California embayments (mean = 22 µg/kg). Estuaries had the greatest pyrethroid concentrations (230 µg/kg), a concentration known to produce toxic responses in native fauna. PBDEs were detected in over 90% of samples and the greatest concentrations were once again measured in estuaries (560 µg/kg). For both pyrethroid and PBDEs, open coastal sediments had the lowest concentrations. The spatial extent and magnitude of these two CECs indicated that pyrethroids and PBDEs are likely entering the marine environment via urban runoff. In southern California, treated municipal wastewaters are discharged miles offshore in 60-100 m depth while runoff is discharged to estuaries, largely without treatment of any kind. Estuaries receiving runoff from the most developed watersheds had the greatest sediment concentrations of both pyrethroids and PBDEs. These findings have motivated resource managers to launch investigations into toxicity and bioaccumulation in marine organisms in embayments for these two CECs.

0292
E4-4

Urban Water Monitoring for Organic Contaminants

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The EPA Region 7 Water Monitoring Team and Regional Laboratory worked to develop a new analysis method for organic contaminants in surface water. The method uses a new extraction technique, stir-bar sorptive extraction (SBSE), coupled with traditional gas chromatograph/mass spectrometry (GC/MS) to identify and quantify semivolatile organic compounds, including pesticides, polynuclear aromatic hydrocarbons (PAH), phthalates, industrial compounds, and personal care products. The extensive compound list (51 analytes) requires 2 separate extractions and analysis, however the extractions require only 105 mL total of sample and once set-up is complete, little analyst intervention. The samples are extracted on a stir plate for 1.5 to 21 hours.

Twelve urban streams were analyzed by the method during the 2011 sampling season, along with reference streams. The results show an array of chemicals detected at levels not possible by the region prior to the new method development. PAHs have now been detected at trace levels below the prior reporting limit of 2 µg/L in many samples, most of which are impacted from pavement runoff. Personal care products such as triclosan and bisphenol A have been detected. Industrial chemicals such as tris(2-chlorethyl)phosphate (a flame retardant) and nonylphenol derivatives are present, and DEET, a common insect repellant, has been detected in many of the streams.

Data from this study will be used to assess the condition of the urban streams in the Kansas City metropolitan area and are made available to the public through the website: www.kcwaters.org. These results, combined with data from other chemical analysis, bacteria analysis, biological sampling, and physical assessment, provide the region and the public a good picture of the health of the urban waterways that provide recreational opportunities.