HYDROGEOCHEMICAL MODELING OF EMERGING MICRO-POLLUTANTS FROM DRINKING WATER SYSTEMS IN SOUTH AFRICA

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Abstract

Although emerging micro-pollutants are ubiquitous in drinking water systems, they remain unregulated and unknown in terms of occurrence and distribution in time and space. The problem is compounded by their persistency, very small size and/or polarity which make it difficult for them to be removed by conventional treatment methods. This study was aimed at characterising emerging micro-pollutants (i.e. Bisphenol A (BPA), technical 4-nonylphenol (NP), caffeine (CAF), galaxolide (HHCB), tonalide (AHTN) and carbamazepine (CBZ)), modeling their occurrence and distribution, and synthesising N-CNTs/PES nanocomposite membranes for effective removal of emerging micropollutants in water systems in Mpumalanga, and Northwest provinces in South Africa. Water samples were collected from raw water, treated water and effluents using standard sampling procedures. The target compounds were extracted and enriched by solid phase extraction (SPE). The extracts were stored in SPE cartridges at -18 °C, until they were ready for gas chromatography coupled to time of flight mass spectrometry (GCxGCToFMS) analyses. Multivariate statistical analyses, centrifugal flow field flow fractionation (CF_4) and PHREEQC hydrogeochemical modeling codes were used to characterise the emerging micro-pollutants in terms of their size, density, occurrence and distribution in time and space.

This study produced an inventory of levels, occurrence and spatial distribution of the selected emerging micropollutants based on PHREEQC hydrogeochemical modeling code. This study also developed a multidisciplinary environmentally sustainable, low cost characterization approach and removal of the emerging micro-pollutants from drinking water systems based on their differences in size and density among others by using CF_4 and/or other techniques. It was found than the distribution of emerging micropollutants is largely affected by a wide range of properties such hydrophobicity, electron polarizability, polarity, size, functional groups and environmental conditions (pH, ionic strength).

Key Words: Emerging micropollutants, GCxGC ToFMS, Hydrogeochemical modeling, Multivariate statistical analyses, PHREEQC.