

Development of practical tools for a circular water economy in H2020

Project Ô

Project Ô develops water management and treatment technologies. They work in harmony with current systems and improve technical and economic success. Combining innovative water treatment technologies with two digital platforms contributes to improving water management for communities in Europe and beyond.

Four demonstration sites have been selected for Project Ô; each site hosts a pilot module combining different advanced technologies for water treatment tailored for the specific needs of the users at each site.

The first demonstration site is located in Lecce, Italy. The challenge is treating small and localised groundwater sources that have been contaminated by microorganisms and seawater intrusion to achieve drinking water quality. This site hosts the ADV.ERT module—designed to treat water with medium salinity, bacterial contamination and low levels of non-biodegradable contaminants, such as pesticides.

The pilot module comprises advanced oxidation and desalination technology: high-voltage nanosecond pulsed electric field (HiNaPEF) and nanofiltration (NF), respectively.

The HiNaPEF has proven highly effective in the disinfection of water and the mineralisation of toxic organic pollutants, making it the most suited technology for the elimination of microbial contamination and degradation of pesticides and pharmaceuticals. HiNaPEF technology generates a wide spectrum of very active oxidative species directly in the water to be treated using nanosecond-pulsed electric discharges, thus requiring no additional chemicals to operate.

NF uses nanoporous silicon carbide (SiC) membranes that have a nominal pore size of 1–2nm; thus, they can retain organic molecules and hydrated polyvalent ions. NF technology was chosen to reduce the salinity of the water in demo site one because of its unique characteristics that come from the innovative technique used for the modification of the surface of mesoporous SiC multichannel tubes.

The second demonstration site in Eilat, Israel, aims at improving land-based mariculture to meet growing demand and comply with regulations. The SALTECH module for water treatment is designed to manage two water loops for recycling/reuse of the produced seawater from fishponds.

Water loop 1:

recycles the sea water of the fishponds, to avoid drawing water from the Red Sea and to discharge nutrients.

Water loop 2:

reuses water in an aquaponic system after total organic carbon (TOC) and microbial abatement and desalination.

The SALTECH module is composed of five advanced technologies for water treatment:

- a denitrification unit (DN) for nitrate removal (water loop 1)
- an algae photoreactor (Ulva plus Gracilaria) for phosphate removal and fish feed production (water loop 1)
- an advanced adsorption unit (AAS) equipped with photoactive carbon for TOC removal and partial disinfection (water loop 1 and 2)
- a HiNaPEF for the disinfection of water and in the mineralisation of residual toxic organic pollutants (water loop 2)
- a membrane distillation desalination technology (MD) (water loop 2).



Figure 1: HiNaPEF unit - demosite 1.



Figure 2: Nanofiltration unit - demosite 1.



Figure 3: Algae plant - demosite 2.

In **Almendralejo, Spain**, the third demonstration site uses the **MOBILE3TECH** module to treat effluents from the wastewater treatment plant (WWTP) of Almendralejo to decrease the TOC values and toxicity of the influent. The MOBILE3TECH module is composed of an advanced adsorption pre-treatment coupled with solar photo-Fenton—an advanced oxidation process that can be employed either to regenerate the carbon and/or to treat the effluents of WWTP with a view to possible reuse.

The MOBILE3TECH also integrates an advanced control capable of assessing the toxicity of the wastewater treated in the WWTP. According to the toxicity of the influent, the module will

automatically choose whether a pre-treatment is necessary in case peaks of organic pollutant load that exhibit bacterial toxicity in wastewater are detected at the Almendralejo plant.

The fourth demonstration site at **Omis in Croatia** aims at supporting the textile industry in reusing water and resources. The **PHOTO.CAT** module that operates at this demonstration site was designed to purify wastewater from the textile industry after secondary treatment. The PHOTO.CAT module technology is composed of a supported photocatalyst solar photoreactor with a UV LED backup source to maintain the UV radiant power on the photocatalyst at optimal levels (20 W/m²). The system is equipped with an array of sensors: solar UV radiant power, pH, conductivity,

dissolved O₂, and (under development) a fast/low power online TOC sensor. Moreover, the pilot module is equipped with an additional NF unit aiming to reject sulfate to reuse water in activities that require low sulfate levels.

The system constitutes one module of the pilot-scale plant that will be deployed as an advanced tertiary treatment to recycle water in the washing and dyeing bath in the textile industry, decreasing the water footprint of the textile production.



Figure 4: Photocatalysis - demosite 4.

PROJECT NAME

Project Ô

PROJECT SUMMARY

Project Ô demonstrates how local, small loops of water management can be beneficial in alleviating the pressures over a water management system while allowing for a circular economy vision of water. The project provides tools and approaches for the reuse/ recycle of water while assessing social acceptability and effects over the system.

PROJECT PARTNERS

IRIS, Aalborg University, Acquedotto Pugliese, Centre National de la Recherche Scientifique, Eilat Municipality, Ekso, Ente Nazionale Italiano de Unificazione, Galeb, Heim.ART - Kulturverein, Institute for Methods Innovation, Israel Oceanographic and Limnological Research, Kalundborg Symbiosis, National Center for Mariculture, Particula Group, Politecnico di Milano, Regione Puglia, Rhine-Waal University, SOCAMEX, Technion - Israel Institute of Technology, Universidade de Aveiro, Università di Torino and Universitat Politècnica de València.

PROJECT LEAD PROFILE

IRIS is an innovative SME specialising in developing applications of laser and plasma technologies focusing on advanced manufacturing and the clean-tech sector. IRIS employs engineers and scientists with a strong and multidisciplinary background in industrial laser, plasma technology, materials, energy, waste and water management.

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