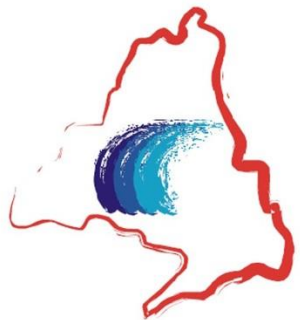


# FENTON OXIDATION OF MICROPLASTICS: IMPACT ON THE NATURE AND SIZE

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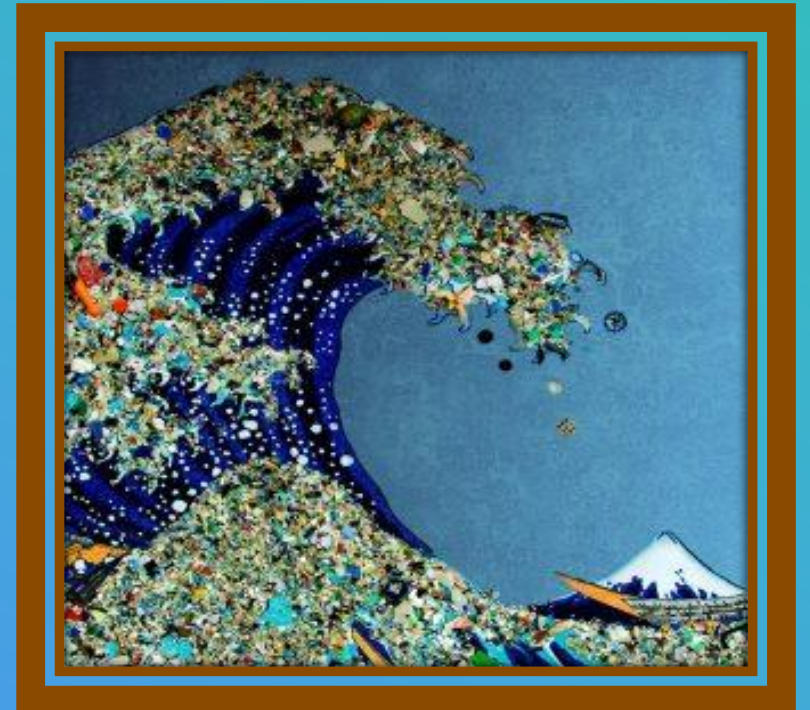


**REMTAVARES**

Red Madrileña de Tratamientos  
Avanzados de Aguas Residuales

**UAM**

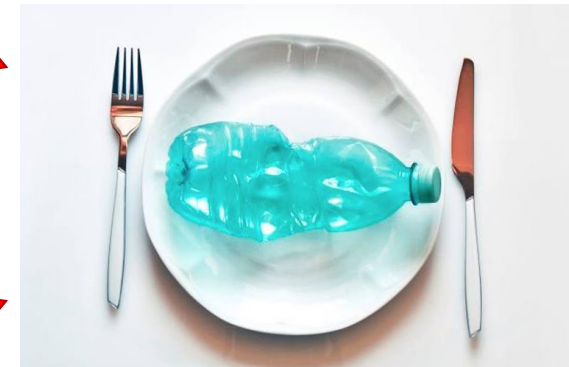
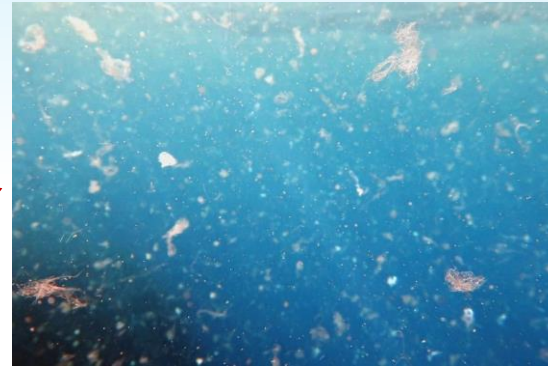
Universidad Autónoma  
de Madrid



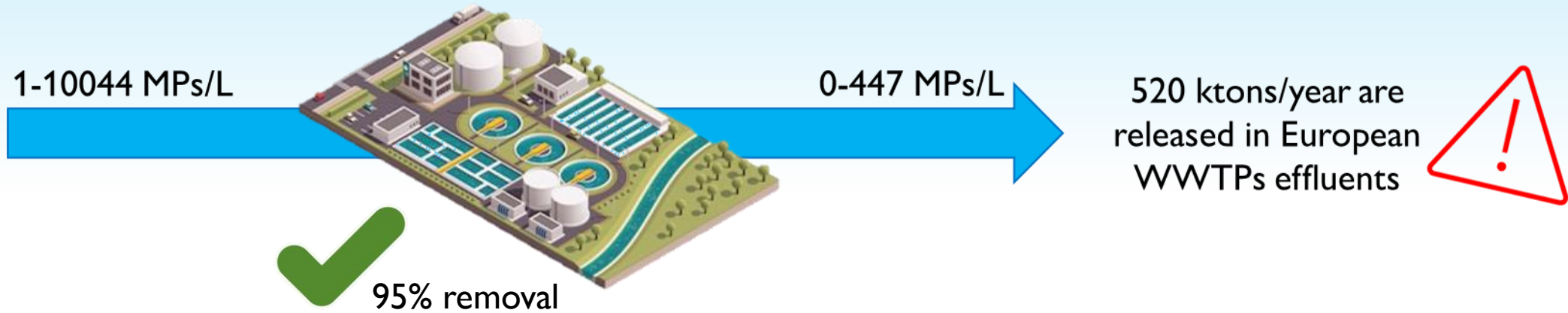
# Microplastics in the aquatic environment



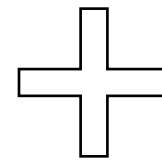
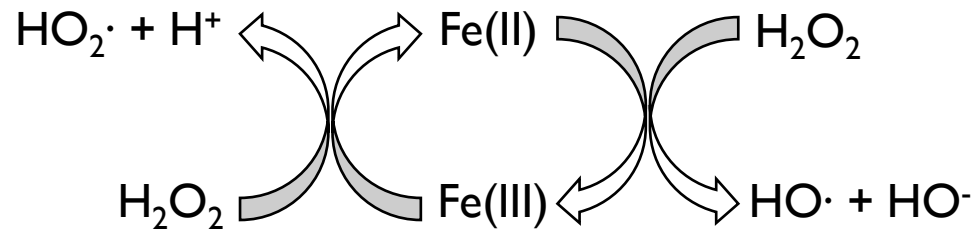
Size < 5 mm



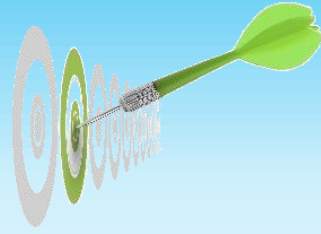
# Microplastics in the aquatic environment



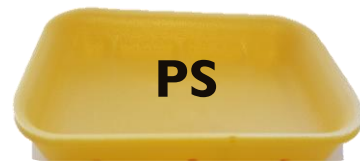
## Fenton Reaction



# Objective



To study the behavior of two microplastics throughout a homogeneous Fenton reaction at high temperature

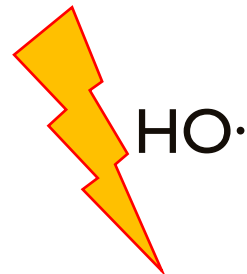
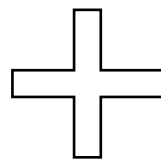


PS

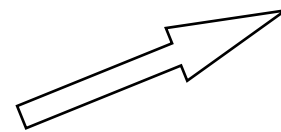
*Polystyrene*



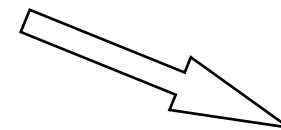
*Glitter*



Fenton  
oxidation



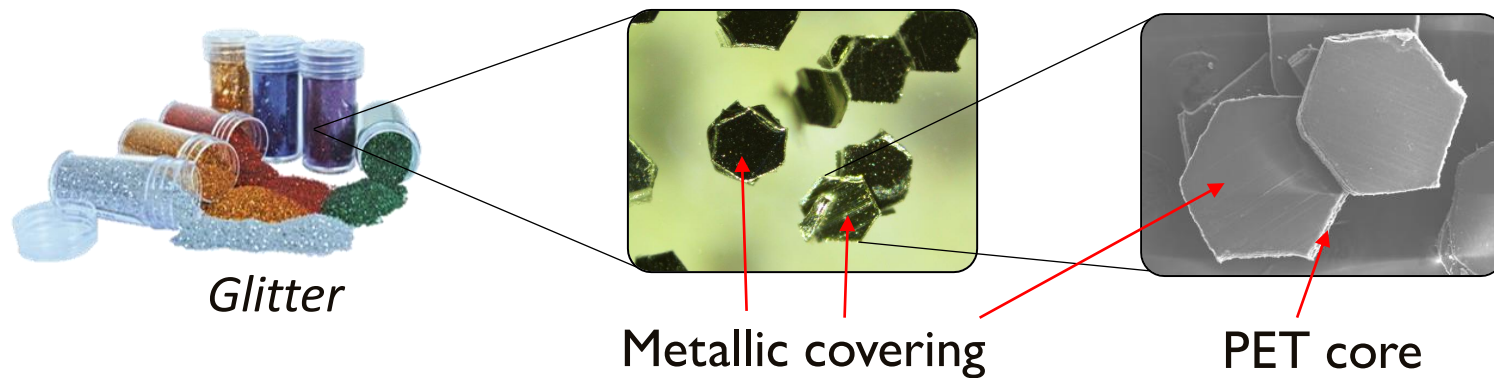
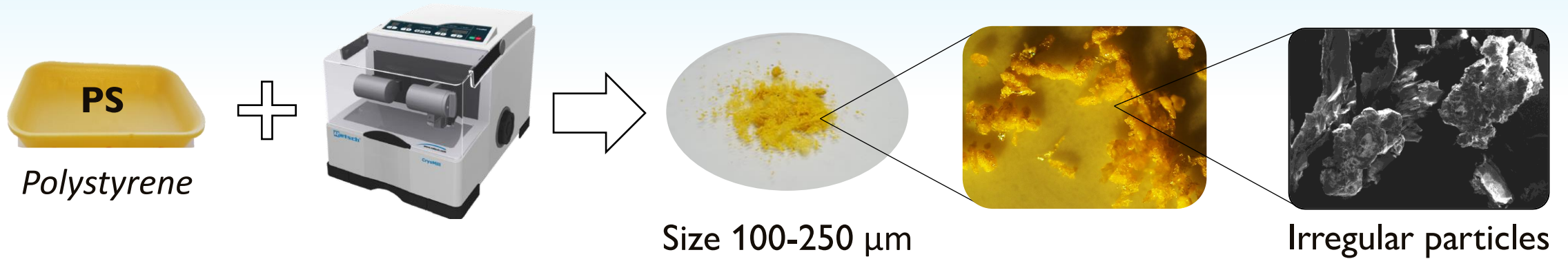
Nature ?



Size ?

# Experimental

## Obtention of microplastics

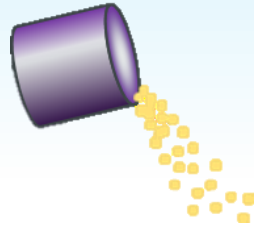


# Experimental

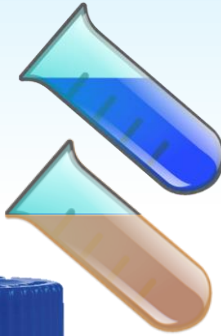
## Fenton oxidation



100 mg  
MP



75 mg  
 $H_2O_2$  x3 per day



0.75 mg  
 $Fe^{3+}$  0-5 pulses



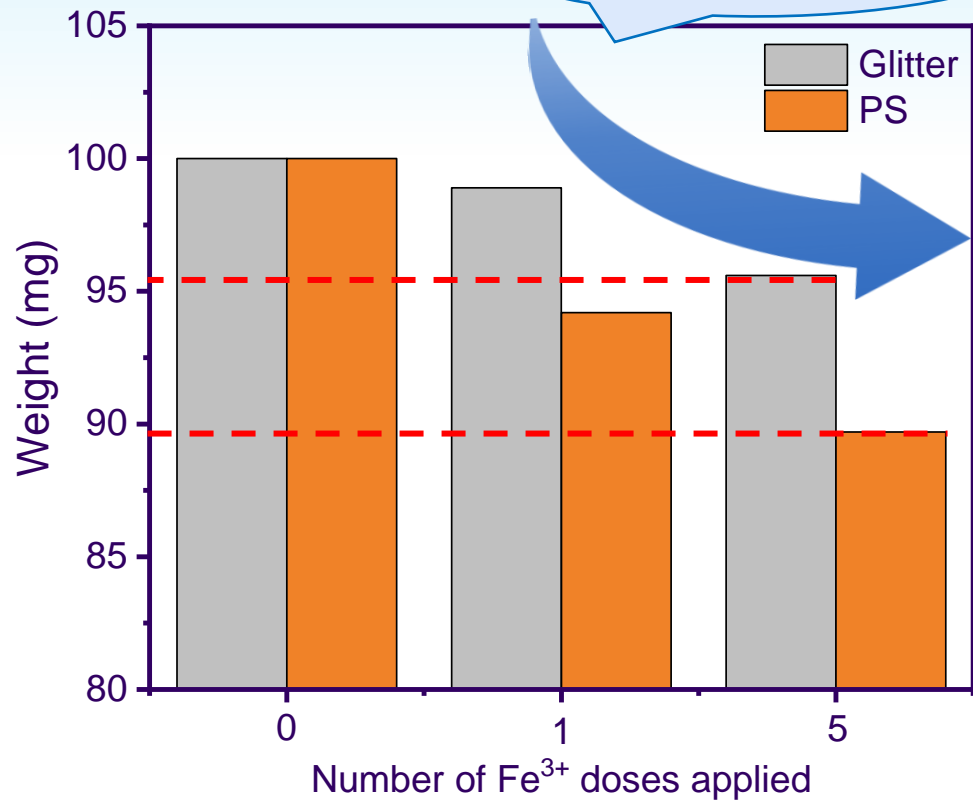
Volume	75 mL
pH	3
Reaction time	5 days
Temperature	80 °C
MP dose	100 mg
$H_2O_2$ dose	75 mg (3 times a day)
$Fe^{3+}$ dose	0.75 mg (0-5 pulses along reaction time)

# Results

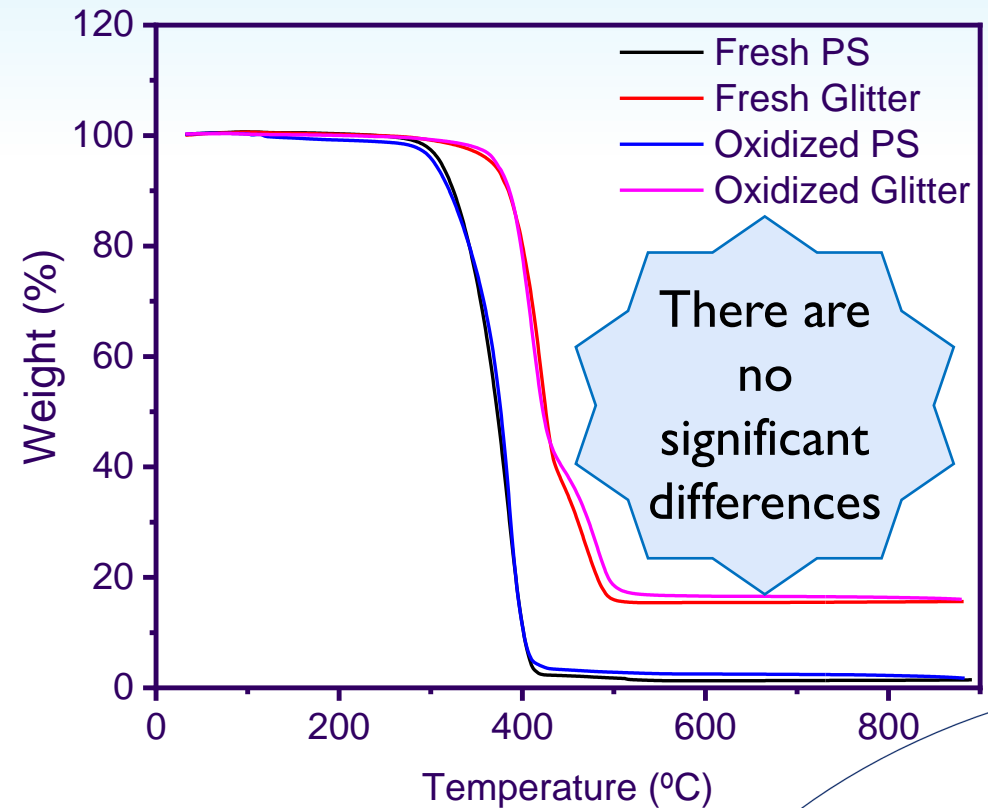


## Mass loss

Higher amount of catalyst  
higher mass loss



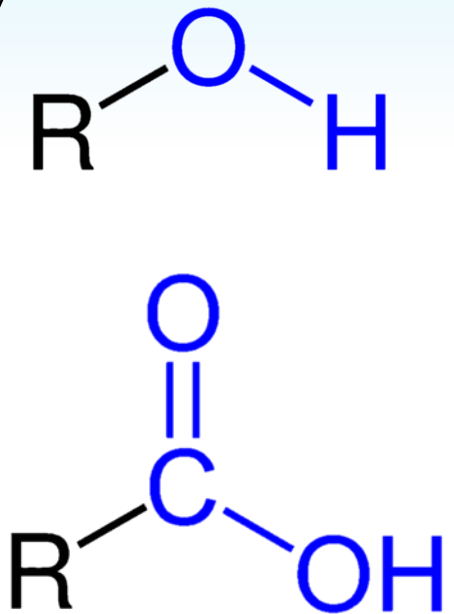
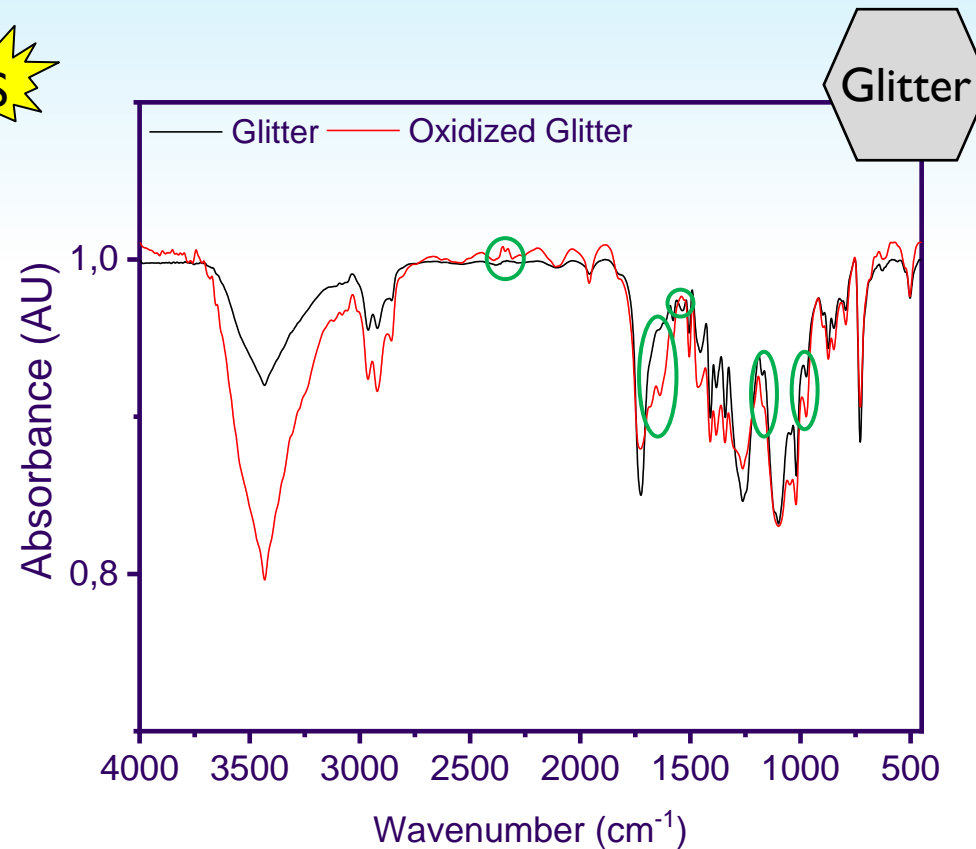
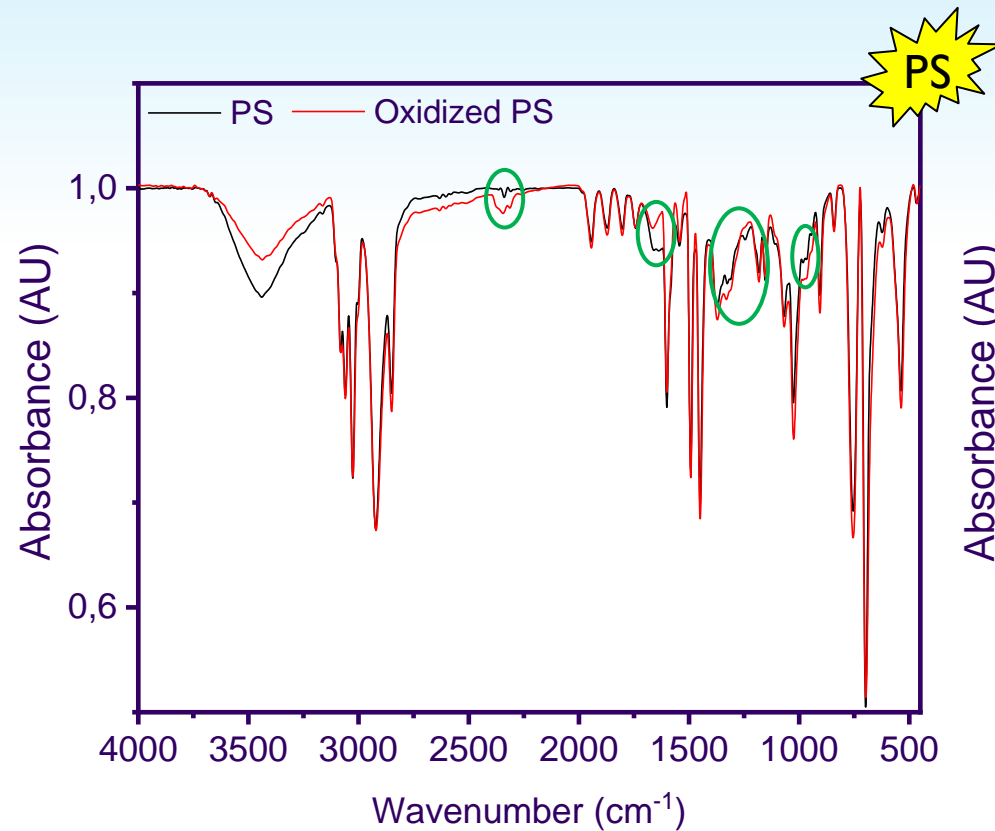
## Thermogravimetric analysis



# Results



## Spectroscopy analysis



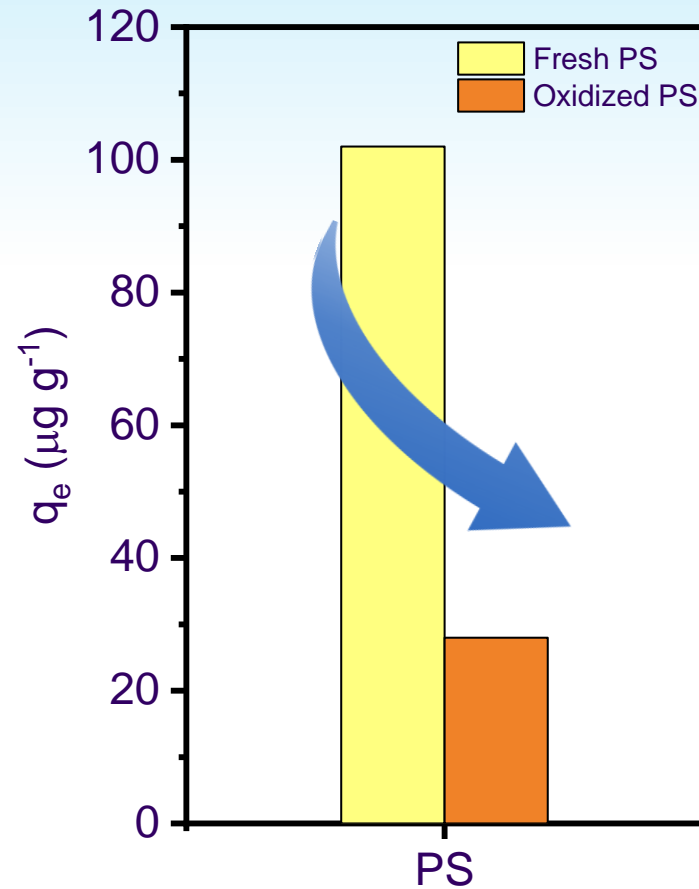
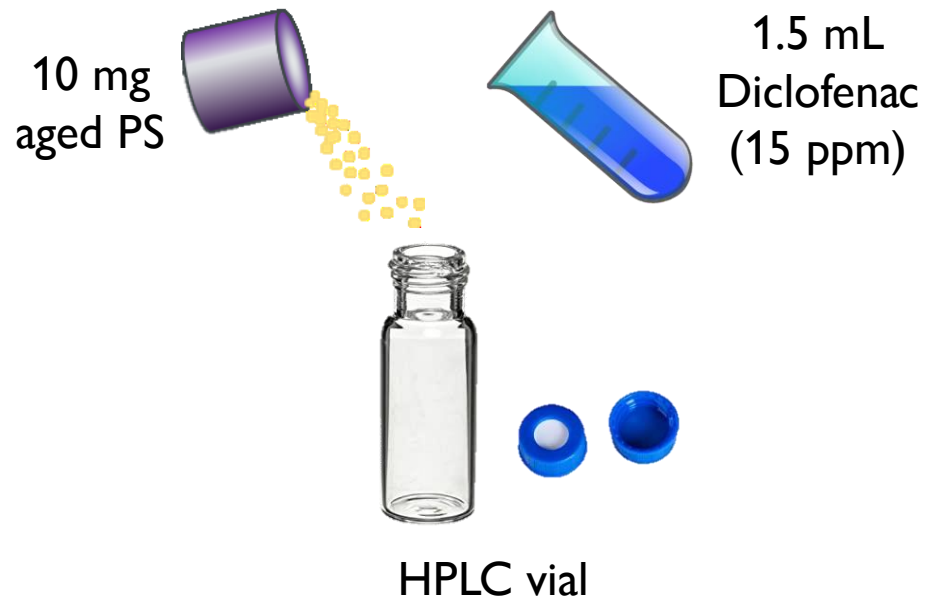


# Results



## Hydrophobicity experiments

Analysis of the adsorption of a hydrophobic micro-pollutant, diclofenac (DCF), on PS.



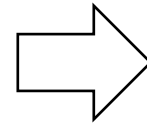
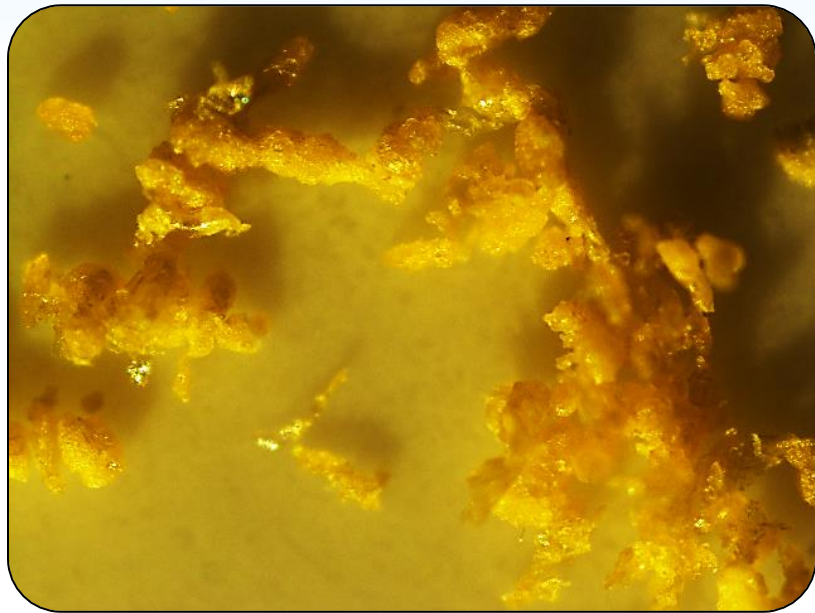
Oxidation reduces MP hydrophobicity

# Results



## Microscopic analysis

Fresh polystyrene



Oxidized polystyrene



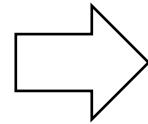
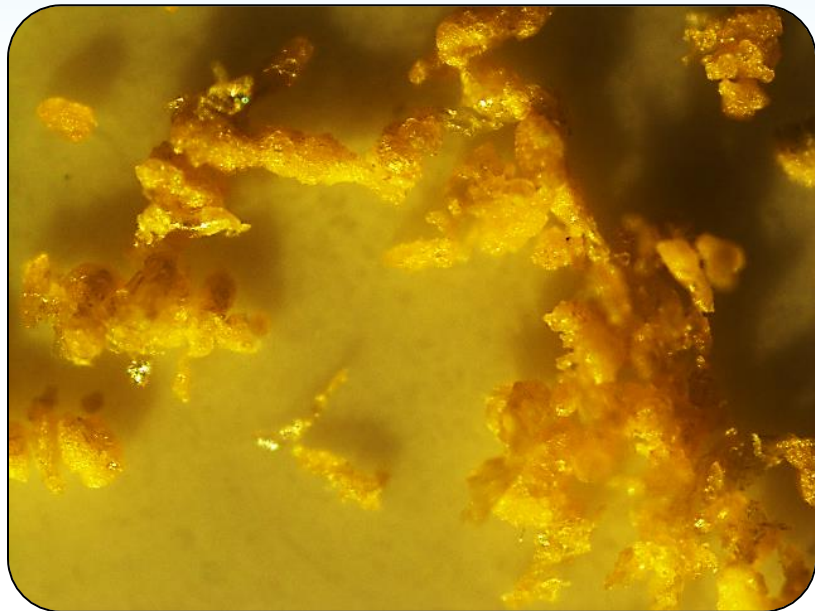
Particle breakdown

# Results



## Microscopic analysis

Fresh polystyrene



Oxidized polystyrene



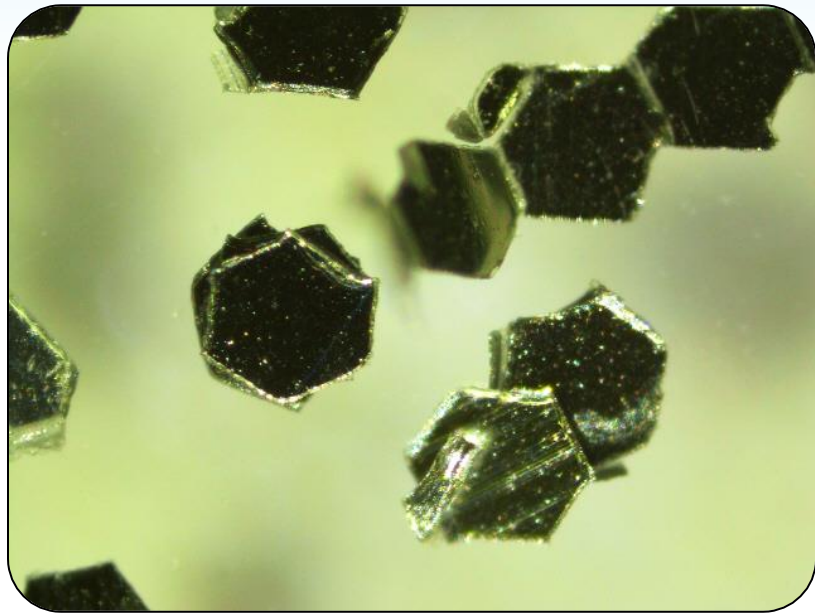
New  
semitransparent  
areas

# Results

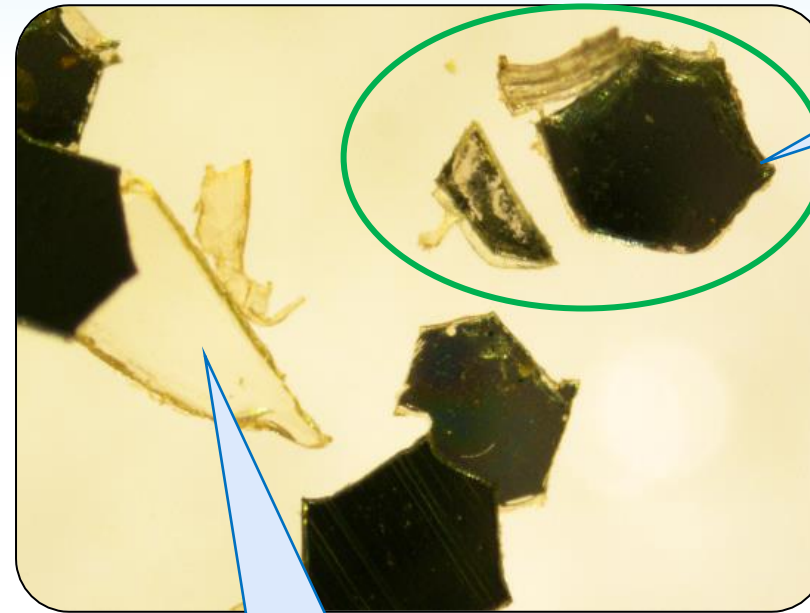


## Microscopic analysis

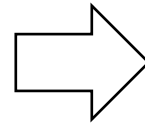
Fresh glitter



Oxidized glitter



Particle breakdown

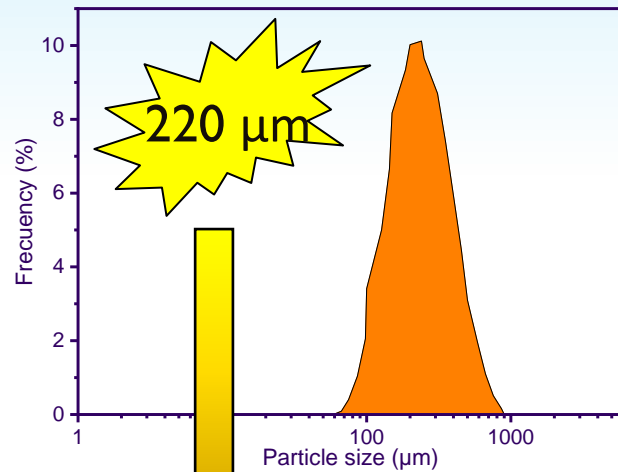


Slight detachment  
of the metallic  
covering

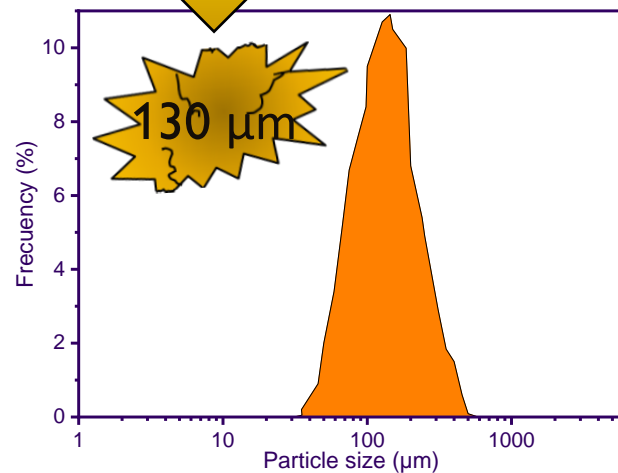
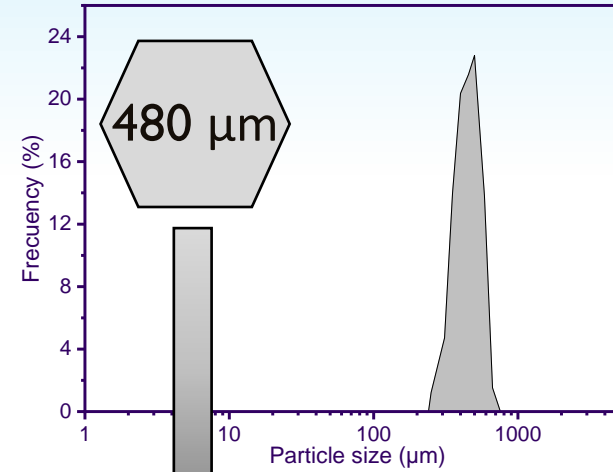
# Results



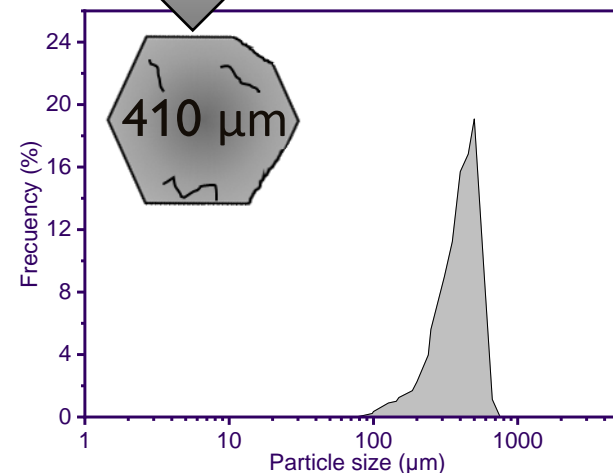
## Microscopic analysis



Fresh  
microplastics



Oxidized  
microplastics

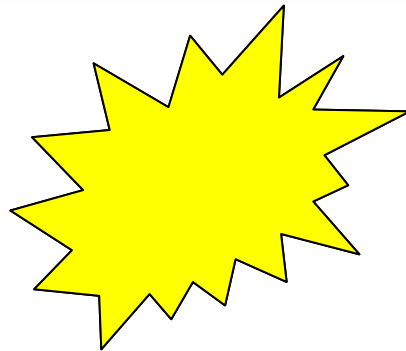


Clear  
decrease in  
MPs size!

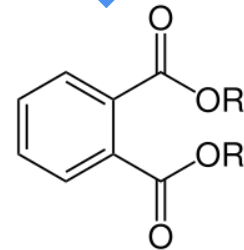
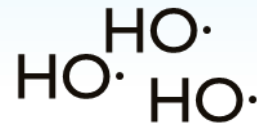
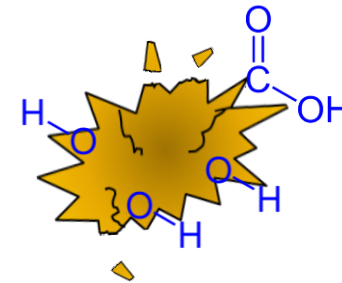
# Hypothesis



Fresh  
microplastics



Oxidized  
microplastics



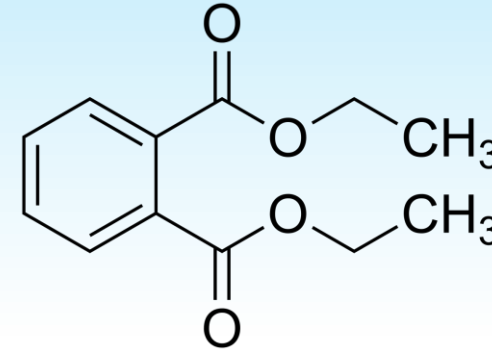
1. Particle breakdown and decrease in particle size.
2. Addition of surface oxygenated groups.
3. Leachate of various compounds.

# Additional results

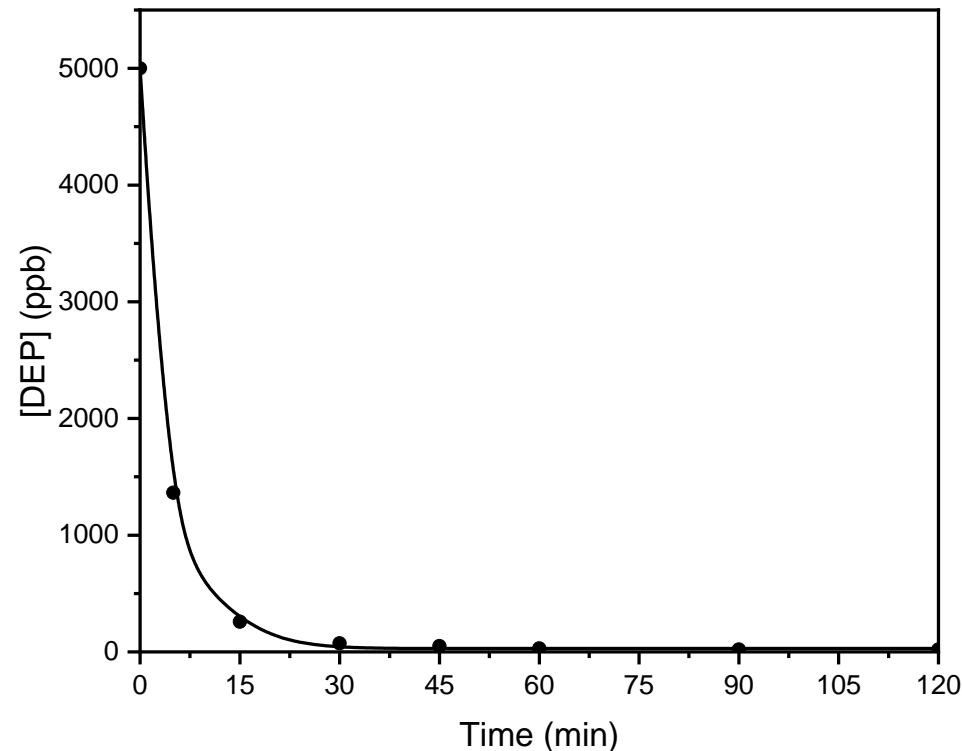


## Leachate degradation

Analysis of the Fenton degradation of a model plasticizer, diethyl-phthalate (DEP).

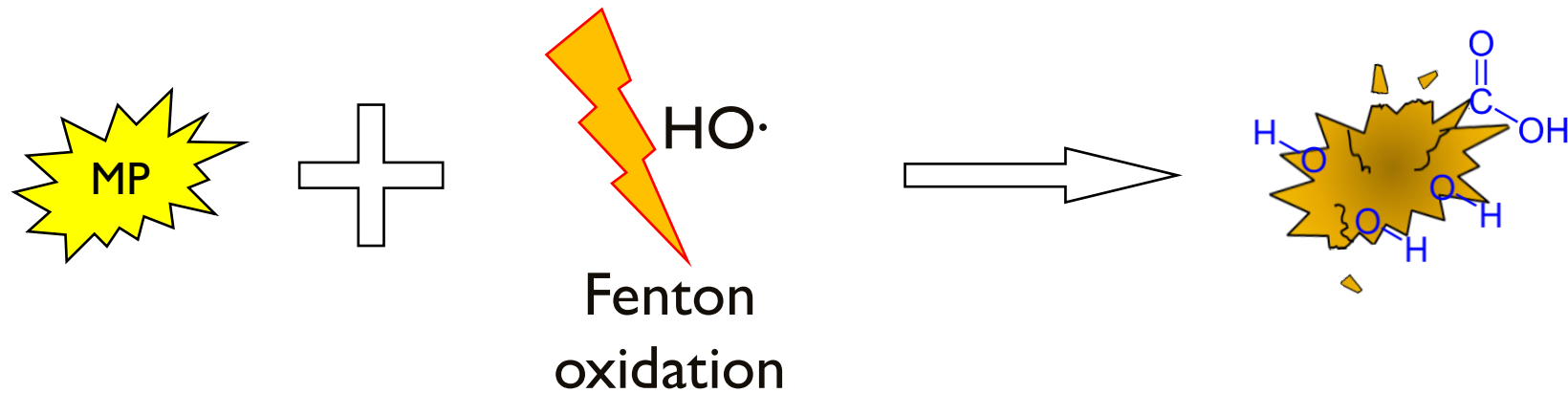


Volume	700 mL
pH	3
Reaction time	2 hours
Temperature	80 °C
[DEP] <sub>0</sub>	5 ppm
[H <sub>2</sub> O <sub>2</sub> ] <sub>0</sub>	20 ppm
[Fe <sup>3+</sup> ] <sub>0</sub>	10 ppm



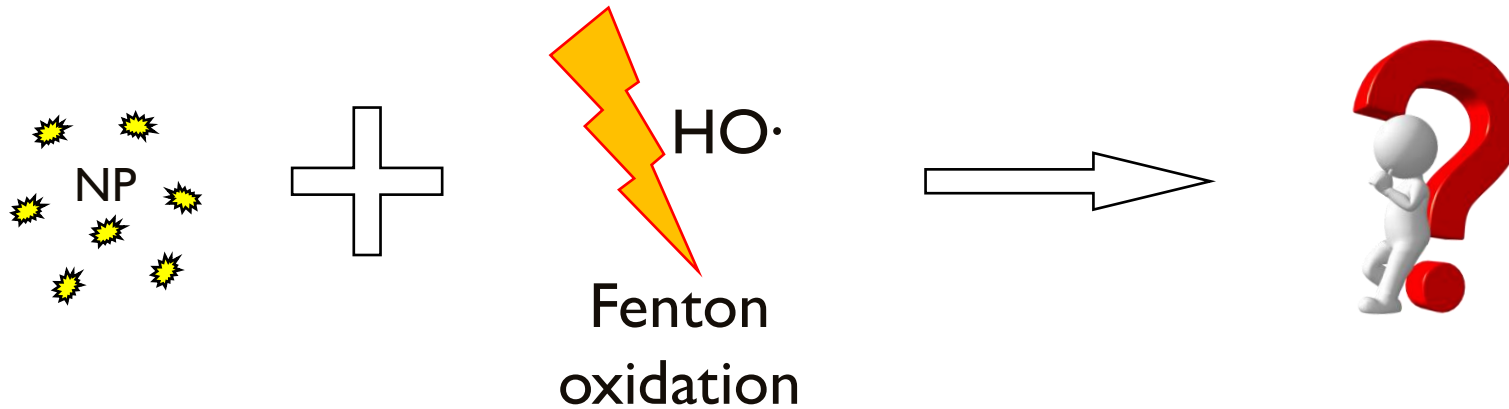
Total elimination of the DEP

# In the not too distant future...





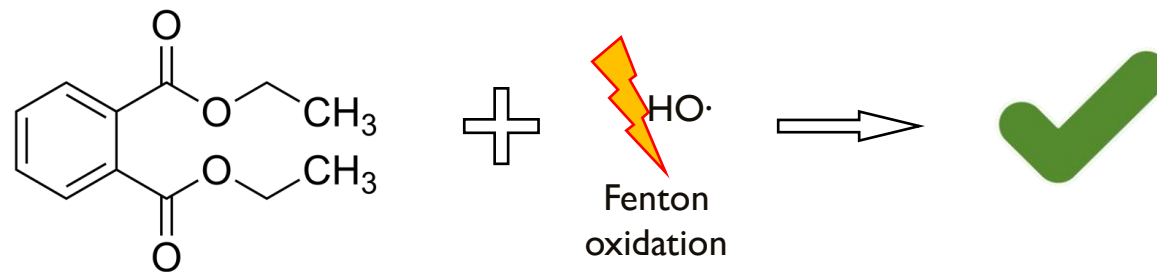
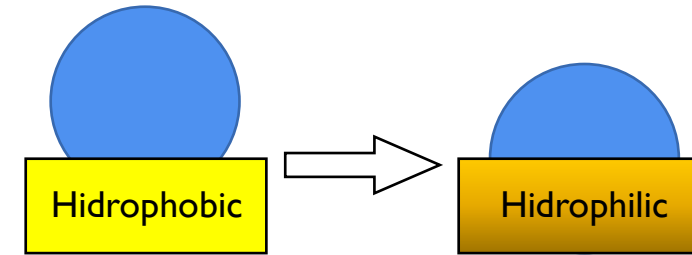
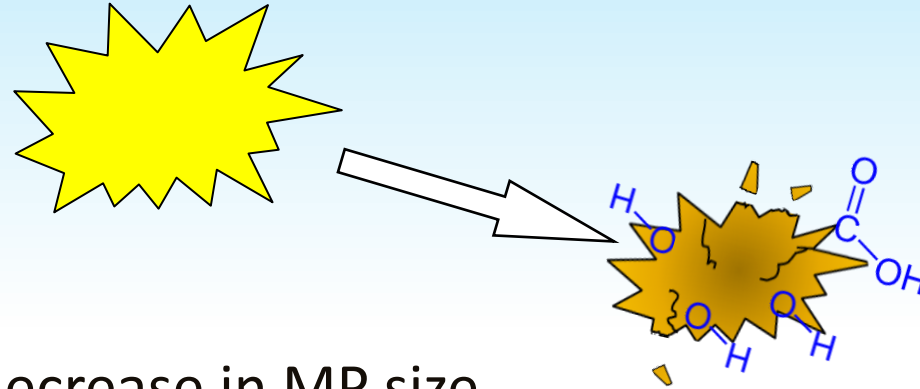
# In the not too distant future...



# Conclusions

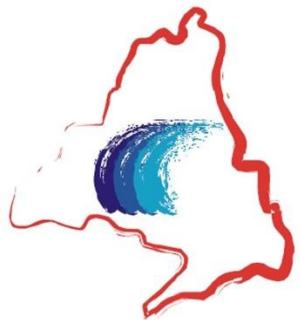


- Low MPs degradability.
- Superficial modifications and decrease in MP size.
- These modifications increase the hydrophilicity of MPs.
- Leachates as phtalates are efficiently removed.



# THANKS FOR YOUR ATTENTION

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**REMTAVARES**

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