PIONEERING DEVELOPMENT OF AUTOMATIC IDENTIFICATION OF MICROPLASTICS BY MICRO-ATR-FTIR SPECTRA

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BRIEFING

STATISTICS
Worldwide plastic production exceeds 368 million tons and over 62% of marine litter is plastic now[1,2].

DEFINITION
Microplastics are plastic pieces ranging from 1 µm to 5 mm.

CONCEPTUALIZATION
The impact of microplastics is only possible to understand if this contamination is characterized adequately and objectively regarding the physical and chemical properties (*i.e.* polymer type) of particles. The polymer type is commonly identified by Fourier-Transformed-Infrared spectroscopy, FTIR, where the acquired infrared spectrum works as a molecular fingerprint of the plastic.

CHALLENGE
Identifying microplastics from the infrared spectrum can be challenging in some cases, particularly when a biofilm covers the particles or whenever spectral inconsistencies appear due to differences in plastic additives and copolymers, ageing, or other coating types.

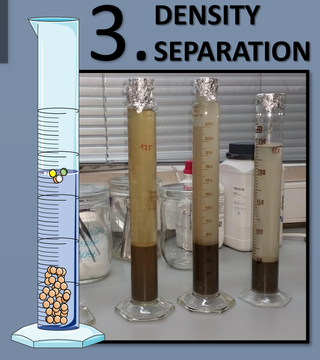
ACHIEVEMENT
This work describes the development and validation of a methodology towards the automatic identification of microplastics by micro-ATR-FTIR, overcoming the complexity and time consuming of a manual interpretation of characteristic spectral bands.
The automatic identification of the IR spectra was supported on a fast mathematical comparison between the unknown microparticle and reference spectra using different signal transformations, match algorithms and thresholds[3].

EXPERIMENTAL

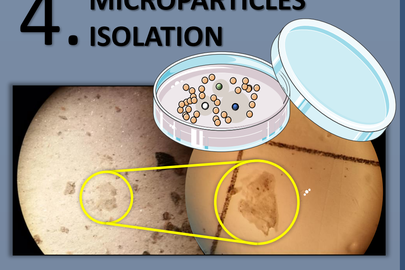
1. SEDIMENT SAMPLING

2. DIGESTION

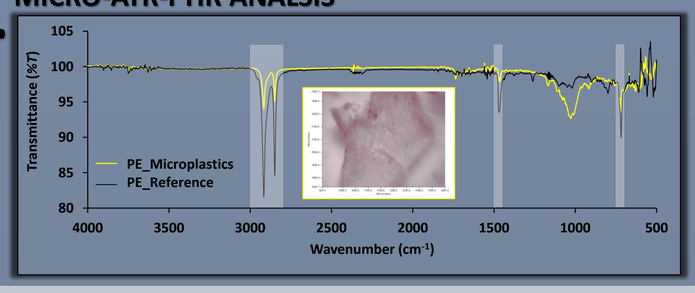
3. DENSITY SEPARATION



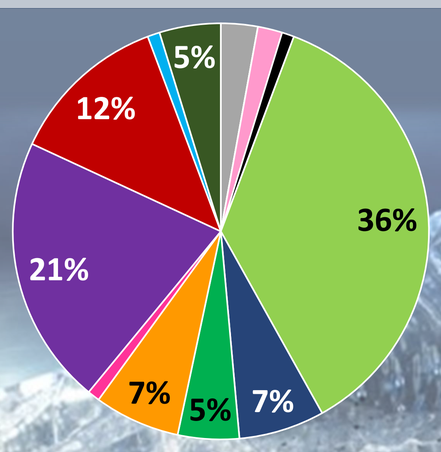
4. MICROPARTICLES ISOLATION



5. MICRO-ATR-FTIR ANALSIS



CHEMICAL CHARACTERIZATION

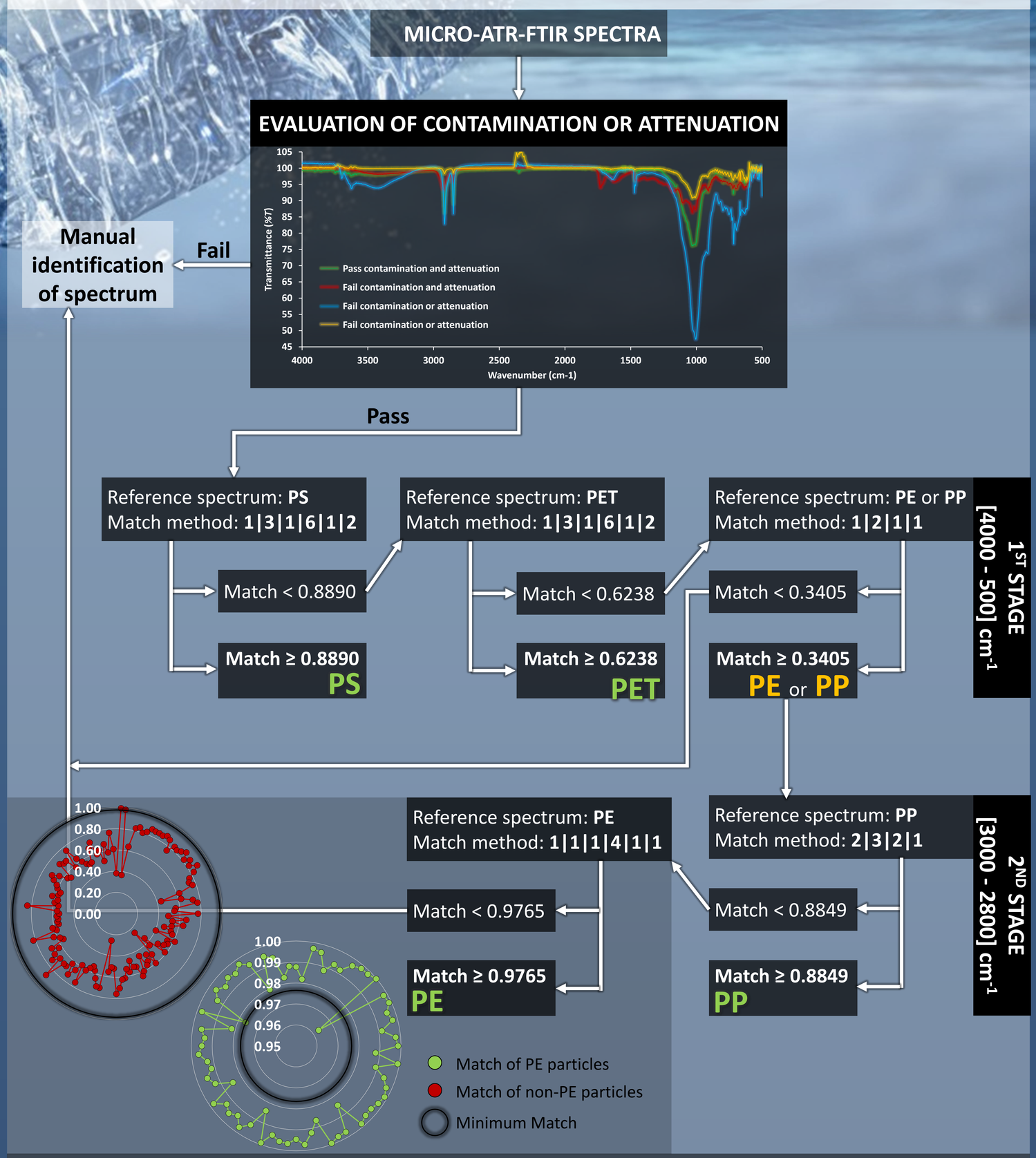


319 Microplastics

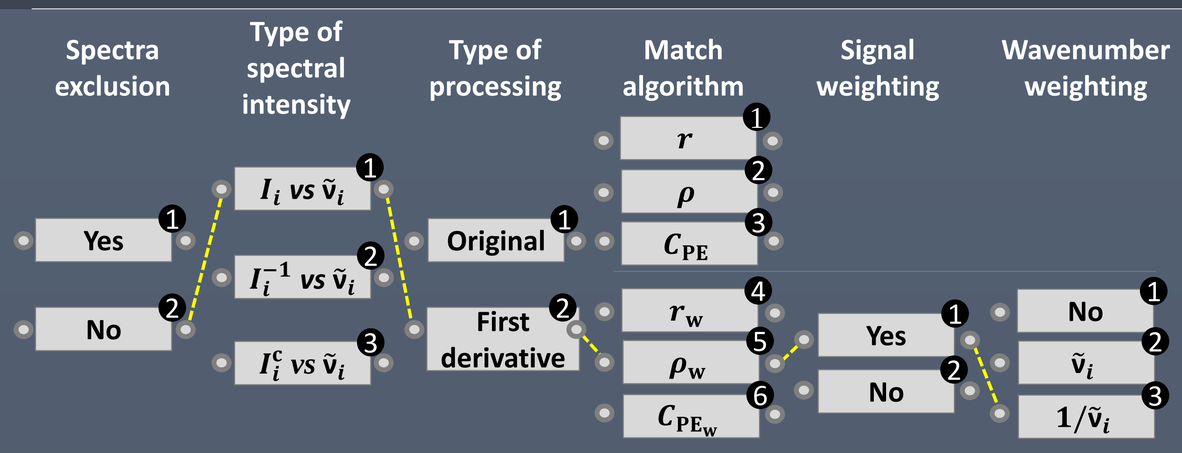
AC	CA	EVA
PA	PDMS	PE
LDPE	HDPE	PET
PMMA	PP	PS
PU	PVC	SBC

AC: Acrylate copolymer; CA: Cellulose acetate; EVA: Ethylene vinyl acetate; PA: Polyamide; PDMS: Polydimethylsiloxane; PE: Polyethylene; LDPE: Low density polyethylene; HDPE: High density polyethylene; PET: Polyethylene terephtalate; PMMA: Polymethylmethacrylate; PP: Polypropylene; PS: Polystyrene; PU: Polyurethane; PVC: Polyvinyl chloride; SBC: Styrene butadiene copolymer

STRATEGY & RESULTS



MATCH METHOD CODING



FINAL REMARKS

- Methodology successfully applied to the identification of PE, PET, PP, and PS particles.
- The performed identifications are associated with a true positive rate, *TP*, and a false positive rate, *FP*, not lower or greater than 95% and 5%, respectively.
- A two stages strategy allowed to distinguish the most similar polymers from a narrow spectral range.
- The defined minimum Match is above the 0.6 value considered in literature.

REFERENCES: [1] PlasticsEurope Association of Plastics Manufactures. Plastics – the Facts 2020 An analysis of European plastics production, demand and waste data (2019) Available via http://www.plasticseurope.org. [2] Tekman, M.B.; Gutow, L.; Macario, A.; Haas, A.; Walter, A.; Bergmann, M. Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung. Litterbase. Online portal for marine litter available via: https://litterbase.awi.de/. [3] Morgado, V.; Palma, C., Bettencourt da Silva, R.J.N. *Talanta* 2021, 224, 121814. DOI: 10.1016/j.talanta.2020.121814. Background Photo credits: alphaspirit/Depositphotos.

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