Methodological approach to characterise tyre and road wear particles (TRWP) for environmental monitoring

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Abstract

Recent studies estimate that tyre and road wear particles (TRWP) are the largest single source of synthetic polymer particles in the microscopic size range (1 to 1000 μm).
Fourier transform infrared (FTIR) spectroscopy has been widely used for microplastic (MP) identification. However, as tyre particles contain black carbon, the infrared light is absorbed causing a potential under-reporting of TRWP. To overcome this limitation, the attenuated total reflection (ATR) mode could be an alternative for strongly-absorbing samples.

Due to the complex chemical composition of TRWP, specific markers are needed to detect them in the environment. Several inorganic and organic tyre components have been proposed e.g., metals as Zn or organic compounds as benzothiazoles. The accurate quantification of TRWPZn is limited by the presence of other Zn-species and particulates in the matrix. Therefore, a density separation is required to isolate this TRWPZn fraction, considering that TRWP have higher densities than "classic" MP.

In this study, a chemical characterisation of tyre wear (TW) and tyre wear particles (TWP) is presented using spectroscopic methods. Several used vehicle classes tyres were collected, shredded and sieved to generate a $<$ 1 mm TWP fraction. ATR-FTIR was explored to generate an in-house TW/TWP spectra library for future identification. Elemental analysis of individual TWP and a composite sample (TWPmix) was conducted using ICP-MS after microwave digestion. Furthermore, salts of different densities were evaluated for the isolation of TRWPZn.

The developed method will support the environmental monitoring of TRWP, providing a more comprehensive characterization of these particles.
This work was supported by the EU Funding for Research&Innovation (H2020-LABPLAS project, Ref. 101003954-H2020-SC5-2020-2) and by the Galician Government (Ref. ED431C 2021/56). M.E.C.B. also thanks the Next Generation EU and the Spanish Government for her María Zambrano Grant (RSU.UDC.MZ08). J.T.B. acknowledges Xunta de Galicia for his postdoctoral Grant (ED481B-2021-090).

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Keywords: TRWP, ATR FTIR, ICP MS, density separation