COESIONE ITALIA 21-27 EMILIA-ROMAGNA

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Regione Emilia-Romagna

ECOMONDO The green technology expo.

INTECH4WATER: an integration of innovative technologies for the depuration and valorization of urban and industrial wastewater

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INTRODUCTION The increasing presence of new micropollutants, including **pharmaceuticals**, **antibiotics**, **microplastics** and **bisphenols**, has raised significant concerns regarding the impact on both the environment and human health. These micropollutants frequently evade standard depuration processes, highlighting the necessity for further research and innovation in wastewater treatment technologies. The objective of the **INTECH4WATER** project is indeed the development of a prototype that combines physical-chemical and biological methods, with the aim of **treating both conventional and emerging pollutants** in accordance with a **circular economy approach**.

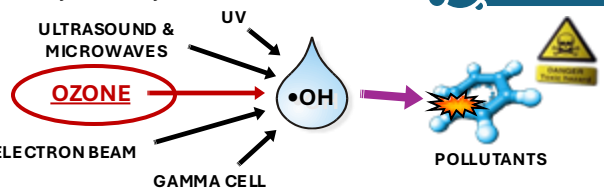
PROAMBIENTE

ADVANCED OXIDATION PROCESSES (AOP)

technology aims at generating radicals **(•OH)** for the degradation of **organic substances** and **persistent pollutants**.

Among the wide range of technologies considered, **ozonation** was selected for implementation. Laboratory-scale tests are currently underway.

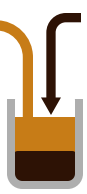
1. AOP



SUPERNATANT WASTEWATER containing:

- NUTRIENTS (N, P)
- ORGANIC MATTER
- PHARMACEUTICALS
- BISPHENOLS
- MICROPLASTICS
- PATHOGENIC BACTERIA

SLUDGE



SLUDGE THICKENING

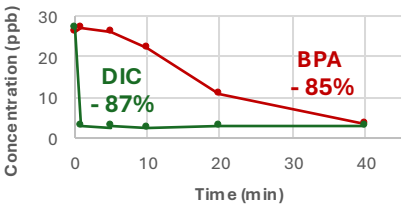
URBAN WASTEWATER

HERA FERRARA TREATMENT PROCESS

CLEAN EFFLUENT

2. UV ENEA-LEA

The ultraviolet (**UV**) light can provide the energy required for the initiation of **radical reactions**, which results in the oxidation of organic molecules.



EMERGING MICROPOLLUTANTS

BISPHENOL A (BPA): Additive in plastics

DICLOFENAC (DIC) Analgesic, anti-inflammatory

CNR-ISSMC

3. Filtration

ADSORBENT FILTERS

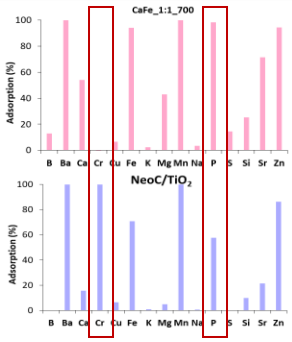
containing liofilised microalgae biomass **(NeoC/TiO2)**, and calcium ferrites nanoclays **(CaFe)**.

ANTIMICROBIAL FILTERS

consisting in silver nanoparticles coated in curcumin **(AgCUR)** immobilized-supported in **100% wool.**

Sample code	Log Reduction *E. coli*			Log Reduction *S. aureus*		
mg/l	50	10	1	50	10	1
AgCUR	4.7	3.1	0.5	4.4	3.1	<0.3

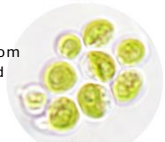
ANTIBACTERIAL EFFECT



HEAVY METALS and PHOSPHORUS REDUCTION

4. Microalgae

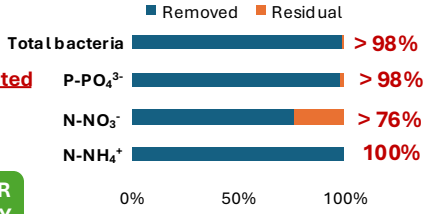
The native microalgae *Chlorella*-like isolated from the same wastewater and used in this project.



UNIFE

MICROALGAE can remove many contaminants from wastewaters, including inorganic nutrients such as **ammoniacal ($N\text{-}NH_4^+$)** and **nitric ($N\text{-}NO_3^-$) nitrogen**, **phosphorus ($P\text{-}PO_4^{3-}$)**, heavy metals, antibiotics and **potentially pathogenic bacteria**.

Near-complete removal of all tested contaminants in 14 days.



CIRCULAR ECONOMY

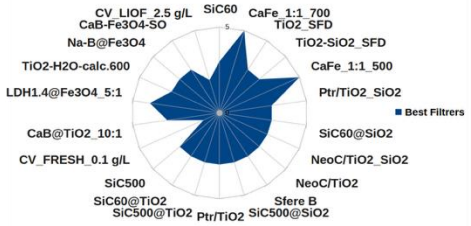
MICROALGAE BIOMASS PRODUCTION

Potential biotechnological applications.

CIRI FRAME

5. Data analysis

Unsupervised machine learning allows comparing absorption capacity of inorganic and organic filters for single and multiple pollutants as well as identifying most cost-effective filters for pollutants removal.



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