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Gilberto Binda[1], Rachel Hurley[1], Luca Nizzetto[1,2]

1 Norwegian Institute for Water Research, Økernveien 94, 0579 Oslo (Norway)
2 RECETOX, Masaryk University, Kamenice 753/5, 625 00 Brno (Czech Republic)

Untangling Environmental Ageing Processes of (Micro)Plastic Toward the Creation of Realistic Reference Materials

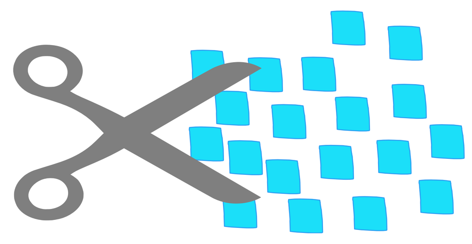
Introduction and aims

- Simulation of different ageing processes can increase environmental relevance of plastic reference materials.
- Several factors affect the environmental ageing of plastics.
- Understanding the effects of different ageing processes provides knowledge and guidance for future studies.

Analyzed factors and processes

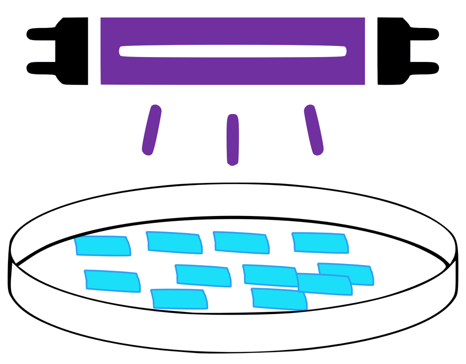
Polymer specimens

- "Confetti-like"(5 x 5 mm) fragments cut from plastic objects.
- Polyethylene (PE) from agricultural mulching films (ca. 0.05 mm thick).
- Polypropylene (PP) and polylactic acid (PLA) from single-use containers (ca. 0.3 mm thick).



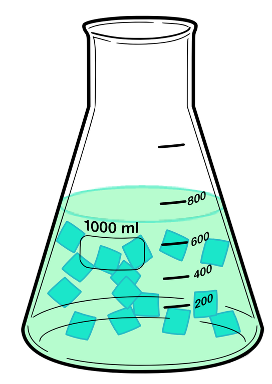
Chemical ageing

- 900 h of ultraviolet (UV) irradiation in ageing chamber.
- UV-B radiation at 5 W/m^2.
- Performed in air.



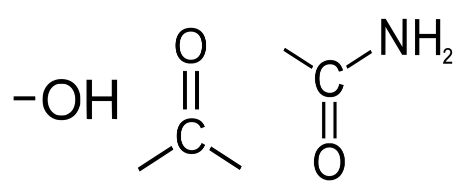
Biological ageing

- Simple freshwater algal community (3 species).
- 10 days of incubation.
- Performed on pristine and previously UV aged polymers.

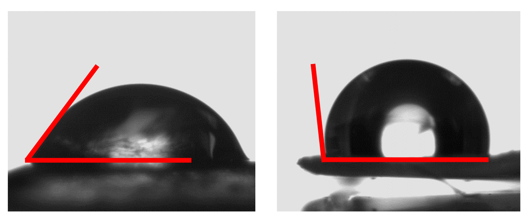


Characterization

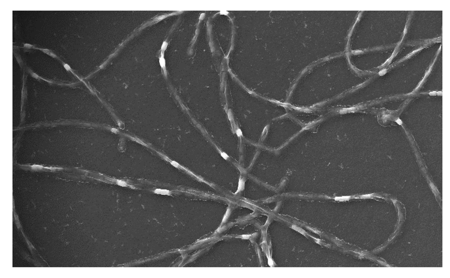
Functional groups
Fourier-transformed infrared spectroscopy



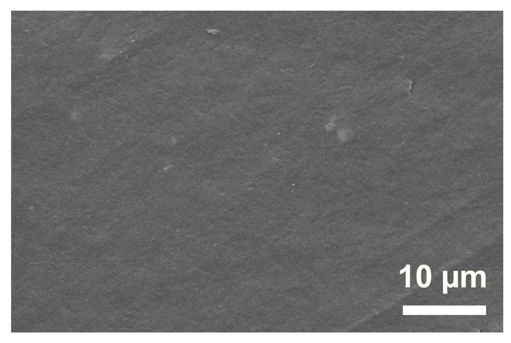
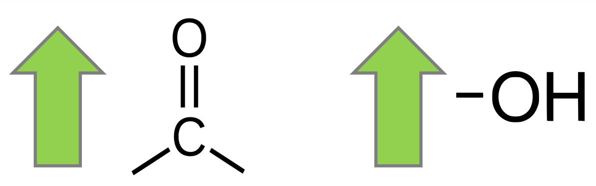
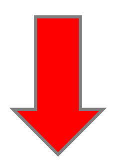
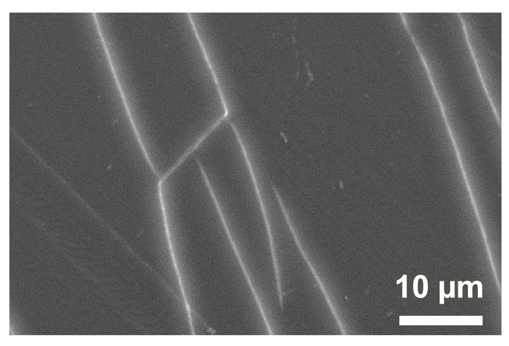
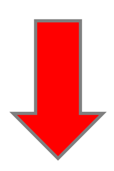
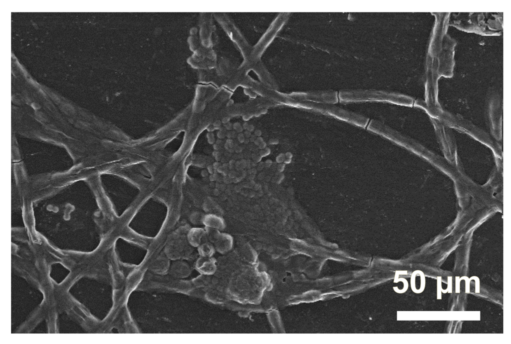
Hydrophobicity
Water contact angle



Morphology
Scanning electron microscopy



Summary of results

	Functional groups	Hydrophobicity	Morphology	
Pristine polymers	**PE and PP** Dominance of alkyl groups **PLA** Dominance of carbonyl groups	**PE and PP** Hydrophobic (contact angle = 100°) **PLA** hydrophilic (contact angle = 80°)		Regular shapes and flat surfaces
UV Aged polymers	 **PE and PP** Increase in carbonyls and hydroxyls **PLA** Less marked increase	 **PE and PP** Become hydrophilic (contact angle = 80°) **PLA** Slightly decrease (contact angle = 75°)		Formation of cracks and surface rugosity
Biofouled polymers	 **All polymers** Increase in hydroxyls and new groups (amides and polysaccharides)	 **All polymers** Become further hydrophilic (contact angle = 60°)		Re-shaped by biofilm community

Conclusions and outlooks

- Polymer type importantly affects the response to chemical ageing, while biofouling changes the properties of every polymer.
- UV ageing alters plastic properties but may have limited environmental relevance if used alone.
- Biofouling process re-shapes the initial surface properties of plastic and need further investigation for the potential environmental consequences (e.g., further degradation or "protection" from the surrounding environment).

Contacts
gilberto.binda@niva.no
@GilbertoBinda
@eu_planet

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Today at 18:00
Level 2 Foyer

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Acknowledgements
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MARIE CURIE ACTIONS