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Stability issue of selected 2-, 3- and 4-ring parent and mono-hydroxylated polycyclic aromatic hydrocarbons in municipal sewage, a factor affecting their use as population exposure markers for wastewater-based epidemiology

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Polycyclic Aromatic Hydrocarbons (PAHs) are a group of ubiquitous environmental contaminants which have aroused public concern over the years. Human exposure to PAHs can take place through various routes including ingestion, inhalation and dermal contact. 1-Hydroxypyrene (1-OH-pyr), which is a Phase-I metabolite of pyrene, has long been a biomarker to monitor human exposure to PAHs. Nevertheless, because of the complexity of PAH occurrence in the urban environment, we cannot solely rely on 1-OH-pyr for the assessment of population exposure to PAHs. Various metabolites of PAHs together with their parent compounds may be needed. In this work, an analytical protocol based on Solid-Phase Extraction (SPE) and Gas Chromatography-Mass Spectrometry (GC-MS) has been developed for the direct quantification of six Low-Molecular-Weight (LMW) and one High-Molecular-Weight (HMW) PAHs, which are all listed as priority PAHs by the United State Environmental Protection Agency (USEPA), as well as 15 mono-hydroxylated PAHs (OH-PAHs) including 1- and 2-OH-naphthalene, 1-OH-acenaphthene, 1-, 2-, 3- and 9-OH-fluorene, 1-, 2-, 3-, 4- and 9-OH-phenanthrene, 1- and 2-OH-anthracene and 1-OH-pyrene in municipal wastewater. Extraction of the PAHs and OH-PAHs from wastewater samples were carried out by mixed-mode solid-phase cartridges and silica cartridges in series. We aim to evaluate whether these PAH metabolites in municipal wastewaters can act as population exposure markers for PAHs by the technique known as Sewage Chemical Information Mining (SCIM). In this context, assessment of the stability of targeted analytes in influent sewage is vital as their concentrations will be used to back-calculate and to correct errors associated with their transformation, degradation or formation inside sewer systems. A stability experiment which lasted for 21 days was conducted at relevant conditions at two temperatures that aimed to imitate typical temperature situations in winter and summer in sewer systems of Hong Kong. Stability models were generated for the targeted analytes based on linear, exponential or quadratic ways depending on the R² values of the models. Our results suggest that degradation of compounds with prominent stability problems should be taken into account for wastewater-based epidemiology. Besides, other detailed sewer information such as temperature and hydraulic retention time is required to back-calculate the original concentrations of the target analytes more precisely.

Biography

Ka-Ki Yuen is a PhD student in Environmental Science from the City University of Hong Kong. His current research focuses on development of an analytical protocol to estimate population exposure to environmental contaminants based on wastewater-based epidemiology.

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