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Master of Science HES-SO in Life Sciences

Textile plastic recycling: Characterization of stability and potential opportunities in sea water

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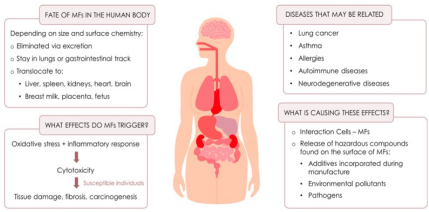
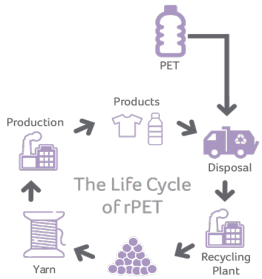
DESCRIPTION

Plastic waste management is a challenge :

➡ Not recycled enough
➡ Incinerated = **Polycyclic Aromatic Hydrocarbons release (PAHs)** + other pollutants
➡ Stored in Landfills
➡ Discarted in the ocean, degradation, **micro-nanoparticles** release, **pollutants sorption**, **bioaccumulation**, danger to the ecosystem and human life !

Effects of microplastics on human health[2]





Life cycle of recycled PET[1]

Idea

Upcycle the waste to purify marine environements !

OBJECTIVES

Define the specifications of the waste PET sourcing (garments selection)

➡ Virgin PET, Bottle PET, **Textile 100% PET**, Textile (30 % cotton) PET, Overtreated PET, Electrospun PET

Characterize the r-PET properties with different methods

➡ DSC, **SEM-EDX**

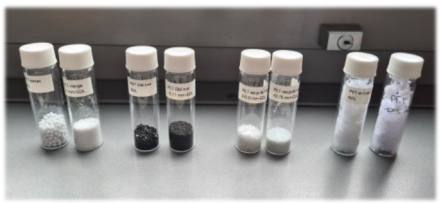
Assess the release of pollutants and PET micro and nano particles

➡ **GCMS**, DLS, UV-vis

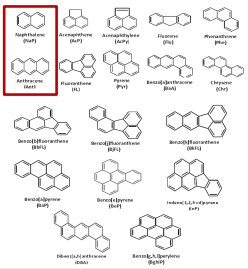
Assess the absorption of PAHs by the selected PETs

➡ **GCMS**

PET types

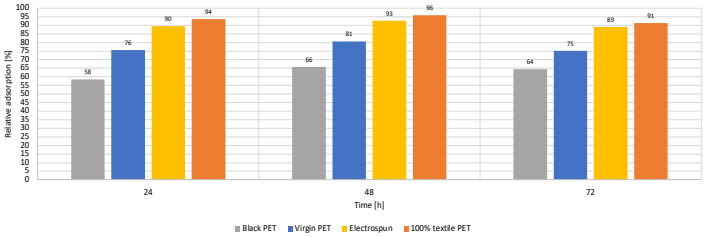


Tested PAHs



RESULTS

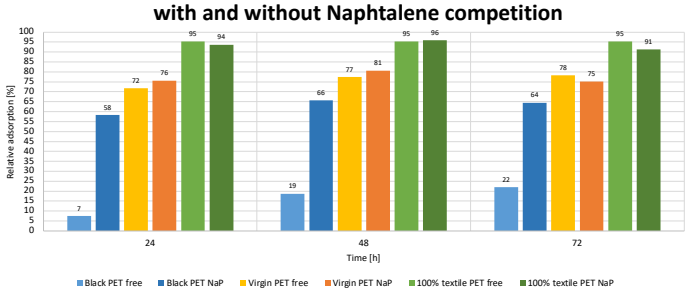
Anthracene relative adsorption on PET samples over time



Nanofibrous PET is **super efficient** !

➡ up to **37 [µg/g]** for Electrospun PET
➡ Only 1.6 [µg/g] for Textile 100% PET
➡ Only 1.0 [µg/g] for Virgin PET

Kinetics comparison of Anthracene's relative adsorption with and without Naphtalene competition



The more **hydrophobic**, the **better** ! But why textiles are more efficient ? **Specific surface area !**

SEM of PETs: Virgin (400x), Textile 70/30 (390x), Textile 100% (380x), Electrospun (4300x)

CONCLUSION

PAHs adsorption is a complex process influenced by many parameters, such as concentration, pH, ionic strenght of the media, viscosity, hydrophobicity, Molecular weight,... The Results were obtained in Milli-Q water but give a good insight as a first approach of what could happen in a sea environement. Experiments gave overall good results regarding PAHs adsorption on a fibrous PET material. Only a small amount of material was needed to achieve high pollutants capture. More importantly, no organic compounds release in water from the PET samples was detected on short periods of time. Therefore, further investigations must be conducted on textile PET adsorption for water filtration. Future research can build on this study's findings to explore the potential for PET waste upcycling in marine environment applications.

[1]Kaelis, site consulted the 15th January 2022: https://kaelis.world/rpet.php
[2]C. Palacios-Mateo, Y. van der Meer, G. Seide, *Environmental Sciences Europe*, **2021**, 33(1). https://doi.org/10.1186/s12302-020-00447-x

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