UNIVERSIDADE DA CORUÑA

METHODOLOGICAL APPROACH TO CHARACTERISE TYRE AND ROAD WEAR PARTICLES (TRWP) FOR ENVIRONMENTAL MONITORING

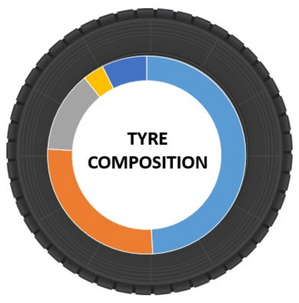
C. Román-Zas, M.E. Del Castillo-Busto, J. Terán-Baamonde, P. López-Mahía and S. Muniategui-Lorenzo

University of A Coruña (SPAIN) - Applied Analytical Chemistry Research Group (**QANAP**) - University Institute of Research in Environmental Studies (**IUMA**)

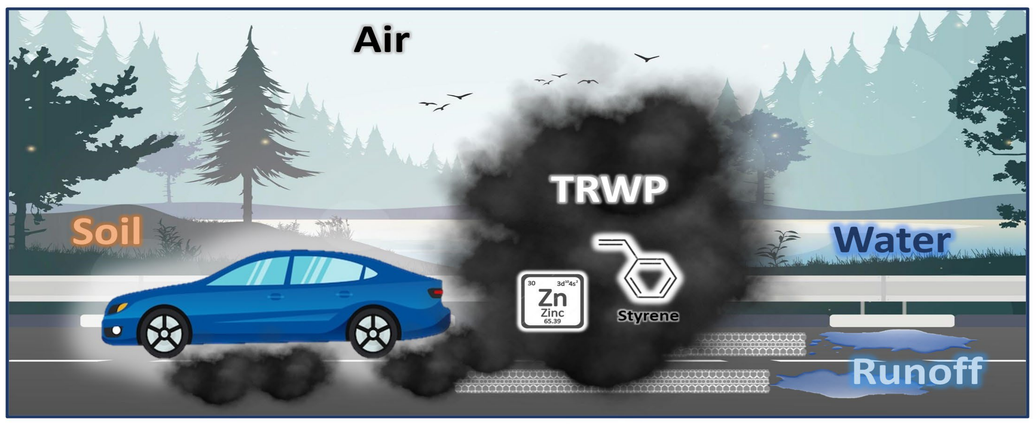
INTRODUCTION

- **Tyre and road wear particles ($TRWP_s$)** are estimated to be the largest single source of microplastics (MP_s), generated from the abrasion of tyre against road surfaces. Occurrence in all environmental compartments: **"from the road to the ocean"**.
- **Specific markers** are needed to detect **$TRWP_s$** in the environment, e.g. **Zn** or organic compounds as benzothiazoles.
- **AIM:** chemical characterization of **tyre wear (TW)** and **tyre wear particles (TWP)** using spectroscopic methods (Fourier transform infrared spectroscopy, **FTIR** and Inductively coupled plasma mass spectrometry, **ICP-MS**) for environmental monitoring.

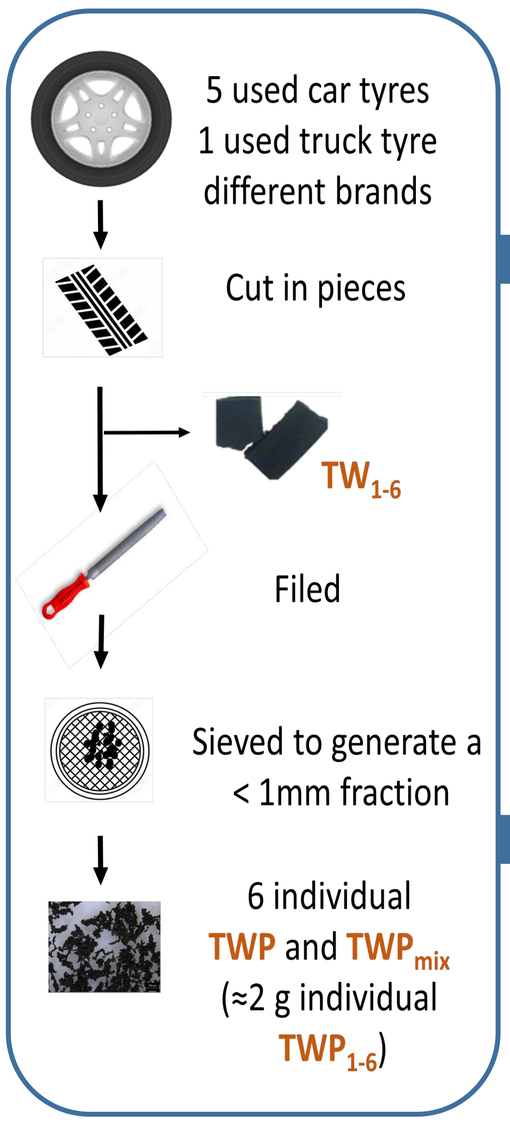
Composition and Fate of TRWPs



- Rubber 40-60 % → Styrene-butadiene (SBR), Polybutadiene rubber (BR), Natural rubber (NR)
- Filler 20-35 %
- Softener 12-15 %
- Vulcanization agents 2-5 % → ZnO, S
- Additives 5-10 % → Metals



PREPARATION AND CHEMICAL CHARACTERISATION OF TRWPs

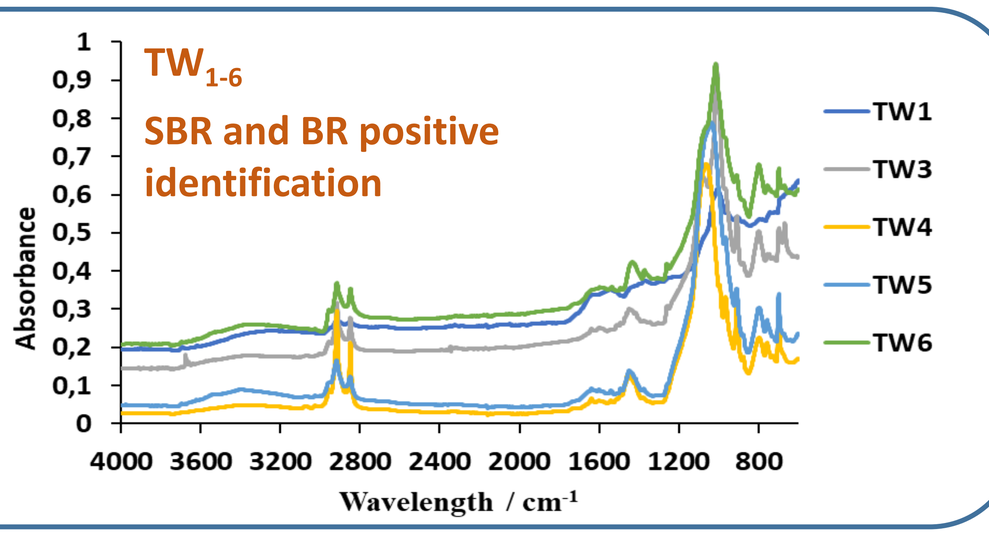


IDENTIFICATION

FTIR spectrometer equipped with an **attenuated total reflection accessory** (ATR).

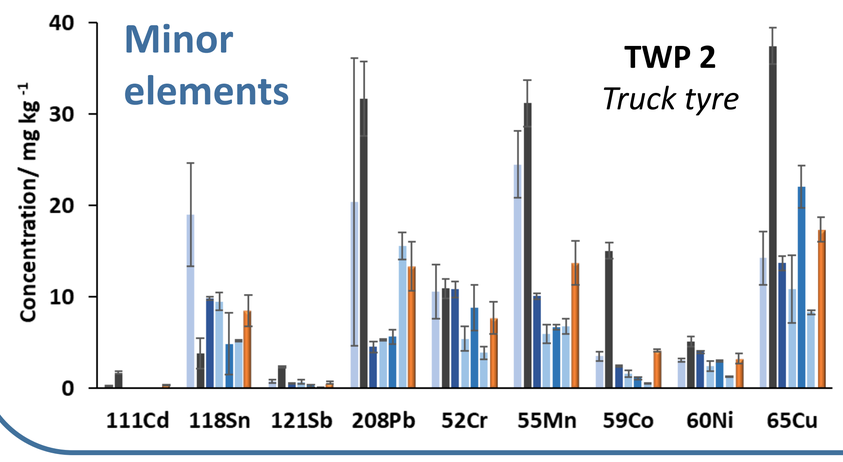
Parameters:

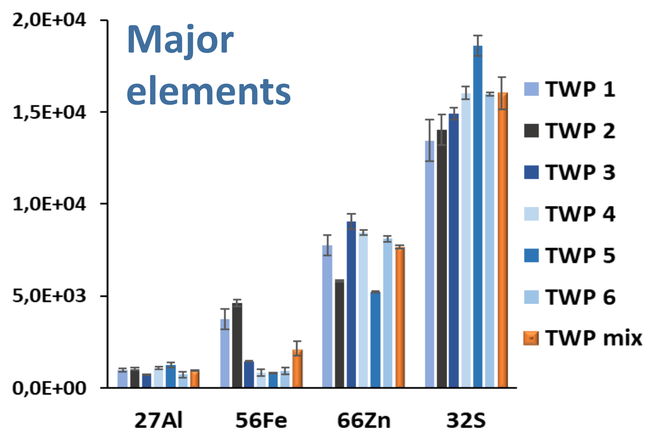
- Wavenumber range: 4000–600 cm^{-1}
- Number of scans: 50
- Resolution: 4 cm^{-1}
- Pressure: 80 cN·m



ELEMENTAL COMPOSITION

Elemental analysis of **TWP_{1-6}** and **TWP_{mix}** was conducted using **ICP-MS after MW digestion (4:1 HNO_3/HCl)**.





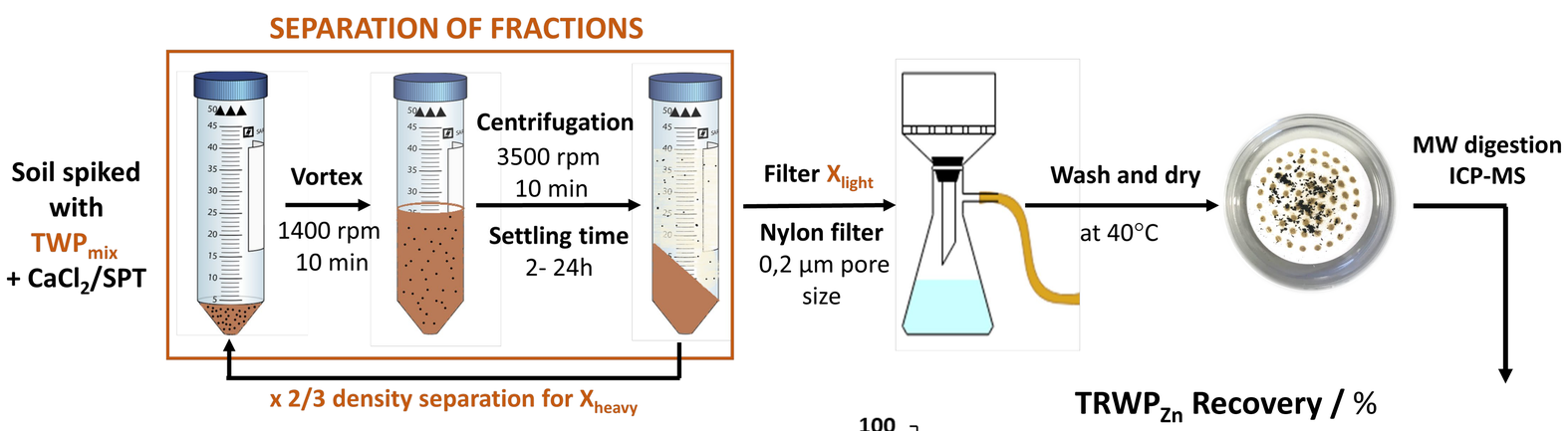
Low resolution
Cd, Sn, Sb, Pb
Medium resolution
Cr, Mn, Co, Ni, Cu, Al, Fe, Zn, S

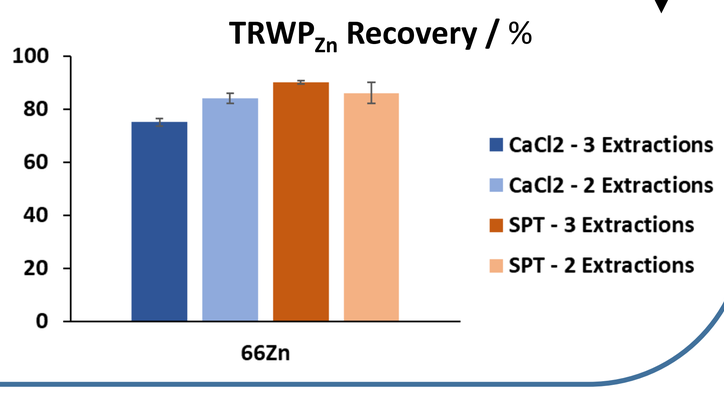
ERM-EC680m
90 - 113 %
SPIKED
102 - 114 %

METHOD VALIDATION

Determination of $TRWP_{Zn}$

A density separation was performed to isolate **$TRWP_{Zn}$** from other particulate matter, including Zn-species, using **$CaCl_2$ (ρ= 1.5 g/cm³, 65 €/kg)** or **SPT (ρ= 1.9 g/cm³, 238 €/kg)**.





- ✚ Positive identification by **FTIR-ATR**
- ▬ **Procedural blanks** were only found significant for **Al, Fe and Mn**
- ✚ Other **potential markers** of TRWP: **S, Pb, Co and Cu**

CONCLUSIONS

- ✓ **FTIR-ATR** is suitable for TW/TWP identification.
- ✓ The most abundant elements in TWP_s were **Zn, S, Fe and Al**. Differences were only found for TWP_2 (truck tyre): Cu, Co, Mn and Pb.
- ✓ Density separation using 2 extractions of $CaCl_2$ or SPT provided **recoveries ≥ 85 %**.
- ✓ **$CaCl_2$** could be an alternative to SPT for the isolation of $TRWP_{Zn}$.

Acknowledgements

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