AGH UNIVERSITY OF KRAKOW


# THE REMOVAL OF MICROPLASTICS FROM SEWAGE SLUDGE BY HYDROTHERMAL CARBONIZATION METHOD

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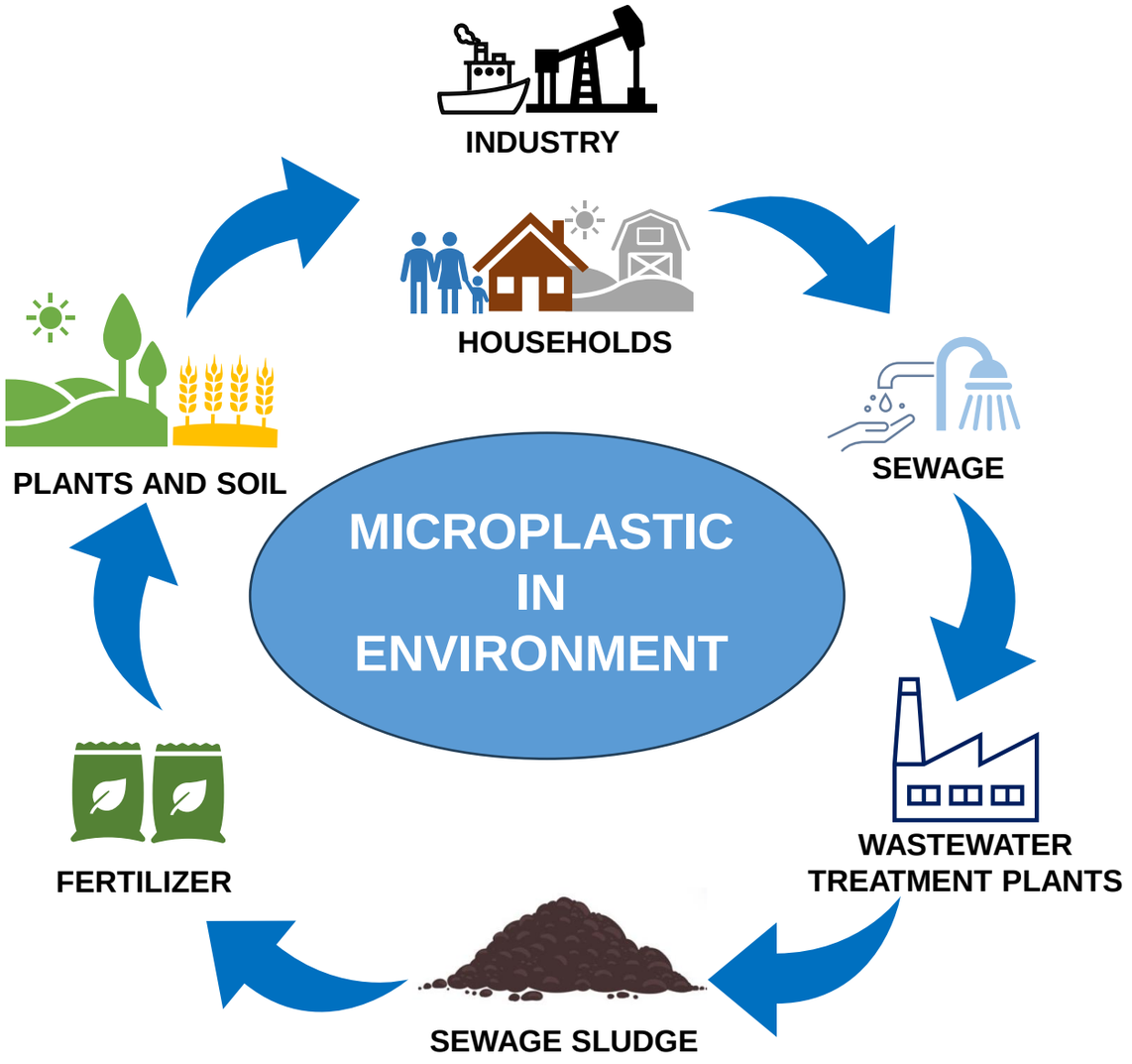
**SS4OS-1: Green deal for climate and resource conservation – energy efficiency, GHGs reduction, circular economy – synergy or exclusion?**

# Outline

- Introduction
  - Microplastic presence in environment
  - Microplastics' characteristics
- Material:
  - Sewage sludge
  - Hydrothermal slurry from sewage sludge
- Methods of Microplastics' identification:
  - FTIR
  - Raman microspectroscopy
- Results
- Conclusions
- Aknowledgements

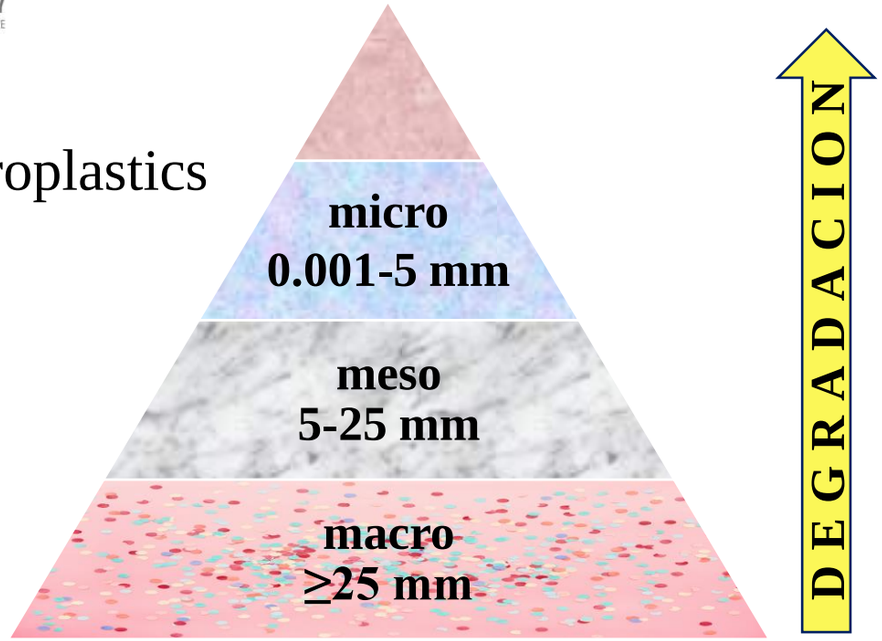
# Microplastics' cycle in environment

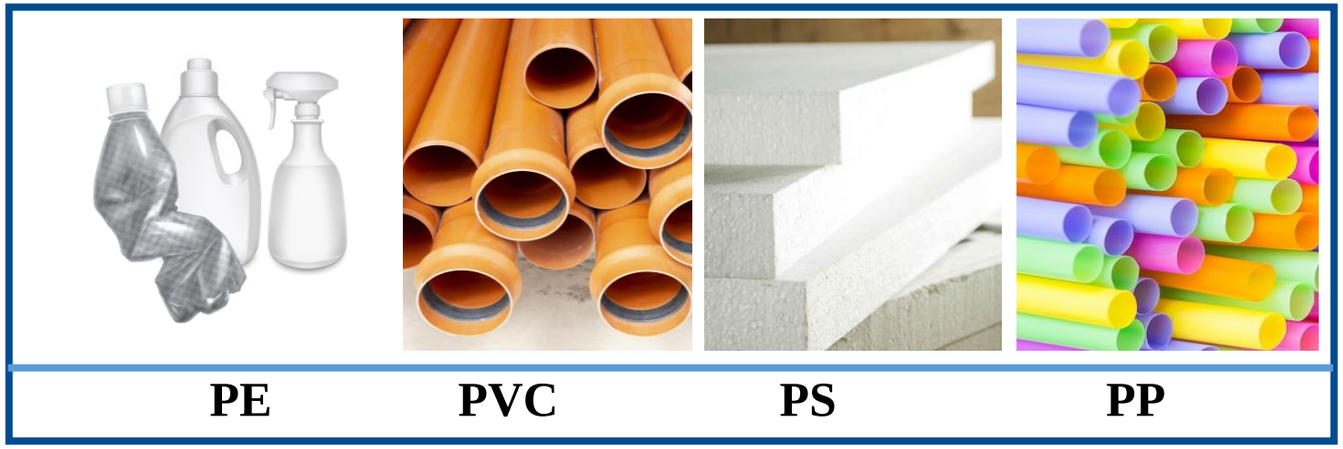


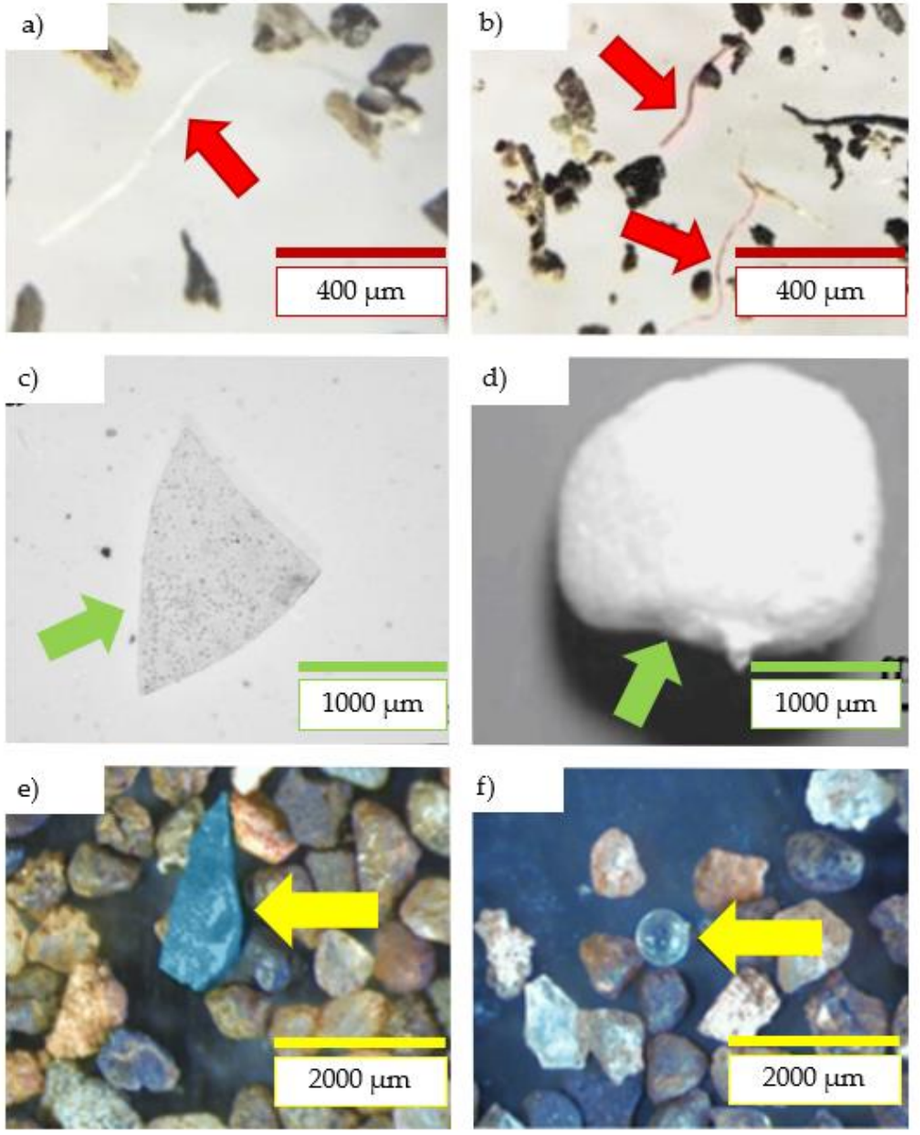
# Microplastics' characteristics

Sources of microplastics

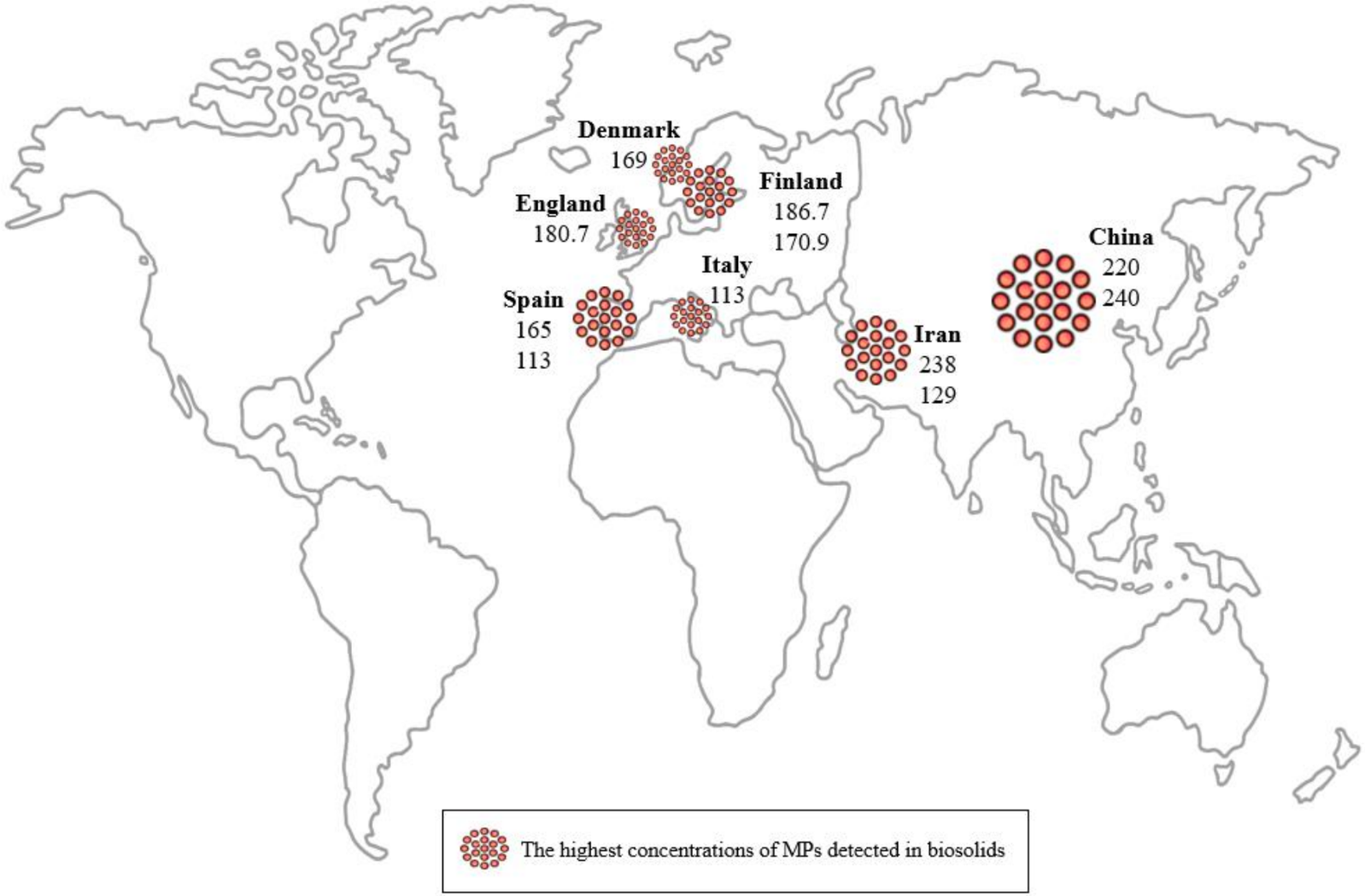
- primary
- secondary



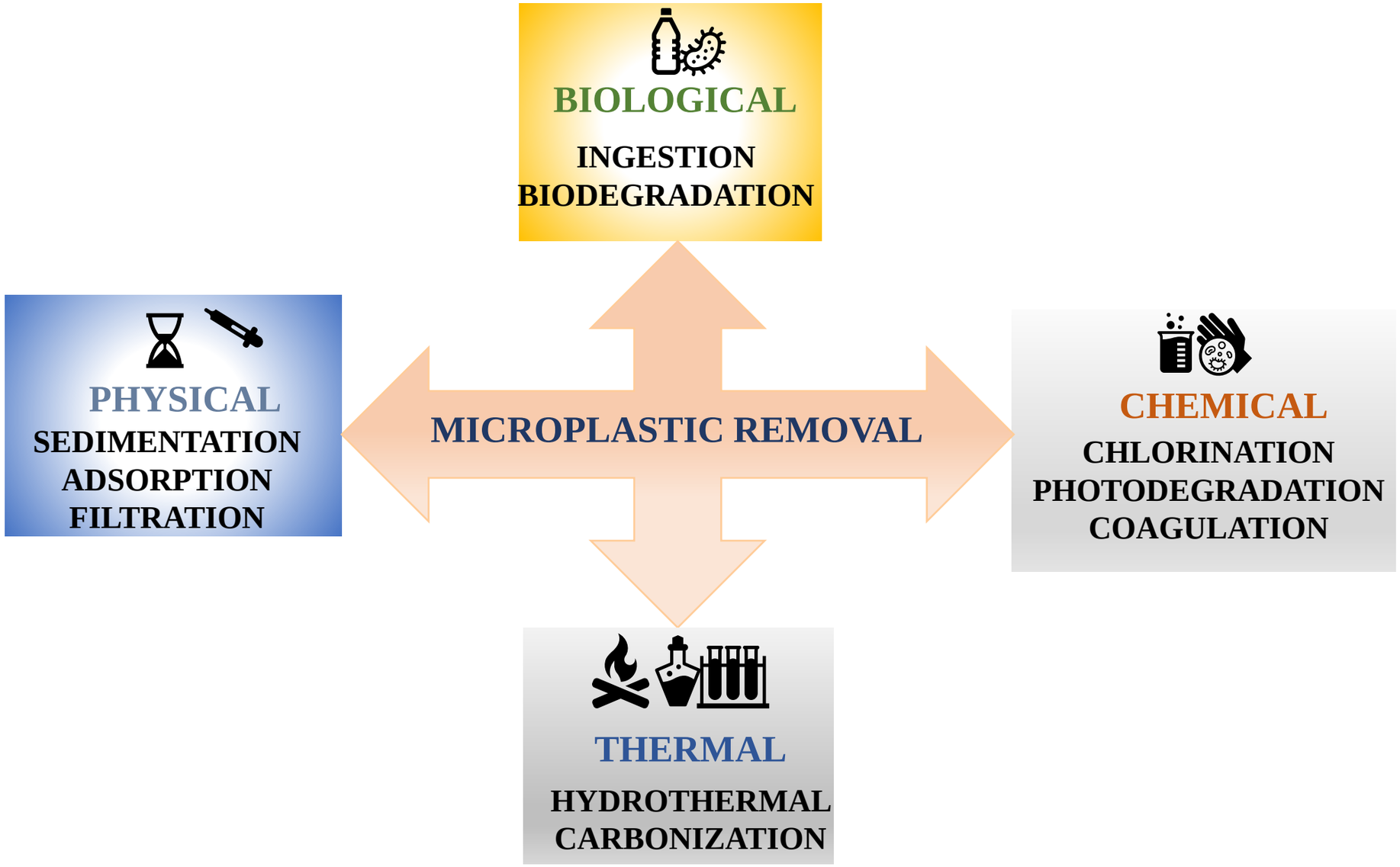



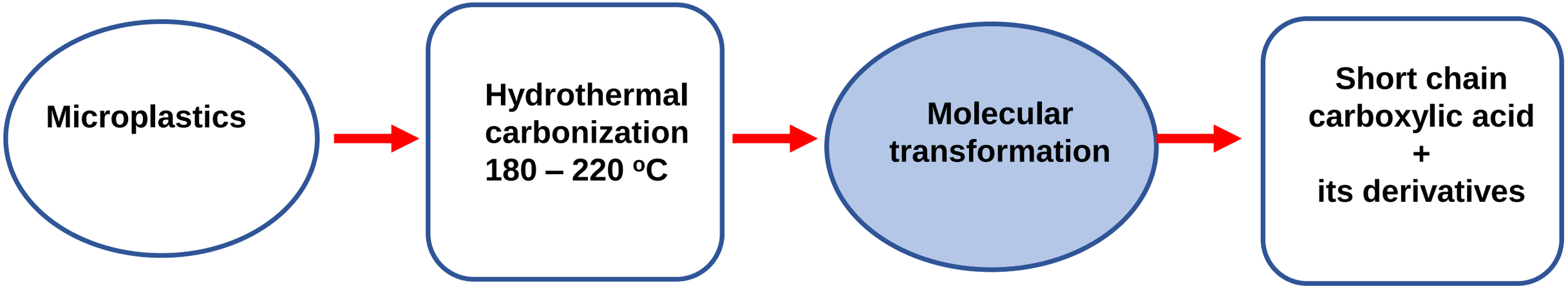
# Wordwide microplastics' presence in sewage sludge



# Microplastics removal methods



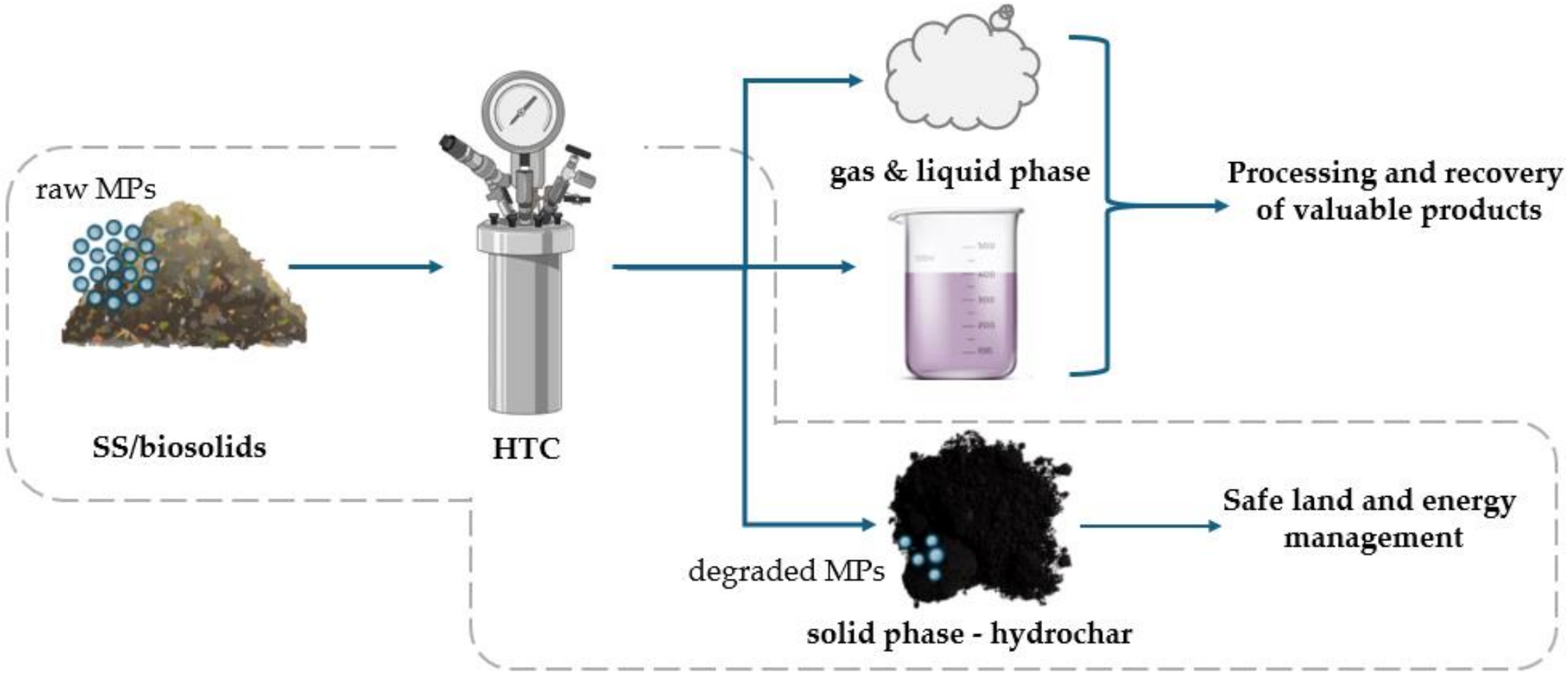
# MPs behaviour during hydrothermal carbonization process



# Goal

- to assess the efficiency of MP removal by HTC process
- to perform hydrothermal carbonization process of sewage sludge
- to observe the shape and size of MPs after the hydrothermal carbonization process of sewage sludge
- to observe MPs in sewage sludge was made for comparison

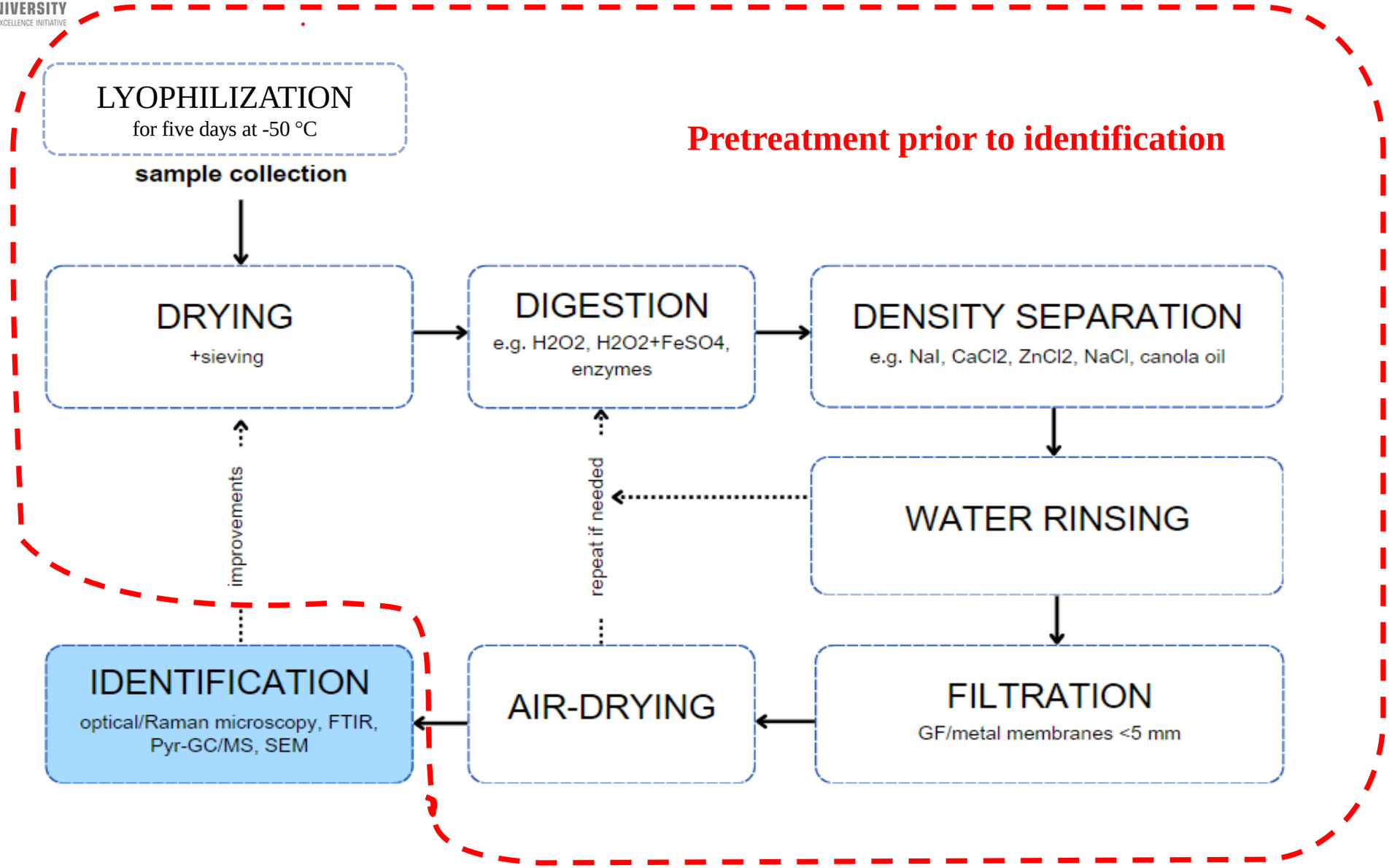
# Hydrothermal carbonization proces (HTC)



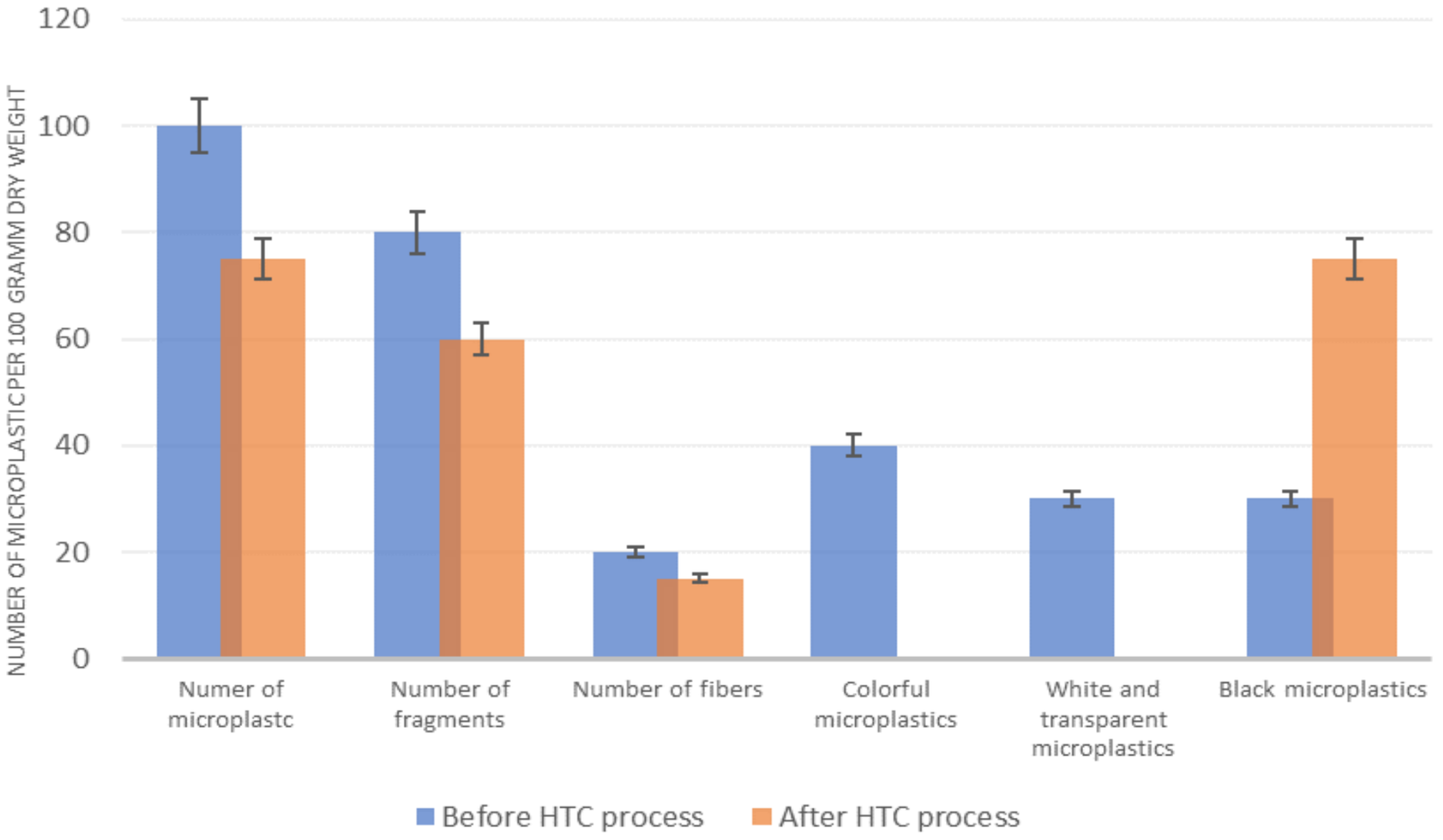

Conditions of hydrothermal carbonization process:

- Temperature: 200 °C
- Residence time: 2 h

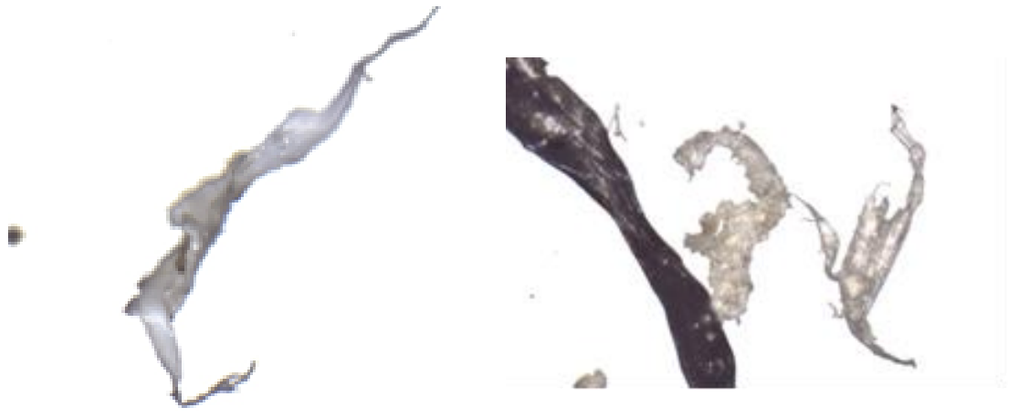
# Procedure


LYOPHILIZATION
for five days at -50 °C
sample collection
DRYING
+sieving
DIGESTION
e.g. H2O2, H2O2+FeSO4, enzymes
DENSITY SEPARATION
e.g. NaI, CaCl2, ZnCl2, NaCl, canola oil
WATER RINSING
FILTRATION
GF/metal membranes <5 mm
AIR-DRYING
IDENTIFICATION
optical/Raman microscopy, FTIR, Pyr-GC/MS, SEM
improvements
repeat if needed
Pretreatment prior to identification

# Results


120
100
80
60
40
20
0
NUMBER OF MICROPLASTIC PER 100 GRAMM DRY WEIGHT
Numer of microplastc
Number of fragments
Number of fibers
Colorful microplastics
White and transparent microplastics
Black microplastics
Before HTC process
After HTC process

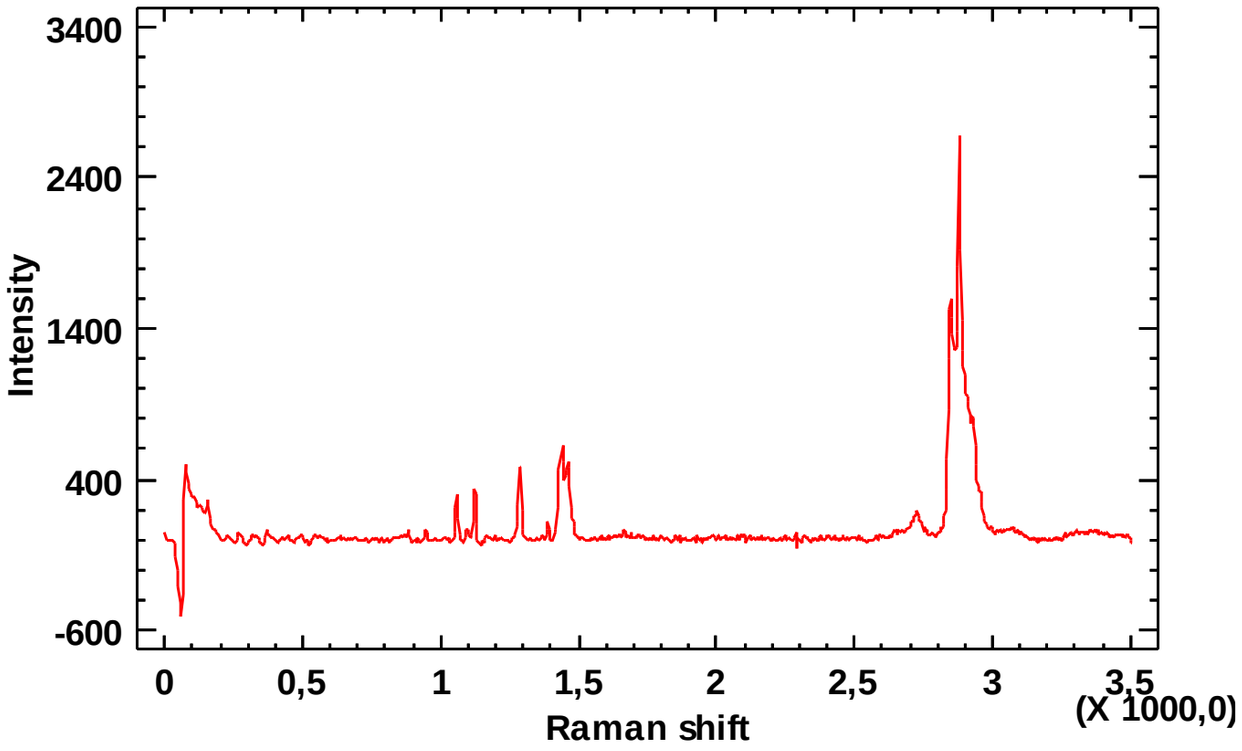
# Results



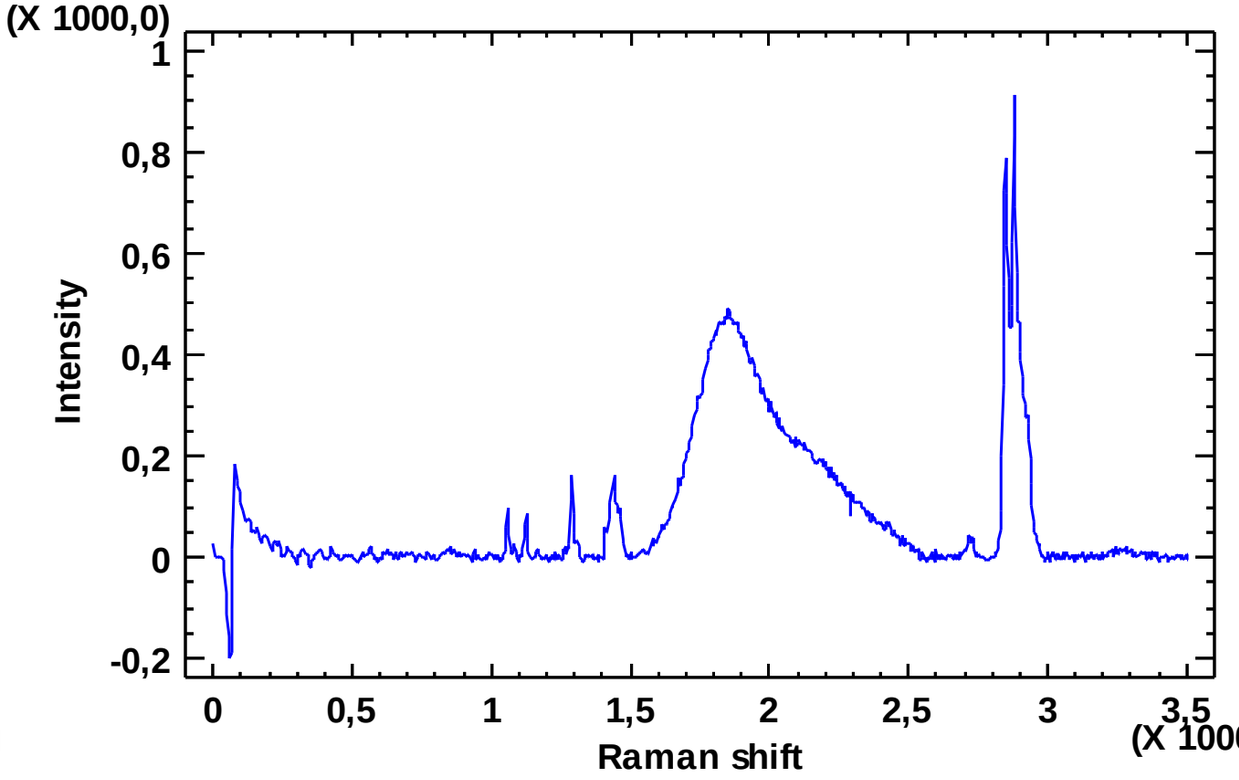
MPs identified in sewage sludge

MPs identified in hydrochar

# Identification




Spectra of microplastics in sewage sludge before HTC process classified PE




Spectra of microplastics in hydrochar (after HTC process) classified PE

# Conclusion

- The efficiency of the removal of microplastics from sewage sludge depends on the treatment techniques applied at the wastewater treatment plants
- Microplastics undergo degradation during hydrothermal carbonization process
- MPs particles identified in hydrochar derived from sewage sludge were significantly defragmented
- The efficiency of microplastic removal resulted in 75%
- Hydrothermal carbonization is an efficient method in the degradation and removal of microplastics in sewage sludge

# Acknowledgements

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# THANK YOU FOR YOUR ATTENTION

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