

Project Technical Progress

Optimization of Experimental Parameters

The NTUA team has optimized the experimental parameters critical to the system's performance. These include:

Reaction time: By optimizing the reaction duration, the team ensured that the process operated at peak efficiency without wasting energy and resources.

Catalyst lifetime: Determining catalyst lifetime is critical. The NTUA team successfully finalized the catalyst's lifetime and improved its performance, reducing the need for frequent replacement, and lowering the system's operational costs and environmental impact.

System pressure: Stabilizing the system's operating pressure was essential to ensure a consistent and controlled reaction environment, preventing potential fluctuations that could affect performance.

H₂/O₂ ratio: Optimizing gas feed composition was another critical parameter. This balance is essential for the safe operation of the system and the maximum detoxification of the pharmaceutical ingredients.

These improvements ensure that the catalytic system operates effectively, enhancing the overall process's efficiency and sustainability.

HPLC Analysis



High-performance liquid chromatography (HPLC) was used to evaluate the effectiveness of the prototype system in detoxifying Active Pharmaceutical Ingredients (APIs). Samples are analyzed before and after treatment by the catalytic system. Wastewater samples from Medochemie's manufacturing site, RO and NF samples from NTUA's Brine Excellence Centre, were studied in detail. These analyses provide valuable data on the system's ability to remove contaminants and pharmaceutical residues. The results of HPLC show a significant reduction of close to 80-90% of the initial concentration of the pharmaceutical.

Toxicity Tests



The NTUA team has recently conducted additional experiments to evaluate the effectiveness of the prototype system in detoxifying Active Pharmaceutical Ingredients. These experiments focused on assessing the toxicological impact of treated samples on both the environment and microorganisms, providing valuable insights into the system's potential to reduce pharmaceutical pollution and to use the recovered water in noncritical applications (heat exchanging systems, cleaning, irrigation).



Toxicity Tests to *Daphnia magna*



Toxicity was measured to heterotrophic bacteria *Daphnia magna*, a zooplanktonic organism quite widespread in lakes and streams, which is a building block of the food chain of aquatic ecosystems. The method of determination was the ISO 6341:2012, Water quality - Determination of the inhibition of the mobility of *Daphnia magna* Straus (Cladocera, Crustacea) - Acute toxicity test. Results were expressed as EC50-24h, EC50-48h, and Toxicity Units (TU).

The tested samples included untreated wastewater from Medochemie manufacturing units, treated wastewater from the prototype system, antibiotic reference solutions, and its treated versions. Initial toxicity results showed that treated wastewater's Toxicity Units (TU) were lower than untreated samples. This optimistic outcome promises further investigation into the treatment's efficiency and potential application in reducing environmental impact.



Phytotoxicity Test



To evaluate the suitability of treated water for irrigation, the NTUA team also conducted Phytotoxicity tests on treated samples. These tests were carried out using the PHYTOTOX-KIT Liquid Samples method, which measures the direct effects of chemical compounds on plant growth. Three plant species were selected for their rapid germination and quick root and shoot growth, enabling completion of the tests within three days. The selected species were:



Phytotoxicity Test

- The monocotyledon Sorgho (*Sorghum saccharatum*)
- The dicotyledon garden cress (*Lepidium sativum*)
- The dicotyledon mustard (*Sinapis alba*)

Preliminary results indicated that the inhibition of root and shoot growth was significantly higher in untreated wastewater compared to treated wastewater. These promising results encourage further investigation into the treatment's potential and long-term impact.

Project Events & Highlights

NTUA team at VerdeTec 2024 exhibition in Greece

March 29th-31st, 2024:

NTUA participated in the 5th International Verdetec Environmental Technologies Exhibition at the MEC Exhibition Centre in Athens, Greece. VerdeTec is an annual exhibition on innovative solutions, products, and services for the environment with thousands of visitors, including professionals, individuals, politicians, and local government officials. The NTUA team showcased the innovative solutions of the LIFE PHARMA-DETOX project for the safe and sustainable management of pharmaceutical wastewater.

Prof. Maria Loizidou presented the project, among other topics, during the NTUA-Unit of Environmental Science & Technology session on "Wastewater Management and Circular Economy".



Project Events & Highlights

Presentation at the 11th International Conference on Sustainable Solid Waste Management on Rhodes Island



On June 20th, 2024, Maria Kyriazi, Senior Researcher from the NTUA team, showcased the Pharma-Detox project at the 11th International Conference on Sustainable Solid Waste Management, held in Rhodes Island.

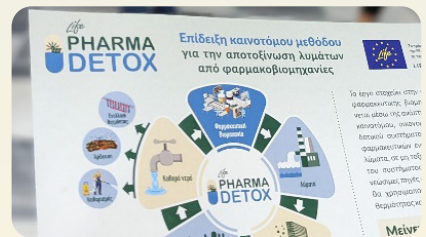
The presentation emphasized the project's progress, actions, and challenges, with a special focus during the LIFE Networking Session on how LIFE projects contribute to advancing the European Circular Economy Policy.

This global conference, which drew over 950 participants, provided a hybrid experience with both in-person attendees and virtual speakers. It gathered scientists, government officials, industry leaders, private organizations, and academic institutions, serving as an important platform for exchanging innovative ideas, methodologies, and best practices in solid waste management.

European Researchers' Night

September 27th, 2024:

At the Researchers Night in Athens, the NTUA-Unit of Environmental Science and Technology project team members presented the PHARMA-DETOX project.



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