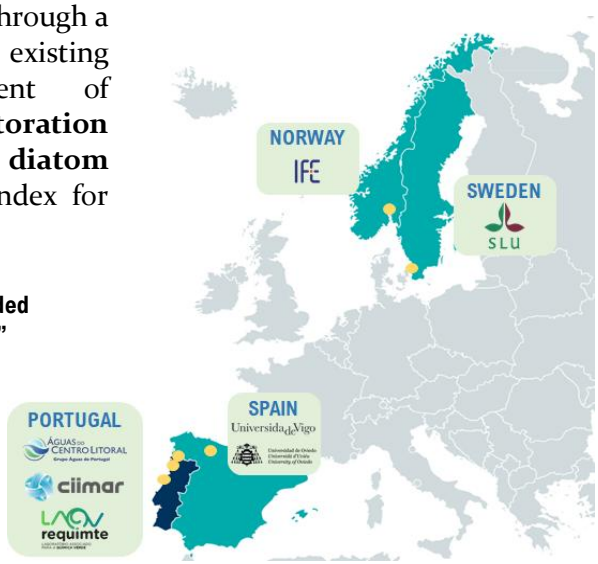
Newsletter 4

December 2024

Biodiversity restoration and conservation of inland water ecosystems for environmental and human well-being

BioReset promotes **ecosystem recovery and conservation** through a combined approach including cutting-edge advances in existing **wastewater treatment processes** and development of **methodologies to assess ecosystem conservation and restoration** provided by these treatments based on investigating **diatom communities**, laying the foundation for a global quality index for ecological status and ecosystem assessment.

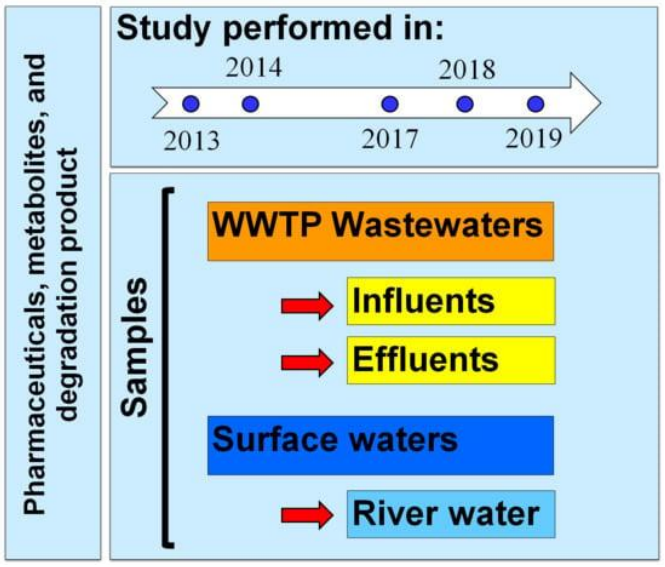


2020 – 2021 Joint COFUND Call on "Conservation and restoration of degraded ecosystems and their biodiversity, including a focus on aquatic systems"

Main results July 2024 – December 2024

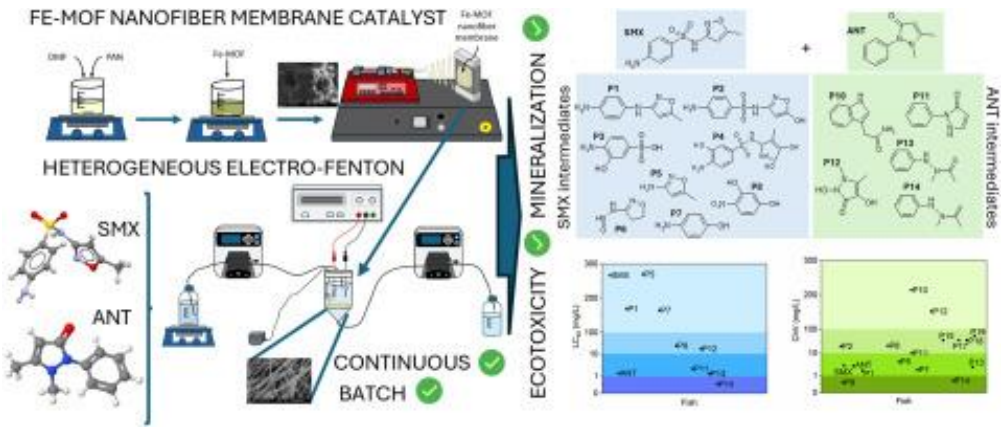
Temporal Analysis of Pharmaceuticals as Emerging Contaminants in Surface Water and Wastewater Samples: A Case Study

J. Xenobiot. 2024, 14(3), 873-892; https://doi.org/10.3390/jox14030048



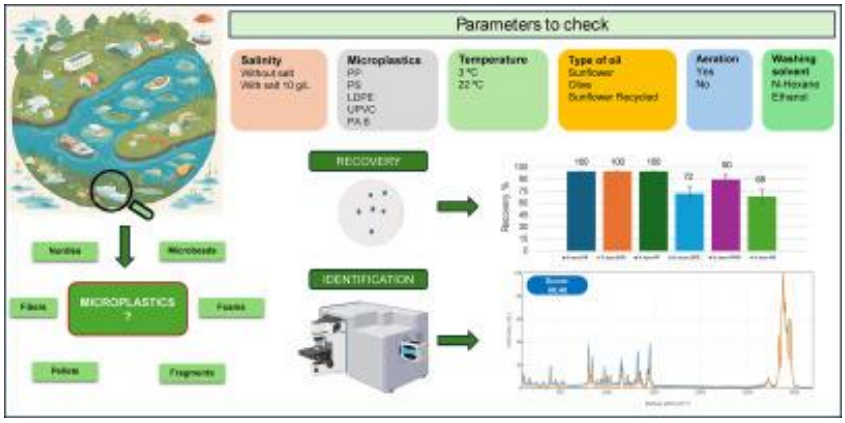
Pharmaceuticals in the environment are a global concern, with studies in all continents highlighting their widespread occurrence and potential ecological impacts, revealing their presence, fate, and associated risks in aquatic ecosystems. Despite typically occurring at low concentrations (ranging from ng/L to µg/L), advancements in analytical methods and more sensitive equipment have enabled the detection of a higher number of pharmaceuticals. In this study, surface and wastewater samples were extracted using solid phase extraction and analyzed using ultra-high-performance liquid chromatography with tandem mass spectrometry. Among the therapeutic classes investigated, nonsteroidal anti-inflammatory drugs/analgesics, antibiotics, and psychiatric drugs showed a higher number of detected pharmaceuticals. Concentrations ranged from below method detection limit (<MDL) to 3.20 µg/L (caffeine) and <MDL to 639 µg/L (hydroxyibuprofen) in 2018, and from <MDL to 0.848 µg/L (diclofenac) and <MDL to 53.0 µg/L (caffeine) in 2019 for river water and wastewater samples. Temporal analysis showed an increase in the sum of pharmaceutical concentrations over the study years, highlighting the importance of monitoring pharmaceuticals in the environment and their potential accumulation over time.

Iron metal-organic framework nanofiber membrane for the integration of electro-Fenton and effective continuous treatment of pharmaceuticals in water Chemosphere 2024, 366, 143447; https://doi.org/10.1016/j.chemosphere.2024.143447



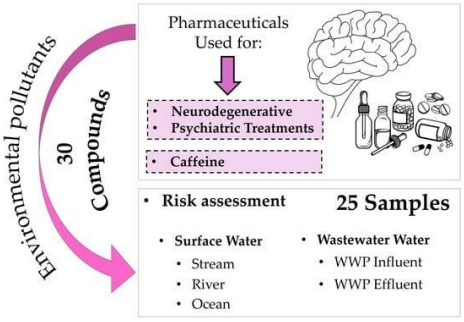
In this study, an iron metal-organic framework (Fe-MOF) was synthesized and immobilized by electrospinning technique with the objective of obtaining a membrane composed of nanofibers of this material (Fe-MOF nanofiber membrane). The characterization performed by XRD, TEM, SEM, EDS mapping and FTIR confirmed the correct synthesis of Fe-MOF as well as its correct retention in the elaborated membranes. The usefulness and effectiveness of the Fe-MOF nanofiber membrane as a catalyst for the electro-Fenton process was evaluated by performing sulfamethoxazole degradation tests. Different parameters such as the effect of intensity (25 and 100 mA), the effect of the drug initial concentration (10–50 mg/L) and the reusability of membranes were studied. Then, the degradation of a drug mixture formed by sulfamethoxazole and antipyrine was evaluated, reaching a degradation of 92.10 % and 87.43 % respectively for each drug in 4 h at 25 mA. In addition, the identification of reactive oxygen species was ascertained by scavenger assays. The study of degradation products was also carried out and their toxicity was predicted by ECOSAR program, concluding that the environmental toxicity would disappear with mineralization. Finally, given the good results obtained in batch tests, the behavior of the process was studied in a system that works continuously, achieving a stable degradation of 83.10 % in the case of treatment with a mixture of drugs. This confirmed the stability of the Fe-MOF nanofiber membrane, as well as, its catalytic activity, making it suitable for long-term treatments.

Investigating multiple vegetable oils and recycled variant for microplastics extraction from water, integrated with Raman spectroscopy Sci. Total Environ. 2024, 955, 177112; https://doi.org/10.1016/j.scitotenv.2024.177112



The global production and disposal of plastics have led to pervasive contamination of natural environments, representing considerable risks to human health and ecosystems. This study introduces a novel oil-based method for extracting microplastics (MPs) from water samples, with a focus on optimizing extraction conditions and improving the quality of MPs identification using Raman spectroscopy. Various parameters including the type of oil, salinity, temperature, air incorporation, and washing solvent were investigated to enhance extraction efficiency and spectroscopic identification accuracy. Sunflower oil emerged as the preferred extraction medium due to its compatibility with Raman spectroscopy, offering high recovery efficiencies for polypropylene (PP) and polystyrene (PS). Additionally, ethanol was identified as a better washing solvent compared to hexane, improving MPs identification. The optimised method was then applied to environmental water samples, revealing matrix effects and challenges with digestion step. Despite these challenges, the proposed method represents a significant advancement in microplastic analysis, offering reliable detection and quantification in aquatic environments. Further optimisation is needed to address matrix effects and improve recovery efficiency, especially for smaller microplastics.

Tracing Pharmaceuticals in Water Systems: Focus on Neurodegenerative and Psychiatric Treatments J. Xenobiot. 2024, 14(4), 1807-1825; https://doi.org/10.3390/jox14040096



Pharmaceutical residues in aquatic ecosystems pose significant environmental and public health challenges. Identifying the presence and levels of these pharmaceuticals is crucial. This study developed an analytical method to detect pharmaceuticals used for Alzheimer's (AD) and Parkinson's (PD) disease, including psychiatric drugs and the stimulant caffeine, targeting 30 compounds. Optimized mass spectrometric and liquid chromatographic parameters enabled robust detection and quantification. The methodology was applied to 25 surface and wastewater samples. Twenty-one compounds were detected including eight psychiatric drugs, five metabolites (citalopram N-oxide, citalopram propionic acid, desmethylcitalopram, O-desmethylvenlafaxine, and 10,11-epoxycarbamazepine), and seven AD/PD pharmaceuticals along with caffeine. Nine compounds (apomorphine, benserazide, donepezil, didemethylcitalopram, carbidopa, norfluoxetine, galantamine, pramipexole, and safinamide) were not detected. Fluoxetine was found in all samples, and caffeine had the highest concentration at 76,991 ng/L, reflecting its high consumption. Concentrations ranged from 29.8 to 656 ng/L for caffeine, <MDL to 381 ng/L for psychiatric drugs, and <MDL to 37.1 ng/L for AD and PD pharmaceuticals in surface water. In wastewater, concentrations ranged from 140 to 76,991 ng/L for caffeine, <MDL to 5227 ng/L for psychiatric drugs, and <MDL to 206 ng/L for AD and PD pharmaceuticals. These findings highlight the critical need for comprehensive environmental monitoring.

Novel 3D electro-Fenton reactor based on a catalytic packed bed reactor of perovskite/carbon microelectrodes for the removal of carbamazepine in wastewater J. Environ. Chem. Eng. 2024, 12(4), 113154; https://doi.org/10.1016/j.jece.2024.113154

Advancements in Copper-Based Catalysts for Efficient Generation of Reactive Oxygen Species from Peroxymonosulfate Appl. Sci. 2024, 14(17), 8075; https://doi.org/10.3390/app14178075

Decorated Electrode Surfaces with Nanostructures and Metal-Organic Frameworks as Transducers for Sensing Sensors 2024, 24(20), 6745; https://doi.org/10.3390/s24206745

Antidepressants and COVID-19: Increased use, occurrence in water and effects and consequences on aquatic environment. A review Sci. Total Environ. 2024, 953, 175993; https://doi.org/10.1016/j.scitotenv.2024.175993

Dissemination activities - Some conferences in which BIORESET results were share

CIPOA 6TH | BRAZIL
Iberoamerican Conference on Advanced Oxidation Technologies
October 7 to 11, 2024
Florianópolis/SC
Oceania Convention Center
NET ZERO CARBON EVENT

BIOSENSING 2024
Towards Future Applications of Bio-Inspired Sensors

SIDISA 2024
XII International Symposium on Environmental Engineering
PALERMO
October 1st - 4th

XI NyNA 2024
International Congress on Analytical Nanoscience and Nanotechnology

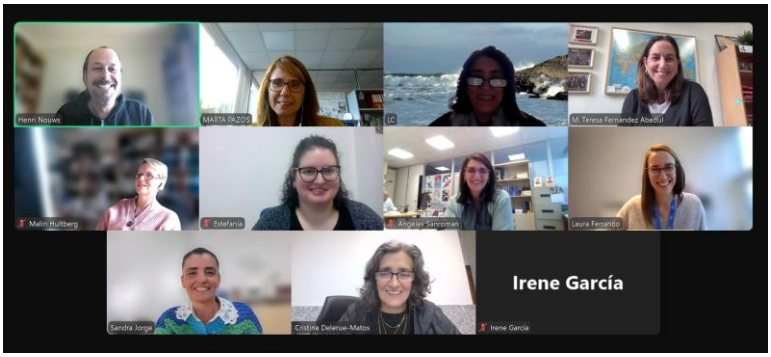
News & Events

September 2024, - BioReset @ 2nd IN2AQUAS Symposium and Summer School

Bioreset researchers Laura Ferrando-Climent (Institute for Energy Technology, Norway), Elena Surra (REQUIMTE, Portugal), and Sandra Jorge (Águas do Centro Litoral, Portugal) participated in the 2nd IN2AQUAS Symposium and Summer School, hosted by Institute for Energy Technology (Norway), marking a productive and insightful few days of collaboration and learning!

November 12, 2024 - Fifth Virtual Consortium meeting

The fifth virtual meeting with the workpackage leaders and several team members was held to discuss the works after two and a half years of the project and to plan ongoing and upcoming tasks.



BioReset

A Biodiversity Project

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