Preferred session: Water Quality

Toxicity characterization of urban stormwater using bioanalytical tools

Janet Tang[1]*, Rupak Aryal[2], Wolfgang Gernjak[2], Meng Chong[3], Jatinder Sidhu[3], Simon Toze[3] and Beate Escher[1]

[1] The University of Queensland, National Research Centre for Environmental Toxicology (Entox), Brisbane Qld 4108, Australia
[2] The University of Queensland, Advanced Water Management Centre (AWMC), Brisbane Qld 4072, Australia
[3] CSIRO Land and Water, Ecosciences Precinct, Dutton Park Qld 4102, Australia
* presenting author

Abstract: The growing demand of urban water supply due to limited water sources and population growth is a pressing issue in Australia. Thus, stormwater harvesting and reuse becomes an attractive alternative strategy to address this water shortage issue. However, urban stormwater has been long considered as a major source of surface water pollution. Runoff from different urban catchments (i.e. source contributions from different anthropogenic activities and land uses) causes variable contaminant profiles and this poses a challenging task for environmental monitoring and risk assessment. The current Australian Guidelines for Water Recycling: Stormwater Harvesting and Reuse only encompasses a limited number of stormwater quality parameters. Surprisingly, only scarce data and information is available on toxicity in urban stormwater. A good understanding on raw urban stormwater is essential to develop water treatment facilities for potential direct or indirect potable reuse schemes. This study is the first comprehensive assessment on chemical, microbiological and toxicological profiles of urban stormwater in Australia. Toxicity testing results from Brisbane, Sydney and Melbourne are presented in this paper. Seven bioassay endpoints targeting respective groups of chemicals with similar modes of toxic action of particular relevance for human and environmental health are investigated: (1) non-specific (or general?) toxicity (Microtox); (2) phytotoxicity (Imaging-PAM); (3) dioxin-like activity (CAFLUX); (4) estrogenicity (E-Screen); (5) genotoxicity (umuC); (6) protein damage (GSH) and (7) oxidative stress (AREc32). The Microtox results demonstrated a high variability in non-specific toxicity and the maximum baseline toxicity equivalent concentration (TEQ) of the collected urban stormwater samples was found to be comparable to the treated effluent from wastewater treatment plant. Phytotoxicity results among three urban stormwater sampling sites were very similar indicating the common application and occurrence of trace levels of herbicides in urban runoff. High level of genotoxicity was also observed at all three stormwater sampling sites suggesting that polyaromatic hydrocarbons (PAHs) from road runoff may be a potential source of contaminants. This is because the observed genotoxic effects were found to be higher in the metabolic activated fraction and the toxic equivalent concentrations were generally higher than the equivalent in raw sewage. Only low levels or no toxicity level were found in the other measured bioanalytical endpoints. This study demonstrates the utilisation of bioanalytical tools for stormwater quality monitoring and forms an important basis to inform on a better risk management framework, design of water treatment facilities and stormwater reuse schemes in the near future.

Keywords: alternative water source, *in vitro* bioassay; reactive modes of toxic action; stormwater harvest, water recycling.