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POLYMERS CATCHING POLYMERS: SOLVENT-FREE PP FLUFF FOR MICROPLASTICS REMOVAL

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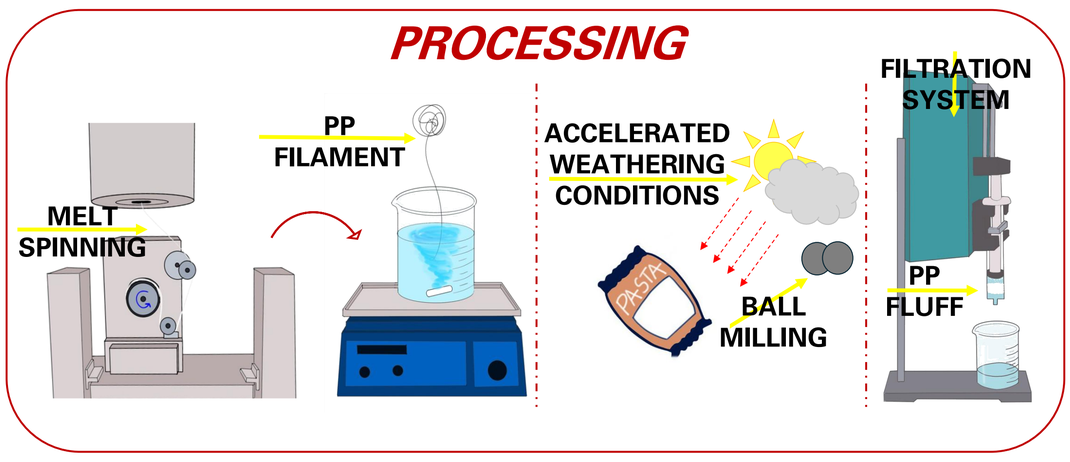
INTRODUCTION

The increase in the use of plastic alarmingly contributes to global pollution because of the inadequacy of methods for their management and disposal. Nowadays, **microplastics** (MPs) (< 5 mm) pollution is one of the most discussed environmental issues. However, accurately predicting the behavior of MPs and developing environmentally friendly systems for their removal remains a significant challenge. Their transport, deposition and interactions with other contaminants are complex and unclear, and the life cycle of **true-to-life MPs** is not analyzed enough.

MATERIALS

The raw material used in this work for fluffs production was **polypropylene** (PP). For microplastics production, **PP pasta bags** of different brands were bought from local supermarkets, emptied, washed and dried in air.

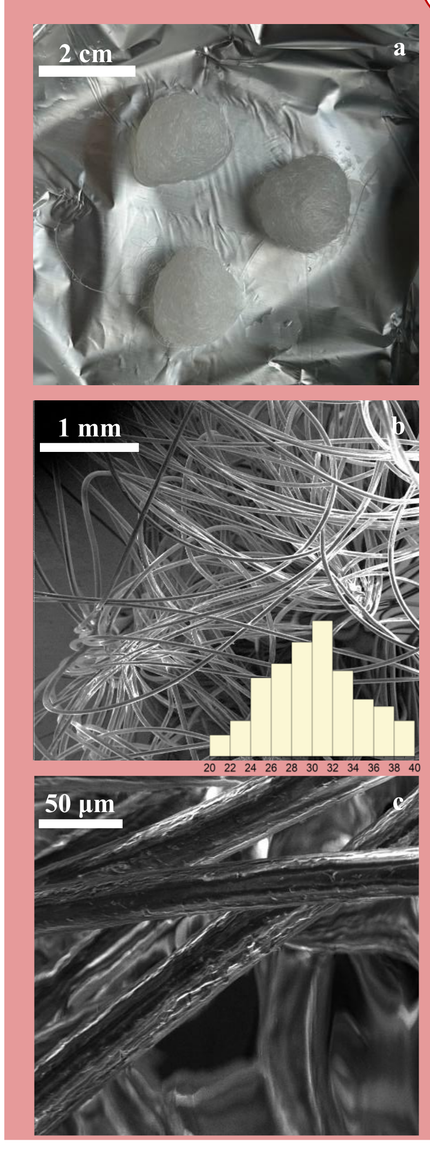
PROCESSING



CHARACTERIZATIONS

1. Morphological characterization of fluff;
2. Chemical and physical variations in PP pasta bags;
3. Morphological characterization analysis of MPs settling behaviour;
4. µATR of fluff post filtration, removal efficiency and reuse.

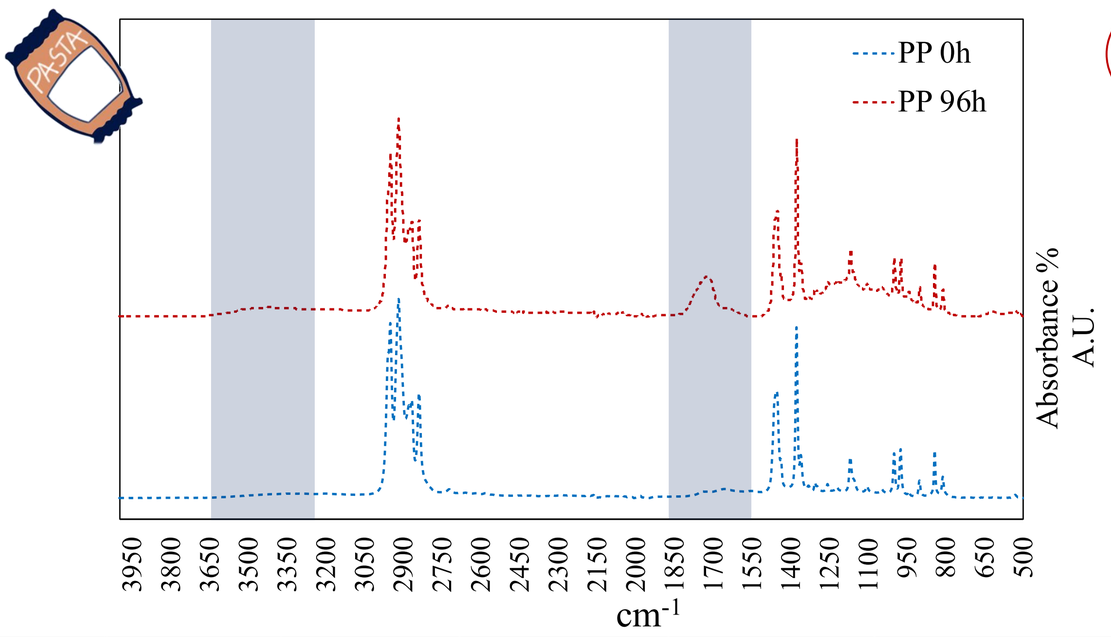
PP FLUFF



1

RESULTS - Fluff

The fluffs produced have a **spheroidal shape** and a diameter of about 2 cm. It resents a fibrous structure with randomly oriented fibers and average diameter of **30.2 µm**. The fiber surface is quite regular, with **surface roughness** attributable to the spinning process.



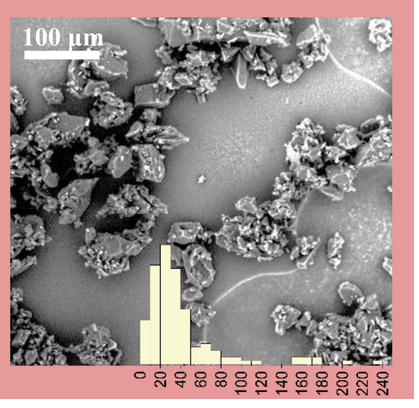
PP	WCA [°]	Density [kg/m³]	Elastic Modulus [MPa]	Breaking Stress [MPa]	Elongation at Break [%]
0h	85	871.02	600.2 ± 41.9	38.6 ± 3.8	86.0 ± 5.1
96h	67	950.37	n.m.	n.m.	n.m.

2

RESULTS – Pasta Bags

It is possible to observe that the **bands of oxygenated groups** and **hydroxyl groups** grow strongly with time, Aa a clear symptom of photo-oxidation.
There is also an expected increase in **hydrophilicity** of the material with the aging time. Moreover, there is a slight increase in **polymer density**, attributable to a typical increase in crystallinity due to photo-oxidation. Notably, prolonged exposure to photo-oxidation causes a dramatic **embrittlement** of the polymer.

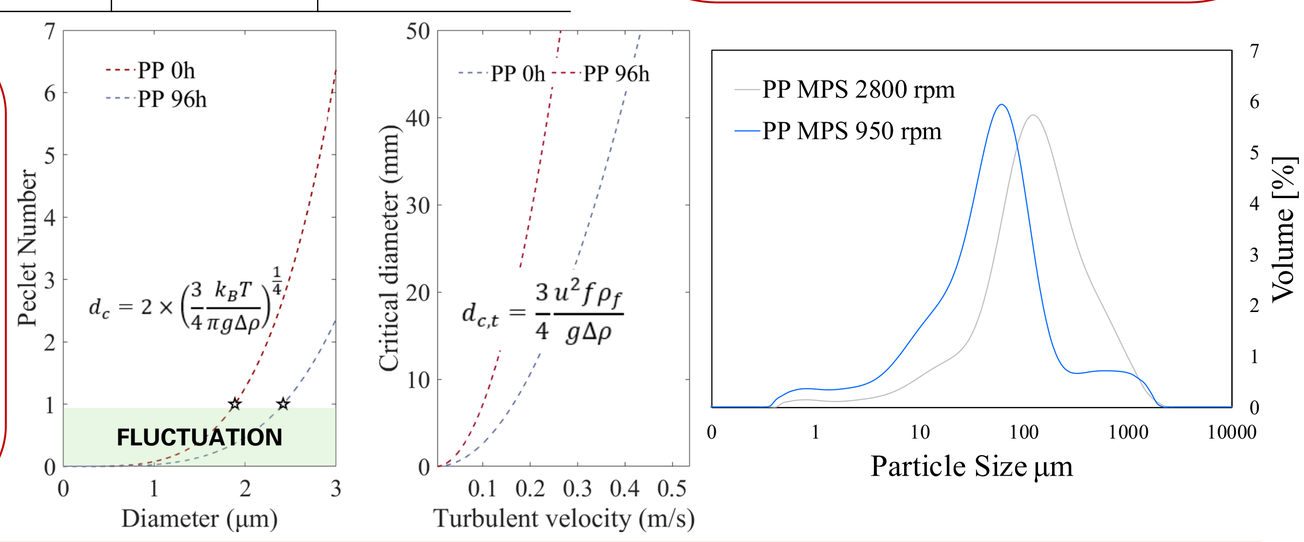
PP MPs



3

RESULTS – MPs

Particles presents an **irregular** and **sharp-edged shape**, confirming their being realistic and representative of true-to-life microplastics. A large range of dimension is found, with an average diameter of **40.3 µm**.



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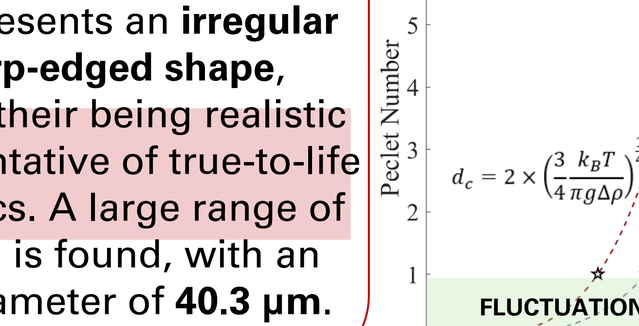
RESULTS - MPs

Both in laminar and turbulent condition, prolonging photo-oxidation times means an increase in polymer density and in the **critical diameter** of microplastics. Below critical diameter, particles will fluctuate in water. DLS confirms that a decrease in turbulence results in a decrease in the critical diameter.

4

RESULTS – Filtration and Reuse

In the fluff post filtration, the oxygenated groups band is visible only for point B, since point A presents no particles. This confirms that the system has trapped the particles efficiently.



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RESULTS – Filtration and Reuse

Removal efficiency remains very high after 10 cycles of reuse, showing a long-term stability.

CONCLUSIONS

This approach has facilitated for a comprehensive evaluation of the behavior of microplastics originating from everyday consumer products. Moreover, the solvent-free and simple nature of the fluff production process makes it particularly advantageous in today's environmental and economic context.

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