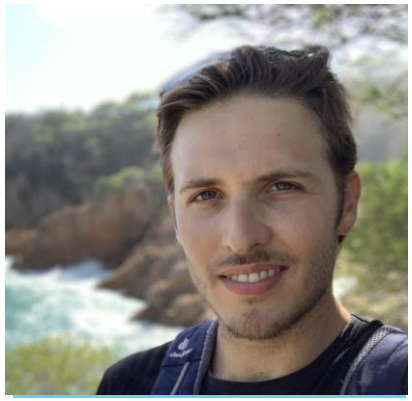
ecoSTP June 21-25, 2021
IWA the international water association
Ecotechnologies for Wastewater Treatment 2021 Milan, Italy

Nowelties
European Joint Doctorate

Anaerobic Degradation of Persistent Pollutants using Bio-reduced Graphene Oxide

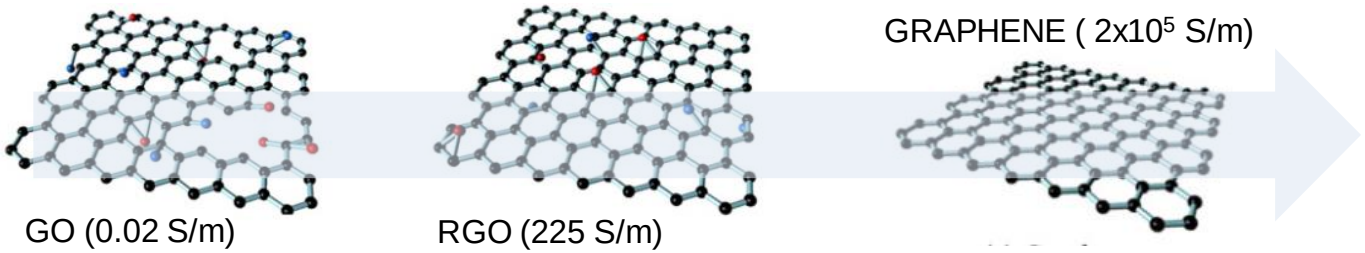
M. PONZELLI* (A,B,C), S. ZAHEDI (A), J. E. DREWES (B), K. KOCH (B), J. RADJENOVIC (A,D)

A ICRA Institute Catalan de Investigacio en del Agua
B TUM
C Universitat de Girona
D ICREA



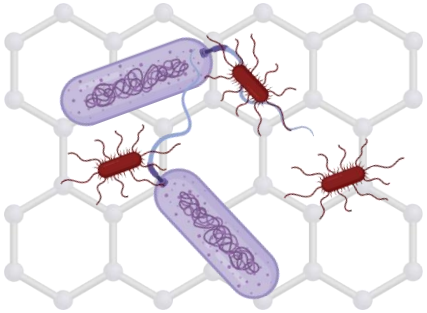
Impacting the environment with innovation in wastewater treatment

Context



- Low-cost material, hydrophilic
- Alternative to other C-based material (e.g., GAC), lower amount needed

bioRGO = Biologically reduced graphene oxide

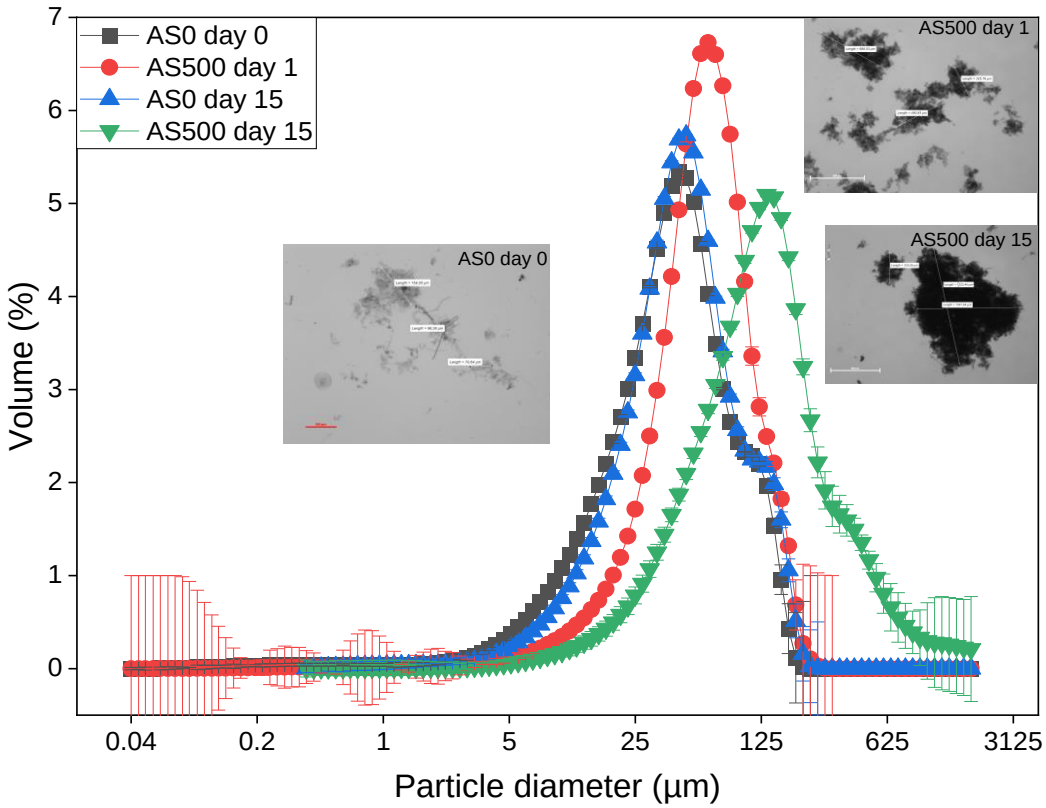


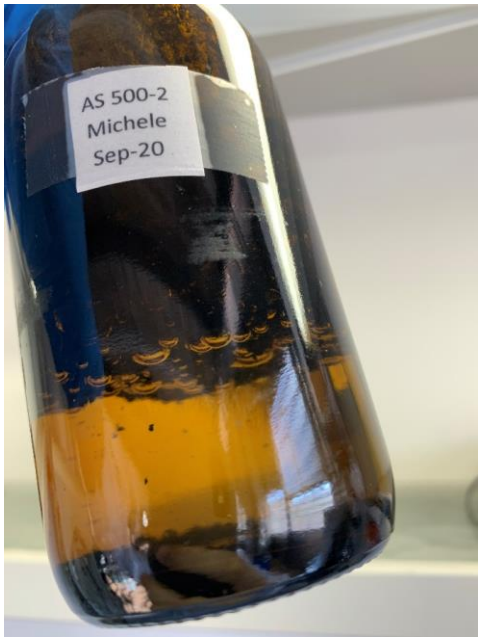
Enhance electron transfer rate to enable organic micropollutants (OMPs) transformation

Objectives

- Evaluate the anaerobic formation of bioRGO
- Evaluate bioRGO impact on the microbial community at different GO conc.
- Assess the role of bioRGO in biochemical methane potential assays (BMP) on:
  - Antibiotics biotransformation/removal,
  - Methane production.

Preliminary Results



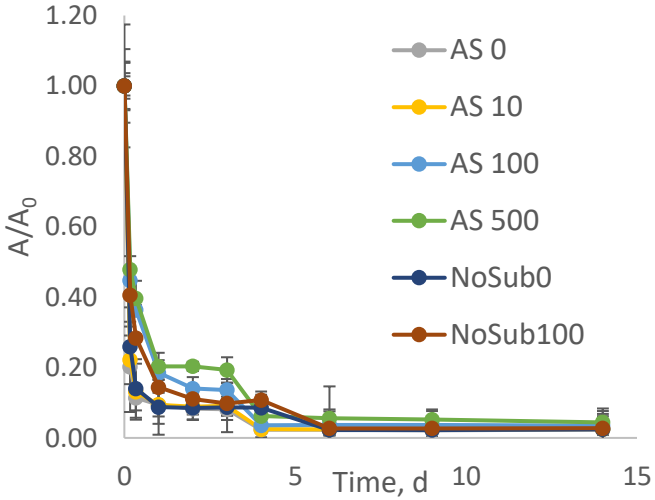


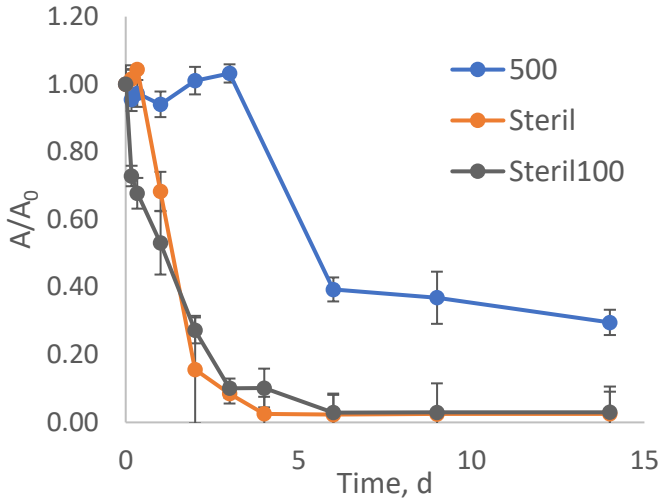
- Hydrogel formation linked to extrapolymeric substances (EPS)

- EPS functions as a cross-linker (“glue”)

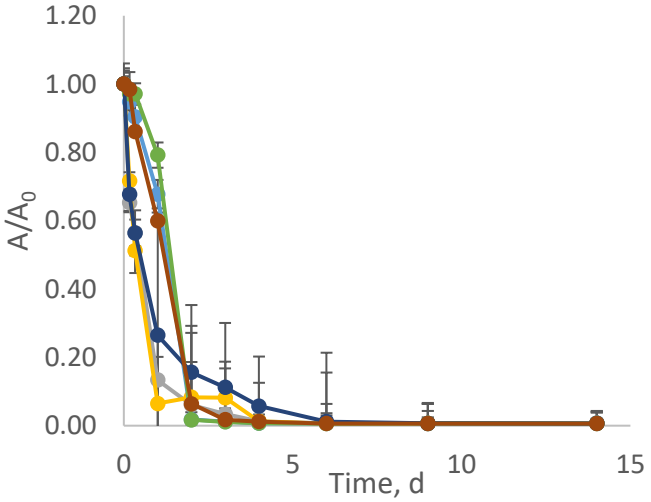
Preliminary Results

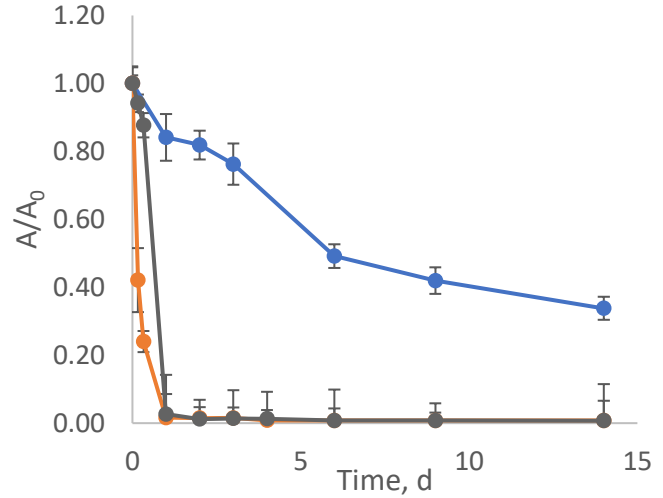
Trimethoprim (TMP)





Sulfamethoxazole (SMX)

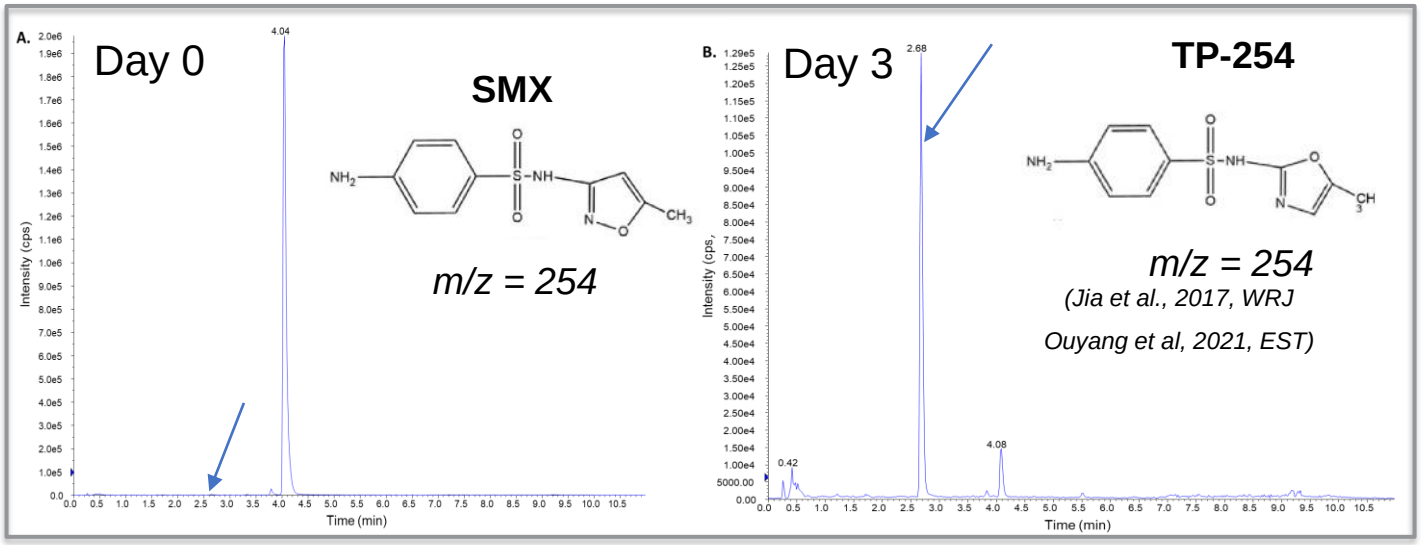




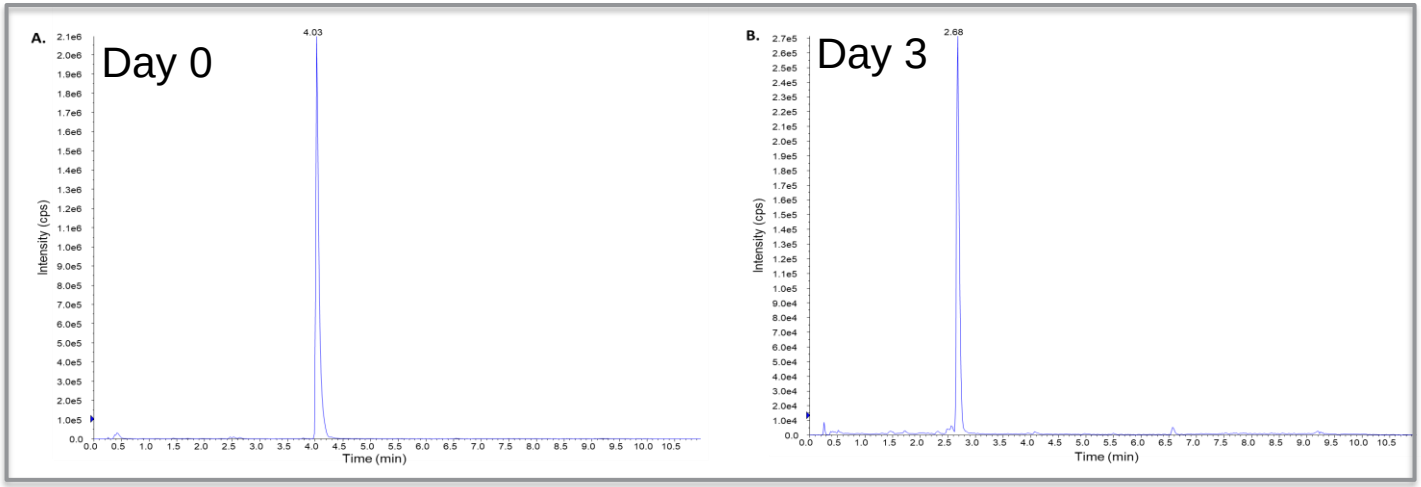
- Regardless the presence of GO,SMX and TMP are rapidly removed.
- Removal seen in sterilized assay may linked to intracellular enzymes.

Preliminary Results

0 mg/L GO

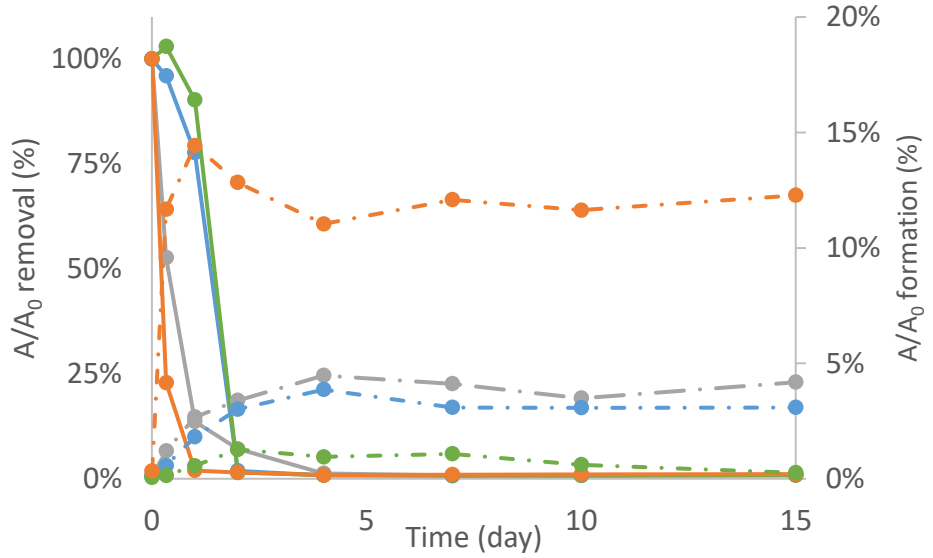


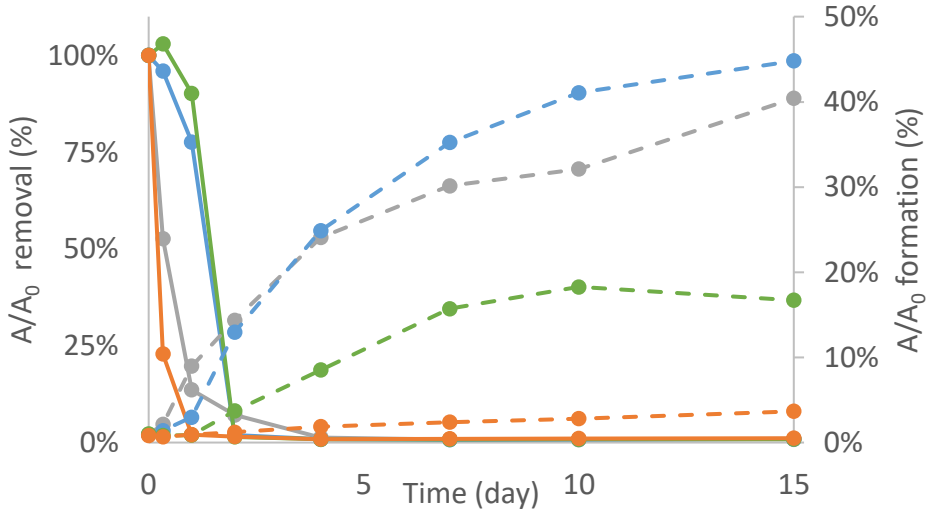
Autoclaved



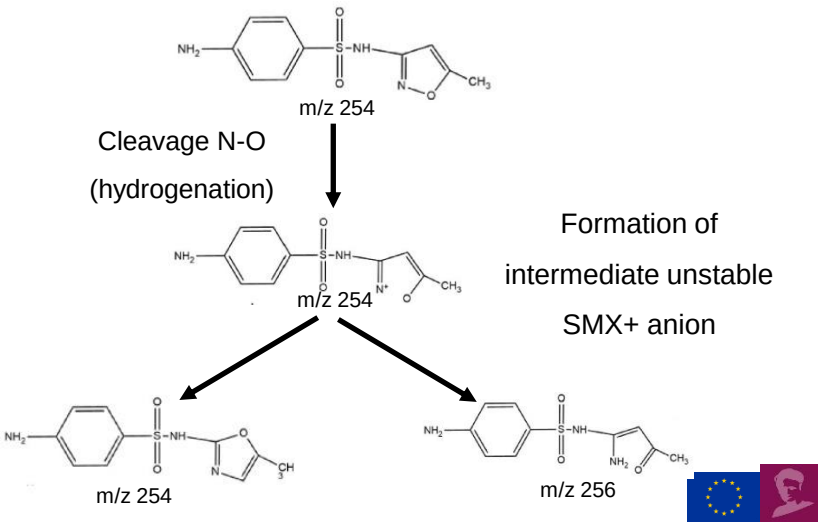
- SMX transformation product (TP-254) has same *m/z* ratio (254), but elutes at a different time.

Preliminary Results



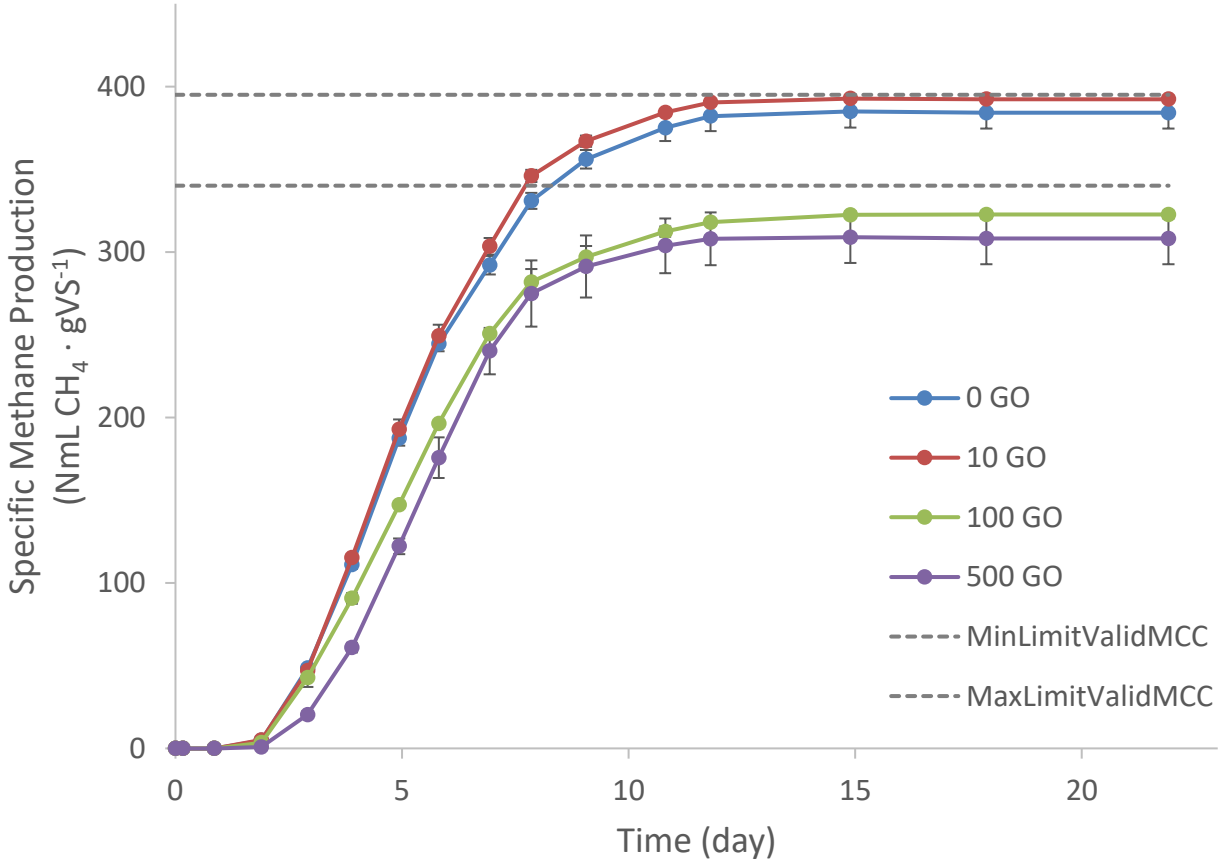


- SMX transformation is catalyzed by microbial activity (and intracellular enzyme)
- GO level impact TP formation.



Preliminary Results

CH_4 production Substrate: Microcrystalline cellulose (MCC)



- Two days lag phase due to hydrolysis of cellulose.
- 100-500 mg/L GO concentrations inhibit CH_4 production.

Conclusions

- GO is rapidly reduced by anaerobic sludge to bioRGO and yields a gel-like structure to the enhanced production of EPS.

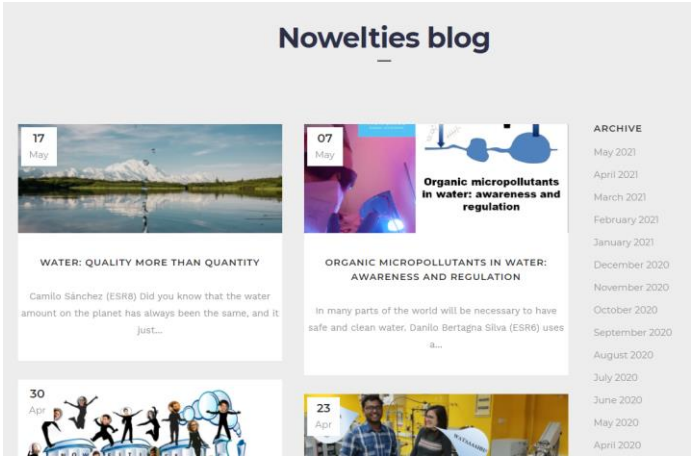
- Although the addition of GO to anaerobic sludge did not impact the removal kinetics of SMX and TMP, the formation of biotransformation products was significantly affected, as both SMX byproducts were formed in significantly lower quantities in the presence of bioRGO.

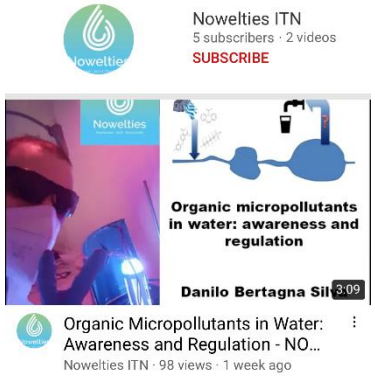
- Current studies are focused on investigating the behavior of anaerobic sludge adapted to GO over long-term using an AnMBR, and studying the response of bioRGO-modified sludge on high/shock organic loadings.

Thank you

mponzelli@icra.cat

nowelties.eu/blog/





This project has received funding from the European Union's Horizon 2020 research and innovation program under the Marie-Sklodowska Curie grant agreement No 812880.