SUSPECT SCREENING OF MICRO(NANO)PLASTICS IN THE DRINKING WATER SUPPLY SYSTEM OF THE BARCELONA METROPOLITAN AREA

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INTRODUCTION

Plastics are recognised by the scientific community as an emerging risk for the environment and human health. The most important sources of plastic pollution come from industrial and anthropogenic activities (primary plastics). This plastic litter undergo continuous degradation processes (secondary plastics) generating a broad amount of microplastics (MPLs; particles size up to 5 mm) and nanoplastics (NPLs; plastic particles less than 1 µm). Main problems associated with micro(nano)plastics (MNPLs) are the lixiviate of contaminants used in their formulation, their small sizes, wide occurrence and long life in the natural environments. In addition, due to their properties, MNPLs can also enhance the transport of many organic chemical contaminants by adsorption/desorption processes, acting as a passive carriers of hydrophobic organic substances [1].

Notwithstanding a large research efforts studying plastics in oceans, there is still a lack of studies focused on drinking water systems. Moreover, common literature about studies of micro(nano)plastic pollution in environmental compartments is related with a prior visual characterization by optical or scanning electron microscopy followed through a chemical confirmation using Fourier Transform InfraRed spectroscopy (FTIR) or related as ATR-FTIR, µFTIR, µRAMAN and other techniques like fluorometric analysis. These kinds of studies are qualitative, and development of new quantitative analytical approaches is necessary.

OBJECTIVES

The goal of this study was to evaluate the possible presence of the common MNPLs used for industrial and anthropogenic purposes: polyethylene (PE), polystyrene (PS), polypropylene (PP), poly(vinyl)chloride (PVC), polybutadiene (PBD), polyisoprene (PI), polyamides (PA) and polydimethylsiloxanes (PDMS) in drinking water supplied through the Barcelona metropolitan area (BMA) network to the end consumers.

A quantitative analytical procedure was applied by high performance liquid chromatography coupled to high resolution mass spectrometry (HPLC-HRMS).

EXPERIMENTAL METHOD

Sample treatment

Pre-treatment

1. Sieve through a stainless sieve of 20 µm mesh.
2. Filtration through a 0.7 µm dry and tared glass fiber filter.
3. Filters with particulate material were dried overnight at 60 ˚C until constant weight.

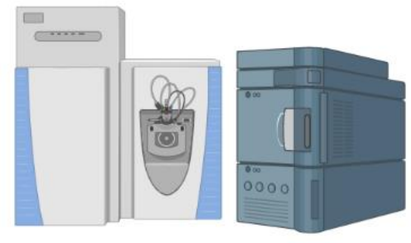
Extraction

10 mL Toluene
+
Ultrasonic assisted extraction (USAE) for 10 min

3 times

Evaporate under a nitrogen steam to concentrate the samples to 1.5 mL.

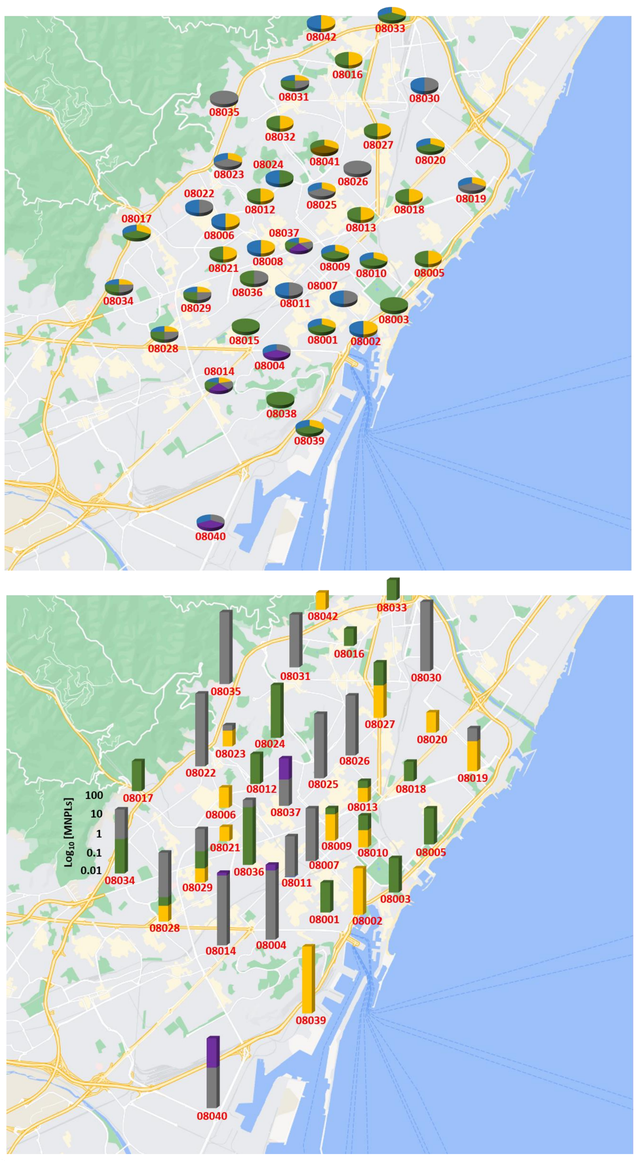
HPLC-HRMS

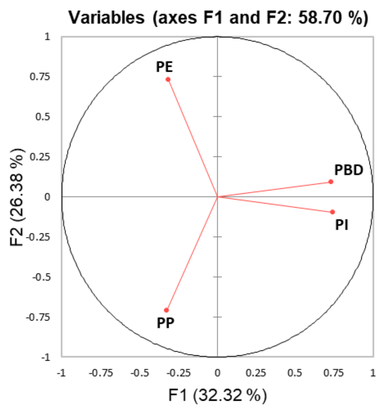


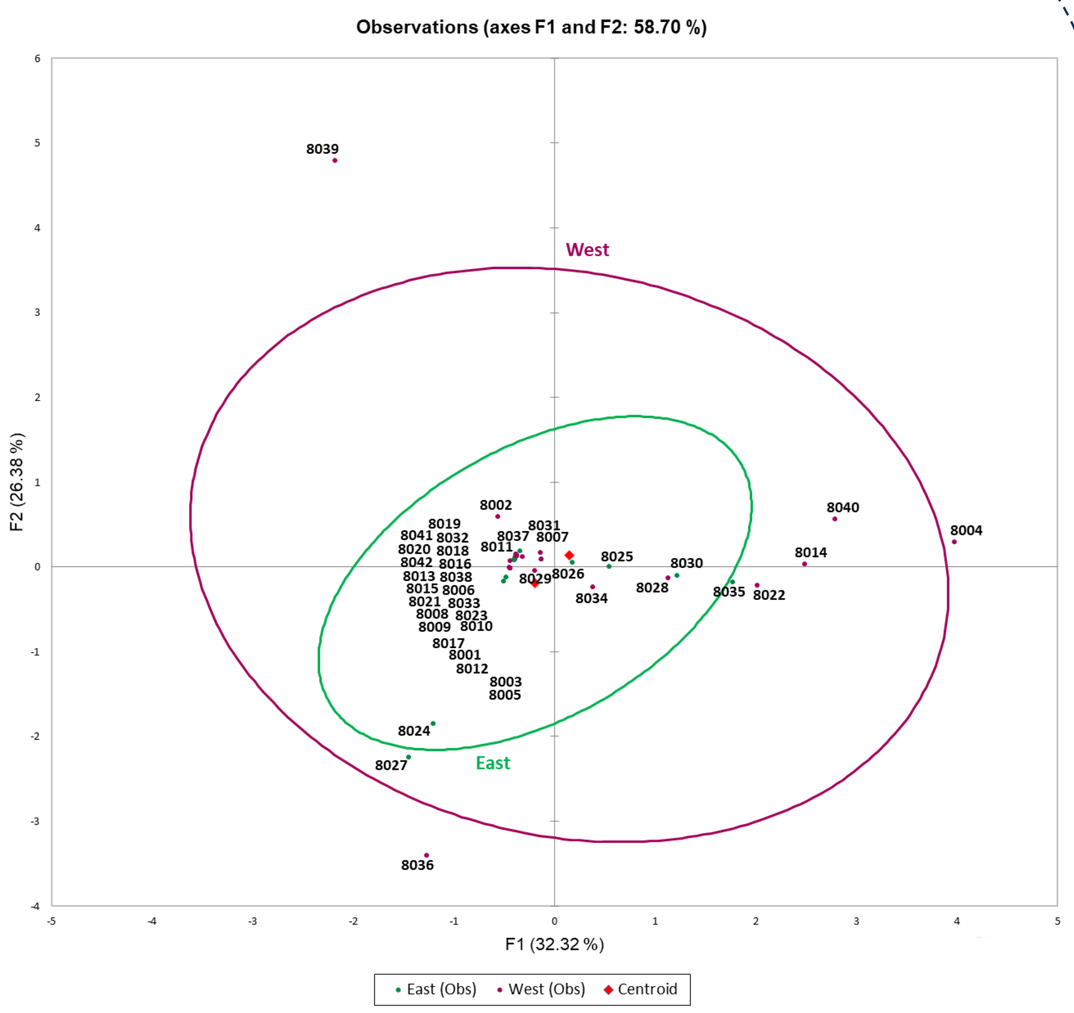
Column: Advanced polymer chromatography column (Acquity APC XT45 1.7 µm).
Mobile phase: Toluene (isocratic conditions).
Flow rate: 0.5 mL/min.
Ionisation: APPI (negative).
Acquisition mode: Full scan (500-3,000 m/z).

RESULTS AND DISCUSSION

Detected and found concentrations of MNPLs along different Barcelona city districts in µg/ L expressed as cumulative sum in base 10 logarithmic scale







Principal Component Analysis (PCA) applied to tap drinking water samples analysed. Loadings (left) and Scores (right) plots were generated from the obtained first two factors (F1 and F2).

CONCLUSIONS

❖ Results showed that PE, PS, PI, PBD, PP, PA and PDMS were found in the drinking water supply system of the Barcelona city. MNPLs concentrations found during the sampling campaign were from 0.05 to 39 µg/ L (ppb). In particular, PE, PP and PA were the most detected polymers, while those found at high concentrations were PI reaching 39 µg/L in 08022 district; and PBD in 08040, reaching 27 µg/L.

❖ As main trend, west districts of BMA present a slightly higher variety and concentrations of MNPLs than districts belonging to east area. A principal component analysis was carried out to assess if there are significant differences about MNPLs pollution in drinking waters provided from St. Joan Despí (west) and St. Adrià del Besòs (east) DWTPs. The multivariate analysis showed that no significance differences were established between drinking water supplied for each DWTP to all the districts of the Barcelona metropolitan area at confidence level of 95 %.

REFERENCES

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