Winter School

# Winter School on Contaminants of Emerging Concern (CECs) and Disinfection By-Products (DBPs)

## Occurrence, Impact and Elimination

**BOOK OF ABSTRACTS**

Vila Nova de Gaia, Porto, Portugal

**25-26th November 2024**

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# VENUE

**WORLD OF WINE (WOW)**

*A CULTURAL DISTRICT WITH A WOW FACTOR*

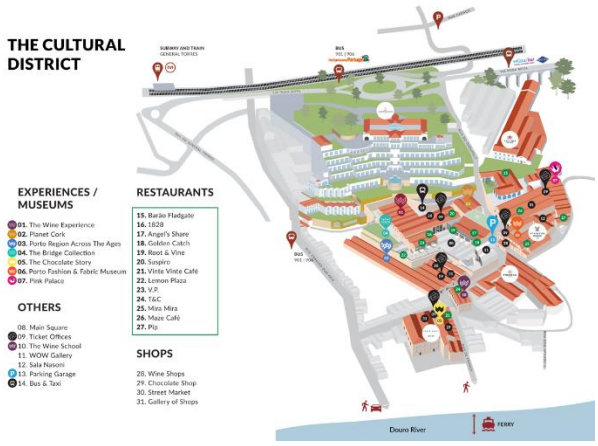
Rua do Choupelo, 39
4400-088, Vila Nova de Gaia, Porto
Portugal

**Website:** ***www.wow.pt***

**WOW** is a huge new cultural district where everyone is welcome. In the historic heart of Vila Nova de Gaia, on the south bank of the River Douro, overlooking the Ribeira of Porto (Porto's Riverside) and the Luís I Bridge, just a short distance from the centre of Porto, WOW pays homage to culture, history and Portugal's main industries. The project started with the restoration of old port wine cellars and aims to convey the history and feeling associated with winemaking in its many forms.

The World of Wine is a complex that houses several experiences in the so-called Wine Quarter. It consists of 7 museums, 12 restaurants, bar and café spaces, a "wine school", multiple shops, an exhibition hall, and an event space.

There are seven themed museums: the Wine Experience, which aims to demystify wine; the Porto Region Across the Ages reveals the history and heritage of the Invicta City; Planet Cork unveils the world of cork; the Chocolate Story reveals the world of cocoa; the Bridge Collection traces the chronology of the glass as an object; the Porto Fashion and Fabric Museum showcases Portuguese fashion; and the Pink Palace, the most recent, immerses visitors in the concept of rosé wine. At the Wine School, you can also attend classes and workshops related to the themes of the museums at the World of Wine.




**SCIENTIFIC SESSIONS**

ROOM NASONI

12. Sala NASONI;

see the WOW map;

Wi-Fi available

**EXHIBITION – STANDS FOR COMPANIES**

ANTECHAMBER OF ROOM NASONI

**POSTER DISPLAYS AND COFFEE BREAKS**

LOBBY

(connected to the antechamber of room NASONI)

## CHAIRS

**Ana Belén Pereiro Estévez**
*NOVA University Lisbon, Portugal*

**João Miguel Mendes Araújo**
*NOVA University Lisbon, Portugal*

**Luísa Maria Rocha Durões**
*University of Coimbra, Portugal*

**Rui Carlos Cardoso Martins**
*University of Coimbra, Portugal*

**Susana Seabra**
*Sociedade Portuguesa de Inovação, Portugal*

**Vítor Jorge Pais Vilar**
*Faculty of Engineering of University of Porto, Portugal*

# LOCAL ORGANIZING COMMITTEE

## Faculty of Engineering of University of Porto, Portugal

Adrián Manuel Tavares da Silva
Ana Alexandra da Silva Pereira
Ana Margarida Gorito Gonçalves
Ana Isabel de Emílio Gomes
Ana Rita Lado Ribeiro
André Tiago Torres Pinto
Carla Alexandra Orge Fonseca
Carmen Susana de Deus Rodrigues
Cátia Alexandra Leça Graça
Catarina da Rocha Cruzeiro
Cláudia Gomes da Silva
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Manuel Fernando Ribeiro Pereira
Manuel José Vieira Simões
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Luís Miguel Palma Madeira
Maria Francisca da Costa Moreira
Maria José Fernandes Sampaio
Marta Filipa Ferreira Pedrosa
Marta Sofia Oliveira Barbosa
Nuno Miguel Ratola Neto
Olga Cristina Pastor Nunes
Olívia Salomé Gonçalves Pinto Soares
Raissa Antonelli
Rui Sérgio da Silva Ribeiro
Tânia Filomena Castro Valente Silva
Vera Maria Ferreira da Cruz Homem
Vítor Jorge Pais Vilar

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Ana Rita Teixeira Fernandes
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Joana Campainhas Bastos

Maria Manuel Serrano Bernardo

Srdana Kolakovic Oliveira Barreiros

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Weronika Filipowska

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# SCOPE AND OBJECTIVES

Water is critical in both agriculture and food processing, as well as in nutrition and human health. Industrialization, agricultural activities, and climate change are reducing the quality of water sources.

The Drinking Water Directive was revised in 2020, and new rules were entered into force across the EU in January 2021. The revised Directive guarantees safer access to water for all **Europeans and ensures the highest standards in the world for drinking water, in line with** the zero-pollution ambition announced in the European Green Deal. The new rules also respond to the first-ever successful European Citizens' Initiative, "Right2Water", which gathered 1.6 million signatures in support of improving access to safe drinking water for all Europeans. The Directive aims to protect EU citizens' health by setting strict quality standards. Member States had to transpose this Directive into national laws by 12 January 2023. Work is ongoing on further methodologies and guidelines required by the Drinking Water Directive, including how to measure disinfection byproducts (DBPs), micro-plastics, and per- and polyfluoroalkyl substances (PFASs) in drinking water. Moreover, the Commission adopted **new minimum hygiene standards for materials and products that come into contact with drinking water**. They will apply as of 31 December 2026 to materials and products used in new installations or when older installations are renovated or repaired. These standards will prevent microbial growth and reduce the risk of harmful substances leaching into drinking water.

Treated wastewater can provide a continuous source of high-quality water with the potential to help meet future water needs, especially for agricultural purposes. However, if not treated properly, wastewater reuse can pose risks to public health and the environment, given the potential presence of toxic chemicals and pathogenic microorganisms. To ensure the safe reuse of wastewater for crop irrigation, the European Union (EU) has adopted the EU Regulation on minimum requirements for water reuse (REGULATION (EU) 2020/741). Furthermore, the EU has proposed a new Urban Wastewater Treatment Directive (Brussels, 26.10.2022 COM(2022) 541 final 2022/0345 (COD)) targeting new standards and limit values and obligations for large wastewater treatment plants (WWTPs) to reduce by 80% a specified set of contaminants of emerging concern (CECs).

The **Winter School** event thus aims to present an overview of the current state of knowledge and the latest advances regarding the occurrence, impact, and elimination of Disinfection By-Products (DBPs),

Contaminants of Emerging Concern (CECs), and microbial contamination to provide solutions face to risks in providing safe drinking water and alternative water sources for crops production.

## The Winter School is organized under the scope of four European projects:

- **BlueWWater project** – *Control, treatment and reduction of microplastics and contaminants of emerging concern in urban wastewater and the transboundary coastal environment (Control, tratamiento y reducción de microplásticos y contaminantes emergentes en aguas residuales urbanas y en el medio costero transfronterizo)* (**www.bluewwater.eu**)

BlueWWater is a POCTEP-funded project that aims to improve the quality of river, transitional, and coastal water bodies by controlling, monitoring, and evaluating emissions of microplastics and contaminants of emerging concern into the aquatic environment, through the study of the efficiency of urban wastewater treatment plants (WWTP) in both regions and the environmental risk of these pollutants, thus ensuring a sustainable use of water resources and contributing to the implementation of community regulations. BlueWWater has a budget of 1.4 million Euros and a three-year duration. It started on 1st September 2023 and includes a multidisciplinary and multi-stakeholder consortium from Portugal and Spain, including leading scientists from 11 partners.

- **H2OforAll Project** – *Innovative integrated tools and technologies to protect and treat drinking water from Disinfection By Products (DBPs)* (**https://h2oforall.eu/**)

The H2OforAll project is an ambitious Horizon Europe-funded project that aims to assess main Disinfection By Products (DBPs) sources through the development of fast, cost-effective, and accurate sensor monitoring devices and by modeling their spread through drinking water distribution systems. DBPs toxicity and environmental impact will be studied, and measures will be proposed to protect the drinking water chain. Breakthrough water treatments to remove DBPs or avoid their formation during water disinfection processes will be developed, paying attention to their life cycle analysis, costs, and risks. A Central Knowledge Base with reliable data on the occurrence of DBPs in the EU and their effects will be created to increase awareness and engagement of society and governmental organizations about these drinking water contaminants and favor new policy responses and guidance. H2OforAll has a budget of 3.5 million Euros over three years. It started on 1st November 2022 and includes a multidisciplinary and multi-stakeholder consortium, including leading scientists from 10 European countries.


- **MAR2PROTECT Project** – *Innovative managed aquifer recharge to prevent groundwater contamination* (**https://mar2protect.eu/**)

MAR2PROTECT is a Horizon Europe-funded project that will provide a holistic approach to prevent groundwater contamination from the impacts of global change and climate change based on a new-generation Managed Aquifer Recharge. The core of this innovative Managed Aquifer Recharge is M-AI-R Decision Support System that will incorporate technological and societal engagement information using an Artificial Intelligence-based approach to improve groundwater quality and quantity. To ensure a high replication potential, M-AI-R Decision Support System will collect information from 5 demos sites in 4 European countries (Portugal, Italy, Spain, Netherlands) and 2 in non-European countries (Tunisia, South Africa), which were carefully chosen by their degree of maturity from previous successful projects and a wide range of settings in terms of climatic conditions, water sources, type of pollution, Managed Aquifer Recharge scheme and political/societal context. All technologies will be tested and validated until Technology Readiness Level 5, and societal activities will be implemented until Societal Readiness Level 6. Besides, MAR2PROTECT will ensure a strong engagement of national and European policymakers that, in collaboration with a Community of Practice, will strengthen the European policy framework in the field of prevention of groundwater contamination. MAR2PROTECT has a budget of 4.1 million Euros over three years. It started on 1st December 2022 and includes a multidisciplinary and multi-stakeholder consortium, including leading scientists from 9 from 6 different European countries (including Switzerland) and 2 international partners (Tunisia, South Africa).

Interreg Sudoe

Co-funded by the European Union

## ALERT-PFAS

- **ALERT-PFAS Project** – *Transnational strategy for the detection and prevention of water pollution by PFAS* (**https://interreg-sudoe.eu/en/proyecto-interreg/alert-pfas/**)

ALERT-PFAS project in an INTERREG V SUDOE-funded project that will design and implement a transnational strategy to detect and prevent PFAS pollution in SUDOE natural spaces (Portugal, Spain, and France), as well as to mitigate its effects on ecosystem biodiversity and climate change. ALERT-PFAS project offers an innovative solution to detect and monitor PFAS in real-time and prevent them from becoming part of the water cycle, contaminating the air, soil, and water. The pilot actions will be carried out in natural parks or protected areas in Portugal, Spain, and France that have been affected by recent fires. ALERT-PFAS also aims to train and sensitize all the stakeholders in the value chain, including the general public. ALERT-PFAS partnership is made up of 10 beneficiaries and 9 associates from the 3 SUDOE countries, who will contribute their complementary skills. ALERT-PFAS will apply innovative technologies such as optical sensors, adsorption and degradation processes, polymeric materials, nanotechnology, and artificial intelligence. The solution, which can be transferred to all the regions in the SUDOE area, is aimed at public authorities, natural park managers, water managers, firefighting organizations, civil protection, and others.

## And the support of:

- **Rede NOR-WATER** – **http://nor-water.eu/**

The NOR-WATER Network was created under the NOR-WATER project, funded by the POCTEP 2014-2017, to provide a forum for multidisciplinary public-private collaboration on the subject of contaminants of emerging concern, with the operational and proactive capacity to facilitate collaboration between its users and act as a driving force and promoter of initiatives in this field.

- **ZeroPollution4Water Cluster** (European Union) – **https://zeropollution4water.eu**

The ZeroPollution4Water Cluster is an initiative originated from the coalition of seven different projects funded by two Horizon Europe 2022 calls aiming at: i) preventing groundwater contamination and protecting its quality against harmful impacts of global and climate change; ii) securing drinking water quality by protecting water sources against pollution, providing innovative monitoring and treatment solutions, and ensuring safe distribution.

# CONFERENCE PROGRAM

The Winter School includes: (i) a section specifically devoted to PhD students ("**Floor to Students**") where they will have the chance to present a **poster communication**, as well as to meet experts from the School; (ii) a **workshop on Publishing Perspectives**; (iii) a **workshop on European Directives on Drinking Water, Water Reuse and Urban Wastewater Treatment**; (iv) **lectures on Complementary Skills** related to high-throughput methodologies for the determination of DBPs, CECs, PFASs, microplastics, ARB and ARGs, environmental and health impacts and prevention measures and, technologies for control of DBPs, CECs, PFASs, microplastics, ARB and ARGs; (v) a **workshop on Wastewater Treatment and Reuse**; (vi) a **co-creation workshop on Future Challenges in Drinking Water Sector - public engagement, communication and raising awareness**; and (vii) **networking Opportunities and Exhibition of water treatment related products and services**.

The **workshop on publishing perspectives** will be given by the Executive Publisher of Elsevier for Chemical and Environmental Engineering, and Executive Editors of the Journal Environmental and Chemical Engineering (Elsevier) and will feature a coffee break sponsored by Elsevier. A range of topics will be covered concerning the publication of scientific articles starting from their preparation, going through the review process, and then ending with the editorial decision and possible transfers of rejected manuscripts to alternative journals. The publisher´s, editor´s, and author´s points of view will be discussed, and the workshop will conclude with a roundtable during which questions will be taken from the audience. Questions can be either sent before the workshop (to vilar@fe.up.pt) or asked during the roundtable. Master and PhD students and junior researchers are encouraged to interact with editors and publishers.

The **workshop on European Directives on Drinking Water, Water Reuse and Urban Wastewater Treatment**, with the participation of Water Europe, National Laboratory of Civil Engineering (LNEC) and Water and Waste Services Regulation Authority (ERSAR), will present the news and challenges regarding drinking water, wastewater treatment and reuse. An overall situation of Poly- or Perfluoroalkyl substances (PFASs) will be also addressed.

**Lectures on complementary skills** will be given by senior researchers, professors and professionals, with high expertise in the topics of: i) high-throughput methodologies for the determination of DBPs, CECs, PFASs, microplastics, ARB and ARGs, ii) environmental and health impacts and prevention measures and, iii) technologies for control of DBPs, CECs, PFASs, microplastics, ARB and ARGs (e.g., ozonation, advanced oxidation processes, membrane filtration, adsorption, biological oxidation, nature-based solutions), as other topics such as CFD simulation, LCA/LCC and water digitalization.

The **workshop on Wastewater Treatment and Reuse** will include several invited talks from i) coordinators of European projects funded by Life, INTERREG, WaterJPI, and Horizon Europe programs, as well as Portuguese Recovery and Resilience Plan, presenting the project goals and main results, ii) water utilities (Águas do Tejo e Atlântico, Águas de Gaia) and companies (Xylem, USP Technologies, ADVENTECH, Aqualia, Arrow Lake AB and Air Liquide), showing case studies and real applications; iii) round table discussion addressing current industry trends, challenges, or innovations.

The **co-creation workshop on Future Challenges in Drinking Water Sector - public engagement, communication and raising awareness** will include i) goals and challenges of ZeroPollution4Water Cluster, H2OforAll, IntoDBP and SafeCREW Horizon Europe projects, Portuguese scenario regarding DBPs, Australia and USA scenarios on DBPs, and ii) opportunity to participate in a round table discussion in the following topics: DBPs technologies for drinking water treatment; Analytical techniques; Public engagement; Legislation; Preventive measures; How to increase the acceptance of tap water. The workshop also includes invited talks from companies (De Nora Water Technologies Italy S.r.l., Air Liquide, Lutz Jesco GmbH) and water utilities (Águas de Gaia).

**Invited Lectures are typically of 10-20 min, including questions.**

## Sunday, November 24, 2024

**13:00 - 17:00**
*World of Wine Central Square*

**Walking Tour through Historic Places of Vila Nova de Gaia and Porto, Social Event 1**
*or*
**Visit to one of the World of Wine Museums, Social Event 1**
*In the case of bad weather conditions (Rainy day)*

## Monday, November 25, 2024

**07:30 - 08:30**
*Lobby*

**Registration**

**08:30 - 09:15**
*Room Nasoni*

**Opening Ceremony**

**Vítor Vilar**, *Host and Chair, Faculty of Engineering of the University of Porto, Portugal*
**Baltazar de Castro**, *Director of REQUIMTE, Faculty of Sciences of the University of Porto, Portugal*
**Fernando Pereira**, *Director of the Department of Chemical and Biological Engineering, Faculty of Engineering of the University of Porto, Portugal*
**Joaquim Faria**, *Director of LSRE-LCM, Faculty of Engineering of the University of Porto, Portugal*
**Margarida Quina**, *Director of CERES, University of Coimbra, Portugal*
**Miguel Lemos**, *Chairman/CEO, Águas de Gaia, Portugal*

**09:15 - 10:30**
*Room Nasoni*

**Workshop on Publishing Perspectives: Q&A in Chemical and Environmental Engineering Publishing**

Chaired by **Suresh Pillai,** *Atlantic Technological University, Ireland*

09:15 - 09:45 — How to Become a Successful and Responsible Author: Editor Perspectives
**Despo Fatta-Kassinos**
*University of Cyprus, Cyprus*

09:45 -10:00 — Elsevier´s Article Transfer Service and Its Impact on Environmental and Chemical Engineering Journals
**Giovanni Palmisano**
*Khalifa University, United Arab Emirates*

10:00 - 10:30 — Round Table Discussion

**10:30 - 11:00**
*Lobby*

**Poster session & Coffee break (*sponsored by Elsevier*) & exhibition**

## Monday, November 25, 2024 *(cont.)*

**11:00 - 12:30** — **Workshop on European Directives on Drinking Water, Water Reuse and Urban Wastewater Treatment**
*Room Nasoni*
Chaired by **Loïc Charpentier** (Water Europe, Belgium) and **Susana Rodrigues** (ERSAR, Portugal)

11:00 - 11:15 — EU Directive on Drinking Water: News and Challenges
**Susana Rodrigues**
*Entidade Reguladora dos Serviços de Águas e Resíduos (ERSAR), Portugal*

11:15 - 11:30 — Water Reuse in EU: Regulation on Minimum Requirements and JRC Guidelines on Risk Management Plan
**Loïc Charpentier**
*Water Europe, Belgium*

11:30 - 11:45 — EU Directive on Urban Wastewater Treatment: News and Challenges
**Maria João Rosa**
*Laboratório Nacional de Engenharia Civil, Portugal*

11:45 - 12:00 — On the Overall situation of Poly- or Perfluoroalkyl substances (PFASs) including Fluoropolymers
**Bruno Ameduri**
*Institute Charles Gerhardt (CNRS), France*

12:00 - 12:30 — Round Table Discussion

**12:30** — **Winter School Official Photo**
*WOW Main Square*

**12:30 - 14:00** — **Lunch Break**
*Lobby Atkinson*

**14:00 - 15:15** — **High-Throughput Methodologies for the Determination of DBPs, CECs, PFAS, Microplastics, ARB and ARGs**
*Room Nasoni*
Chaired by **Félix Hernández,** University Jaume I, Spain

14:00 - 14:15 — Targeted and Non-targeted Analysis of Disinfection Byproducts in Drinking Water
**Maria José Farré**
*Catalan Institute for Water Research, Spain*

## Monday, November 25, 2024 *(cont.)*

14:15 - 14:30 — Analytical Methodologies for Contaminants of Emerging Concern (CECs), including Per-/poly-FluoroAlkylated Substances (PFASs)
**José Benito Quintana**
*University of Santiago de Compostela, Spain*

14:30 - 14:45 — Challenges and Methodologies for Sampling and Determination of Microplastics in Wastewaters, Inland Surface Waters, and Marine Waters
**Maria Augusta de Sousa/Juan Santos Echeandía**
*Águas e Energia do Porto, Portugal/Spanish Institute of Oceanography, Spain*

14:45 - 15:00 — Methodologies for the Determination of Antibiotic-Resistant Bacteria (ARB) and Antibiotic-Resistance Genes (ARGs) in Environmental Samples
**Olga Nunes**
*Faculty of Engineering of the University of Porto, Portugal*

15:00 - 15:15 — Real-Time Monitoring
**Rogério Nunes Nogueira**
*Instituto de Telecomunicações, Portugal*

**15:15 - 16:00** — **Environmental and Health Impacts and Prevention Measures**

*Room Nasoni* — Chaired by **Paola Verlicchi,** University of Ferrara, Italy

15:15 - 15:30 — Ecotoxicology of Contaminants of Emerging Concern: Key Challenges and Approaches
**Miguel Santos**
*Interdisciplinary Centre of Marine and Environmental Research, Portugal*

15:30-15:45 — Understanding DBPs: Ranking, Environmental Impacts and Associated Health Risks
**Daniela Meilmann**
*DHVMED, Israel*

15:45 - 16:00 — Back to Basics: Key Principles and Approaches in Environmental Risk Assessment
**Vera Homem**
*Faculty of Engineering of the University of Porto, Portugal*

**16:00 - 16:30** — **Coffee break & Posters & Exhibition**

*Lobby*

**16:30 - 18:00** — **Technologies for Control of DBPs, CECs, PFAs, Microplastics, ARB and ARGs**

*Room Nasoni* — Chaired by **Salomé Soares**, Faculty of Engineering of the University of Porto, Portugal

## Monday, November 25, 2024 *(cont.)*

16:30 - 16:45 — Ozone Fundamentals
**Sylvie Baig**
*Suez, France*

16:45 - 17:00 — Ozone and Advanced Oxidation Processes – Key Features
**Sylvie Baig**
*Suez, France*

17:00 - 17:15 — Hybrid Adsorption/Membrane Processes for Controlling Organic Contaminants of Emerging Concern in Urban Water Treatment
**Maria João Rosa**
*Laboratório Nacional de Engenharia Civil, Portugal*

17:15 - 17:30 — Adsorption Processes for the Removal of Contaminants of Emerging Concern and Disinfection By-Products
**Dario Frascari**
*University of Bologna, Italy*

17:30 - 17:45 — Biological Removal and Recovery of Micro/plastics
**Maria Reis**
*NOVA School of Science & Technology, Portugal*

17:45 - 18:00 — Nature-Based Solutions - Natural and Constructed Wetlands to Remove Pollutants and Potentiate Water Reuse
**Marisa Almeida**
*Interdisciplinary Centre of Marine and Environmental Research, Portugal*

**18:00 - 19:00** — **CFD, LCA/LCC and Digitalization**

*Room Nasoni*

Chaired by **Susana Gonzalez Blanco** (CETAQUA, Spain) and **Domenico Santoro** (USP Technologies Canada)

18 :00 - 18:15 — Seeing the Light, the Microbes, and the Dead Zones: Computational Fluid Dynamics (CFD) for Advanced Disinfection and Oxidation Process Analysis
**Domenico Santoro**
*USP Technologies, Canada*

18:15 - 18:30 — Life Cycle Thinking Applied to Drinking Water Treatment
**Rafael Laurenti**
*IVL Swedish Environmental Research Institute, Sweden*

## Monday, November 25, 2024 *(cont.)*

18:30 - 18:45
Digitalization in the Water Sector: Development of a Reliable Real-Time Virtual Trihalomethane Sensor Solution for Drinking Water Facilities
**Susana Gonzalez Blanco**
*CETAQUA, Spain*

18:45 - 19:00
Digitalization in the Water Sector
**Lydia Vamvakeridou-Lyroudia**
*University of Exeter, United Kingdom*

19:00 - 20:00
*Looby*
**Porto de Honra (Welcome Drink)**
**Women's Engineering Tuna of the University of Porto**
(TUNAFE – Tuna Feminina de Engenharia da Universidade do Porto), Social Event 2

## Tuesday, November 26, 2024

**08:00 - 10:30**
*Room Nasoni*
**Workshop on Wastewater Treatment and Reuse - Part I**
Chaired by **Maria João Rosa** (LNEC, Portugal) and **Célia Manaia** (Universidade Católica Portuguesa, Portugal)

08:00 - 08:20
Water Reuse Strategies in Portugal
**Nuno Brôco**
*Águas do Tejo e Atlântico, Portugal*

08:20 - 08:30
Status Implementation of EU Reuse Regulation 2020/741 in Germany - Wastewater Reuse for Agriculture and Urban Irrigation
**Achiem Ried**
*Xylem, Germany*

08:30 - 08:40
The Reuse of Reclaimed Water in Italy: Polishing Treatments, Destination, Risk Assessment
**Paola Verlicchi**
*University of Ferrara, Italy*

08:40 - 08:50
Challenges Associated with Wastewater Treatment and Reuse in Brazil
**Camila Amorim**
*Federal University of Minas Gerais, Brazil*

08:50 - 09:00
Overview of the EU-India Collaboration on Water Treatment Technologies
**Suresh Pillai**
*Atlantic Technological University, Ireland*

09:00 - 09:10
Reclaimed Water Distribution: Chlorine Decay Modelling and Case Study Application
**B-WaterSmart - H2020**
**Rui Viegas**
*Laboratório Nacional de Engenharia Civil, Portugal*

## Tuesday, November 26, 2024 *(cont.)*

09:10 - 09:20 — Innovative Strategies for Industrial Wastewater Reuse: A Case Study and Practical Approaches
**Sérgio Silva**
*ADVENTECH, Portugal*

09:20 - 09:30 — An Overview of Project GIATEX - Intelligent Water Management in the Textile and Clothing Industry **GIATEX - PRR**
**Fernando Pereira**
*Faculty of Engineering of the University of Porto, Portugal*

09:30 - 09:40 — Closed-Loop Water Systems in Textile Industrial Districts: Orchestrated Removal of Emerging Pollutants from Textile Wastewater **CASCADE - Life**
**Beatrice Cantoni**
*Politecnico di Milano, Italy*

09:40 - 09:50 — AWARE - Aquaponics from Wastewater Reclamation **AWARE - Horizon Europe**
**Célia M. Manaia**
*Universidade Católica Portuguesa, Portugal*

09:50 - 10:00 — Advancing Water Purification: PANIWATER's Innovations in Tackling Contaminants of Emerging Concern for Safe Irrigation and Drinking Water **PANIWATER - India-EU H2020**
**Despo Fatta-Kassinos**
*University of Cyprus, Cyprus*

10:00 - 10:10 — Anaerobic Processes Combined with Membranes to Ensure Water Reuse and Net Energy Production
**Nicolás Morales**
*Aqualia, Spain*

10:10 - 10:30 — Round Table Discussion

**10:30 - 11:00** — **Poster Session & Coffee Break & Exhibition**
*Lobby*

**11:00 - 12:30** — **Workshop on Wastewater Treatment and Reuse - Part II**
*Room Nasoni*
Chaired by **Nuno Brôco**, Águas do Tejo e Atlântico, Portugal

## Tuesday, November 26, 2024 *(cont.)*

11:00 - 11:10 — Wastewater Regeneration by the Solar Photo-Fenton Process: From the Lab to the Plant. LIFE ULISES & LIFE PHOENIX projects **ULISES & PHOENIX - LIFE**
**José Luis Casas**
*University of Almería, Spain*

11:10 -11:20 — Demonstrating the Control of Pharmaceutical Compounds in Large Activated Sludge Wastewater Treatment Plants **Fitting - LIFE**
**Catarina Silva**
*Laboratório Nacional de Engenharia Civil, Portugal*

11:20 - 11:30 — Potential of Decentralized Wastewater Treatment for Preventing the Spread of Antibiotic Resistance, Organic Micropollutants, Pathogens and Viruses **PRESAGE - WaterJPI**
**Francisco Omil**
*University of Santiago de Compostela, Spain*

11:30 - 11:40 — Control, Treatment and Reduction of Microplastics and Emerging Pollutants in Urban Wastewater and the Transboundary Coastal Environment - The BlueWWater Project and Rede NOR-WATER – POCTEP
**BlueWWater and Rede NOR-WATER – INTERREG POCTEP**
**Patricia Quinta Pérez**
*CETMAR, Spain*

11:40 - 11:50 — Transnational Strategy for the Detection and Prevention of Water Pollution by PFAS
**ALERT-PFAS – INTERREG SUDOE**
**João M. M. Araújo**
*NOVA School of Science and Technology, Portugal*

11:50 -12:00 — Advancing Municipal Wastewater Disinfection with Novel Disinfectants and Advanced Process Control Strategies
**Domenico Santoro**
*USP Technologies, Canada*

12:00 - 12:10 — Effluent Ozonation in Urban Wastewater Treatment Plants – A Growing Opportunity To Exploit Synergies in the Activated Sludge Process
**Jan Mante**
*Air Liquide, Germany*

12:10 -12:20 — The Issues of Using Oxygen from Electrolysis for Ozone Generation
**Arnaldo Oliveira Araújo**
*Air Liquide, Portugal*

## Tuesday, November 26, 2024 *(cont.)*

12:20 - 12:30 — Preserving Fresh Produce Quality: The Crucial Role of Process Water
**Camilla Khrulova**
*Arrow Lake AB, Sweeden*

**12:30 - 14:00** — **Lunch Break**
*Lobby Atkinson*

**14:00 - 16:00** — **Co-Creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I**
*Room Nasoni*
Chaired by **Rui Martins** (University of Coimbra, Portugal) and **Maria José Farré** (ICRA, Spain)

14:00 - 14:15 — ZeroPollution4Water Cluster – Goals, Challenges and projects involved
**Loïc Charpentier**, *Water Europe , Belgium*
**Rui Martins**, *University of Coimbra, Portugal*

14:15 - 14:30 — The Regulatory Approach to Disinfection By-Products
**Luís Simas**
*Entidade Reguladora dos Serviços de Águas e Resíduos (ERSAR), Portugal*

14:30 - 14:40 — Upgrading Water Treatment Plants to Comply with the DBPs Standards Introduced by the Directive (EU) 2020/2184
**Paolo Roccaro**
*University of Catania, Italy*

14:40 - 14:50 — The Perfect Balance on Improving Water Quality by Reducing Bioproduct, while CAPEX Drops Down and Operations in Disinfection Benefits
**Vincenzo Rocca**
*Lutz Jesco GmbH, Portugal*

14:50 - 15:00 — $O_3$+BAF (Biological Activated Filter) to make Fewer Disinfection Byproducts
**Cristian Carboni**
*De Nora Water Technologies Italy S.r.l., Italy*

15:00 - 15:10 — Ozone Strong Water, an Innovative Side-Stream Injection Technology for Ozone Applications as Micropollutant Abatement and Disinfection
**Jan Mante**
*Air Liquide, Germany*

15:10 - 15:30 — DBPs - A Showcase from Around the World: Prevention Measures and Practices
**Daniela Meilmann**
*DHVMED, Israel*

## Tuesday, November 26, 2024 *(cont.)*

15:30 - 16:00 — Unravelling Consumers' Awareness and Engagement with Residential Water Quality: The Case of Disinfection By Products (DBPs)
**Evangelos Pournaras**
*University of Leeds, UK*

**16:00 - 16:30** — **Poster Session & Coffee Break & Exhibition**
*Lobby*

**16:30 - 17:30** — **Co-Creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part II**
*Room Nasoni*
Chaired by **Rui Martins** (University of Coimbra, Portugal) and **Maria José Farré** (ICRA, Spain)

16:30 - 17:15 — **RoundTable Discussion**
Topics to be Discussed: Technologies for DPBs; Preventive Measures; Public Engagement (How to Increase the Acceptance of Tap Water)
Discussion Facilitators: **Rui Martins; Evangelos Pournaras; Luísa Durães; Daniela Meilman; Luís Simas; Loïc Charpentier; Maria José Farré; Beatrice Cantoni; Paolo Roccaro; Jaume Cotolí; Miguel Lemos; Jan Mante; Cristian Carboni; Vincenzo Rocca**

17:15 - 17:30 — Take-Home Messages

**17:30 - 17:50** — **Awards Ceremony and Final Remarks**

**Ana Pereiro**, *Host and Chair, NOVA University Lisbon, Portugal*
**João Araújo**, *Host and Chair, NOVA University Lisbon, Portugal*
**Luísa Durães**, *Host and Chair, University of Coimbra, Portugal*
**Rui Martins**, *Host and Chair, University of Coimbra, Portugal*
**Rita Lado**, *Local Organizing Committee, Faculty of Engineering of the University of Porto, Portugal*
**Susana Seabra**, *Host and Chair, Sociedade Portuguesa de Inovação, Portugal*
**Vítor Vilar**, *Host and Chair, Faculty of Engineering of the University of Porto, Portugal*

**18:00 - 20:00** — **Visit to Ferreira Wine Cellars, Social Event 3**
*Lobby*

**20:00 - 02:00** — **Dinner at Sancho Panza (Cais de Gaia) & Drink at Galerias (Porto), Social Event 4**
*Ferreira Wine Cellars or WOW Main Square*

# SPEAKERS

## Workshop on Publishing Perspectives: Q&A in Chemical and Environmental Engineering Publishing

**Suresh Pillai**

Ireland

Head of Nanotechnology and Bio-Engineering Research Group, Atlantic Technological University; Executive Editor of the Chemical Engineering Journal and Results in Engineering, Elsevier

Suresh C. Pillai completed PhD from Trinity College Dublin, Ireland, and then performed his postdoctoral research at the California Institute of Technology (Caltech), USA. He is the recipient of various awards, such as 'The Boyle-Higgins Award 2019', 'The Linus Pauling Lecture Award 2020', 'The Industrial Technologies Award 2011' and 'The Enterprise Ireland Research Commercialization Award 2009'. Currently, he is Executive Editor of the journals Results in Engineering and the Chemical Engineering Journal.

***Session Chair***

**Despo Fatta-Kassinos**

Cyprus

Professor, University of Cyprus; Executive Editor of the Journal of Environmental Chemical Engineering and Editor of Water Research, Elsevier

She holds a Diploma and a PhD in Chemical Engineering from the National Technical University of Athens. Since 2003, she has attracted 14.4 million € as project coordinator/principal investigator. She is a Highly Cited Researcher since 2018. In 2022 she received the Noack Laboratorien Outstanding Science Career Award by The Society of Environmental Toxicology and Chemistry (SETAC).

***Talk: How to Become a Successful and Responsible Author: Editor Perspectives***

## Workshop on Publishing Perspectives: Q&A in Chemical and Environmental Engineering Publishing

**Giovanni Palmisano**

United Arab Emirates

**Full Professor, Khalifa University, Deputy Director of the Research and Innovation Center on $CO_2$ and Hydrogen (RICH); Executive Editor of the Journal of Environmental Chemical Engineering, Elsevier**

Giovanni Palmisano is a scholar based in Abu Dhabi since 2014, and specialized in photo(electro)catalysis applied to energy, materials functionalization, environment, and water. He is co-author of ca. 170 journal papers, 9 patents, 9 book chapters, and 7 books, including a textbook on heterogeneous catalysis. In the course of his career, he has been recipient of research awards and lately he has been listed among world's top 2% scientists by the Stanford University ranking.

***Talk: Elsevier´s Article Transfer Service and its Impact on Environmental and Chemical Engineering Journals***

## Workshop on European Directives on Drinking Water, Water Reuse and Urban Wastewater Treatment

**Loïc Charpentier**

Belgium

Water Policy Manager, Water Europe

Loïc Charpentier is the manager of the advocacy program of Water Europe, the European association of the innovative water sector. He also contributes to the communication of EU research & innovation projects on behalf of Water Europe to the European institutions and manages the MEP Water Group's secretariat. He is also involved in different European research clusters and the chairman of the Policy working group of the ZeroPollution4Water cluster. He is a member of the Brussels Sustainability Club. With a background in law and a master in European studies, Loïc worked previously at the European Association of Research and Technology organisations as policy assistant. In 2017, he received the College of Europe – Arenberg European Prize for its master thesis, a comparative study of the European integration and the creation of the federal states of Indonesia.

***Session Chair/Talk: Water Reuse in EU: Regulation on Minimum Requirements and JRC Guidelines on Risk Management Plan***

## Workshop on European Directives on Drinking Water, Water Reuse and Urban Wastewater Treatment

**Susana Rodrigues**

Portugal

Head of Quality Department, ERSAR, Entidade Reguladora dos Serviços de Águas e Resíduos

Susana Sá e Melo Rodrigues holds a PhD in Environment from NOVA School of Science and Technology (NOVA FCT). She graduated in Environmental Engineering in 2000 from Instituto Superior Técnico, Technical University of Lisbon, and has a postgraduate degree in Integrated Management and Waste Recovery from NOVA FCT (2006). With more than 20 years of professional activity in the environment area, particularly in water and waste sector, she has worked as a consultant and a technical and commercial director in the public and private sector, in central (INAG, ERSAR) and local public administrations (HPEM, SMAS de Sintra) and in leading companies in water and waste services (FBO Consultores - DHV international consultancy and engineering Group, Luságua - Aquapor Group and Ecoambiente - FomentInvest Group). She is currently head of Quality Department at ERSAR. With several publications focused on performance indicators, she is a member of the MARE Research Centre and belongs to the group of researchers Waste@nova, at FCT/UNL.

***Session Chair/Talk: EU Directive on Drinking Water: News and Challenges***

**Maria João Rosa**

Portugal

Principal Researcher, National Laboratory for Civil Engineering (LNEC)

Maria João Rosa, Principal researcher at LNEC, Head of LNEC's Urban Water Unit and coordinator of the R&D Group on Water Quality, Treatment, and Reuse. R&D and advanced consultancy projects for the water industry, water services regulator and governmental agencies, many on the control of contaminants of emerging concern in drinking water and urban wastewater treatment (LIFE Fitting, LIFE Impetus). B-WaterSmart Lisbon Living Lab mentor, international expert on water reuse (ISO, IWA).

***Talk: EU Directive on Urban Wastewater Treatment: News and Challenges***

## Workshop on European Directives on Drinking Water, Water Reuse and Urban Wastewater Treatment

**Bruno Ameduri**

France

**Senior Researcher, Institute Charles Gerhardt, CNRS**

Dr. Bruno Ameduri is a Senior Researcher (DR CNRS) at Institute Charles Gerhardt in Montpellier, France. After a MSc degree at Laval University, Quebec, Canada (1984-1986), he did an internship at IBM, San Jose, California and came back to France to start his PhD (1988); then joined CNRS the same year. His main interests focus on the synthesis and the characterization of fluorinated monomers, telomers, and copolymers for various applications such as F-elastomers, F-coatings, and F-polymers related to energy (fuel cell membranes, polymer gel electrolytes for Li-ions batteries, piezo-, ferro- or electroactive films, and nanocomposites). These new FPs have led various applications via industrial collaborations with Arkema, DuPont, Great Lakes/Chemtura, Honeywell, Pall and many academic Labs all over the world. Coauthor of seven books (a recent one on PFAS), >50 reviews or book chapters, >420 peer review publications and coinventor of more than 80 patents, he is also a member of the French Chemical Societies and is a member of the Editorial Boards of the Journal Fluorine Chemistry, European Polymer Journal, Polymer Bulletin. In 2012, he received the Award for outstanding contribution and innovation in Fluoropolymer Science and 2024 is recipient of International Prizes for Society of Polymer Science, Japan and the Asian Polymer Association. Besides Science, Bruno enjoys cycling and has some volunteered activities, dressed in clown to visit sick children in the hospitals of Montpellier and in Japan.

***Talk: On the Overall Situation of Poly- or Perfluoroalkyl Substances (PFASs) including Fluoropolymers***

## High-Throughput Methodologies for the Determination of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

**Félix Hernández**

Spain

Head of the Institute for Pesticides and Water, University Jaume I of Castelló

Prof. Félix Hernández is full Professor Analytical Chemistry, coordinator of Analytical Chemistry and Public Health research group (around 25 scientists), and head of the Institute for Pesticides and Water, Univ Jaume I, Castellón, Spain. He is also the director of the GLP-certified Laboratory of Pesticide Residue Analysis at this University. His research is focused on advanced chromatography-mass spectrometry applied to the environmental, food-safety and toxicology fields (e.g. wide-scope screening for organic pollutants in water and food based on HRMS; Wastewater-Based Epidemiology; investigation of metabolites and transformation products of organic micropollutants; illicit drugs and new psychoactive substances, metabolomics, etc). Responsible for around 60 research projects; around 400 ISI-scientific papers (h index=78); supervisor of 26 PhD.

***Session Chair***

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**Maria José Farré**

Spain

Senior Researcher, Catalan Institute for Water Research, ICRA

Dr. Maria José Farré (PhD 2007 UAB, Spain) is a research scientist and former MSCA (EC, 2014-2017) and Ramon y Cajal fellow (AEI-MICIU, 2017-2022) at the Catalan Institute for Water Research (ICRA, Spain). She has been working in the field of disinfection by-products since 2008, first at the Advanced Water Management Center (UQ, Australia) and since 2014 at ICRA. María José investigates water treatment with a multidisciplinary approach and in close collaboration with the water industry, focusing on public health, civil and environmental engineering, and analytical chemistry. She is the scientific coordinator of the Horizon Europe project into DBP "Innovative tools to control organic matter and disinfection byproducts in drinking water"

***Talk: Targeted and Non-Targeted Analysis of Disinfection Byproducts in Drinking Water***

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## High-Throughput Methodologies for the Determination of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

**José Benito Quintana**

Spain

Associate Professor, Aquatic One Health Research Center (iARCUS), University of Santiago de Compostela

Dr. José Quintana is an associate professor at the University of Santiago de Compostela since 2013, with a vast experience in the analysis and investigation on the fate of organic micropollutants in the aqueous environment. In particular, he is interested into the use of chromatography coupled to mass spectrometric techniques for persistent and mobile organic chemicals and other contaminants of emerging concern. Other topics of interest include the analysis of drugs of abuse and wastewater-based epidemiology applications. He has published over 140 articles and several book chapters and is a member of the editorial board of Science of the Total Environment and in the Belgium funding agency FWO projects pannel for chemistry.

***Talk: Analytical Methodologies for Contaminants of Emerging Concern (CECs), including Per-/Poly-FluoroAlkylated Substances (PFAS)***

**Maria Augusta Dionísio de Sousa**

Portugal

Area Manager of Organic Chemistry Laboratory, Águas e Energia do Porto, E.M.

Maria Augusta Sousa obtained her Ph.D. in Pharmaceutical Sciences – Hydrology (2013), from the Faculty of Pharmacy of University of Porto (FFUP). Concurrently, she also acted as Invited Lecturer at FFUP. From 2013 to 2015, she was a Contract Employee at the U.S. Food and Drug Administration and, in 2019, she got her MBA degree at Porto Business School. At present, M. A. Sousa is the Area Manager of Organic Chemistry, at the Laboratory of Águas e Energia do Porto, being responsible for quality control analyses and new method development and validation for the determination of different organic parameters.

***Talk: Challenges and Methodologies for Sampling and Determination of Microplastics in Wastewaters, Inland Surface Waters, and Marine Waters***

## High-Throughput Methodologies for the Determination of DBPs, CECs, PFAS, Microplastics, ARB an ARGs

**Juan Santos Echeandía**

Portugal

Senior Researcher, Spanish Institute of Oceanography, IEO-CSIC

Juan Echeandía completed his PhD at the University of Vigo (Spain) in 2009, working on the biogeochemical cycling of trace metals in seawater, from the coast to oceanic waters. After three postdoctoral periods: LEMAR-UBO (Brest, France), IPIMAR (Lisbon, Portugal) and Instituto de Investigaciones Marinas (IIM-CSIC) (Vigo, Spain), he joined the Marine Pollution Group of the Spanish Institute of Oceanography in 2016 with a permanent position. His scientific interests include biogeochemistry and trace element oceanography, including their organic speciation. In recent years he has been working on the study of interactions between microplastics and metals due to the growing interest and social concern. To date he has more than 70 publications in SCI journals, has participated as PI in several national and international projects and has supervised 3 PhD theses.

***Talk: Challenges and Methodologies for Sampling and Determination of Microplastics in Wastewaters, Inland Surface Waters, and Marine Waters***

**Olga Cristina Pastor Nunes**

Portugal

Associate Professor, Faculty of Engineering of University of Porto (FEUP)

Olga C. Nunes holds a Ph.D. in Biochemistry/Microbiology from the Faculty of Science and Technology of the University of Coimbra and is an Associate Professor at the Faculty of Engineering of University of Porto. She is a senior researcher at LEPABE, an R&D unit classified as "Excellent" by the Portuguese Science Foundation (FCT), which is part of the ALICE associate laboratory. Her research focuses on environmental microbiology, especially bioremediation and microbial ecology and biodiversity. Her main interests include the study of the effects of anthropisation on bacterial communities, the assessment of the associated impacts and methods to mitigate them. She is (co-)author of more than 145 articles in leading international scientific journals and 29 book chapters. According to Scopus, she has a *h*-index of 46 and more than 8500 citations.

***Talk: Methodologies for the Determination of Antibiotic-Resistant Bacteria (ARB) and Antibiotic-Resistance Genes (ARGs) in Environmental Samples***

## High-Throughput Methodologies for the Determination of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

**Rogério Nunes Nogueira**

Portugal

Head of Photonics, Instituto de Telecomunicações

Rogério Nogueira is Principal Research Scientist at Instituto de Telecomunicações (IT) and the national coordinator of the Optics and Photonics Thematic Line for IT. He is Vice-President/Co-founder of the Portuguese Optical Society and President of the Portuguese branch of the International Commission for Optics (ICO). He is also member elected of the Board of Stakeholders of the Photonics21 PPP. He has co-authored >500 publications including books, books chapters and 8 patents related to optical sensors and communications. Serves the scientific community by being Chair and TPC member of renowned international conferences in the field of optical sensors and optical communications. Dr Nogueira has also relevant experience in the industry. He was co-founder of Watgrid SA, Innovation manager at Nokia Siemens Networks and Coriant and was also General Director of the Creative Science Park. The research interests include design and production of optical components, optical sensors, microwave photonics and fiber optical communication systems.

***Talk: Real-Time Monitoring***

## Environmental and Health Impacts and Prevention Measures

**Paola Verlicchi**

Italy

Associate Professor, University of Ferrara

Degree in Chemical Engineering at the University of Bologna, Italy, PhD in Environmental and Safety Chemical Engineering. Assistant researcher at the University of Bologna and then of Ferrara. Associate Professor in Environmental and Sanitary Engineering at the University of Ferrara, Italy. Her main research fields include water and wastewater treatments and options for reuse, occurrence and removal of contaminants of emerging concerns (mainly pharmaceuticals) from (waste)water, hospital effluent management and treatment, environmental risk assessment, water and sanitation safety plans. Author and co-author of more than 140 peer-reviewed scientific publications. Editors of three books in Springer and Elsevier and one in Italian by Hoepli. Scientific Responsible of three European projects: H2020-SafewaterAfrica (2016-2019), H2020-MSCA Nowelties (2019-2023) and EraNET-JPI SERPIC (2019-2024). Editor of WST, special issue editor and Associate editor in STOTEN, Coeditor in chief of ENMM.

***Session Chair***

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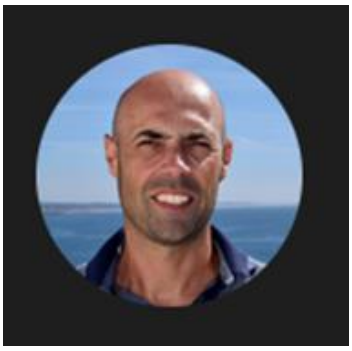

**Miguel Machado Santos**

Portugal

Assistant Professor, Faculty of Sciences of University of Porto; Group Leader (CIIMAR)

Miguel Santos is a professor at the Dept. of Biology of the Faculty of Sciences, University of Porto, and a researcher at the Interdisciplinary Centre for Marine and Environmental Research (CIIMAR) of University of Porto where he coordinates the group of Endocrine Disruptors and Emerging Contaminants, https://www.ciimar.up.pt/pt-pt/teams/endocrine-disruptors-and-emergent-contaminants/. His main focus of research has been the hazard assessment of endocrine disrupting chemicals and other priority and contaminants of emerging concern. He has been working towards the implementation of the Water Framework Directive and the Marine Strategy Framework Directive.

***Talk: Ecotoxicology of Contaminants of Emerging Concern: Key Challenges and Approaches***

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## Environmental and Health Impacts and Prevention Measures

**Daniela Meilmann**

Israel

International Business Development Director, DHVMED

Daniela has over twenty three years' experience in the field of environmental engineering and sustainability, with particular focus on compliance and operational management. An Environmental engineer by training, Daniela managed many projects worldwide covering Brazil, USA, Finland, Israel and across Europe, covering a variety of industries: Construction, Hospitality, Electronics, Housing, Manufacturing, Oil and paper industry, ICT and Telecoms in the areas of corporate sustainability, risk assessments, auditing and reporting. Over the years, she has developed rounded expertise, while working with large corporations local and national governments, SMEs, NGOs, in developing practical tools and world-class scientific methods for the assessment of KPIs that promote innovation and sustainability. Daniela (MSc from the University of Edinburgh, Scotland) is a Chartered Environmentalist and a Member of the Institute of Environmental Management and Assessment (England).

***Talk: Understanding DBPs: Ranking, Environmental Impacts and Associated Health Risks***

**Vera Maria Ferreira da Cruz Homem**

Portugal

Assistant Professor, Faculty of Engineering of University of Porto (FEUP)

Vera Homem received her PhD in Environmental Engineering from the Faculty of Engineering of University of Porto (FEUP) in 2011 and is currently an Assistant Professor at the same institution. Her research focuses on analytical chemistry, particularly instrumental analytical methods for the determination of emerging contaminants at trace levels in the environment. Her research strategy also includes the creation of an integrated and multidisciplinary approach to the treatment and management/valorisation of wastewater and sewage sludge through the detection and mitigation of emerging risks, the development of environmental risk assessment studies, prioritisation systems and plant uptake studies.

***Talk: Back to Basics: Key Principles and Approaches in Environmental Risk Assessment***

## Technologies for Control of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

**Olívia Salomé Gonçalves Pinto Soares**

Portugal

Assistant Researcher, Faculty of Engineering of University of Porto (FEUP)

Salomé Soares has a background in the field of Chemical and Environmental Engineering, focused on heterogeneous catalysis, having relevant experience in the design of nanostructured materials, metal-free, supported metal or metal oxide catalysts, as well as in their application in environmental technologies (water/wastewater treatments, abatement of air pollutants), $CO_2$ valorisation, electrochemical energy conversion, and smart textiles. She co-authored more than 160 publications in ISI-indexed papers (H-index 36) and more than 200 communications in conference proceedings and co-inventor of 4 patent applications.

***Session Chair***

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**Sylvie Baig**

France

Scientific Manager, Suez

Sylvie Baig received her degree as a chemical engineer in 1989 and obtained her PhD in 1992 from the National Superior School of Chemistry at Toulouse, France. She then joined Degrémont, subsidiary of Suez. She is currently Scientific Manager at the Suez, Engineering & Construction division. She is Editor in Chief of the Suez's Degrémont water handbook, active in the international network of scientific associations, particularly the International Ozone Association.

***Talk: Ozone Fundamentals***

***Talk:* Ozone and Advanced Oxidation Processes – Key Features**

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## Technologies for Control of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

**Maria João Rosa**

Portugal

Principal Researcher, National Laboratory for Civil Engineering (LNEC)

Maria João Rosa, Principal researcher at LNEC, Head of LNEC's Urban Water Unit and coordinator of the R&D Group on Water Quality, Treatment, and Reuse. R&D and advanced consultancy projects for the water industry, water services regulator and governmental agencies, many on the control of contaminants of emerging concern in drinking water and urban wastewater treatment (LIFE Fitting, LIFE Impetus). B-WaterSmart Lisbon Living Lab mentor, international expert on water reuse (ISO, IWA).

***Talk: Hybrid Adsorption/Membrane Processes for Controlling Organic Contaminants of Emerging Concern in Urban Water Treatment***

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**Dario Frascari**

Italy

Associate Professor, University of Bologna

Dario Frascari is Associate Professor of Chemical and Environmental Engineering at Bologna University, Italy. His research focuses on the development, modeling and scale-up of processes for the treatment and valorization of wastewater and groundwater, with specific focus on the removal of pharmaceuticals and the recovery of nutrients and antioxidants by adsorption. He is the technical coordinator of the MAR2PROTECT Horizon Europe project. He has been the scientific coordinator of the MADFORWATER Horizon 2020 project. He participated in numerous EU and national research projects. He published 49 articles in international scientific journals with IF and 8 chapters in international series and books.

***Talk: Adsorption Processes for the Removal of Contaminants of Emerging Concern and Disinfection By-Products***

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## Technologies for Control of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

**Maria Reis**

Portugal

**Full Professor, NOVA School of Science & Technology**

Maria Reis is a Full Professor in Environmental Biotechnology at FCT-UNL. Main research interests have been in the area of Environmental/Industrial BioEngineering, with special focus on the development of sustainable bioprocesses for the removal of pollutants from water and wastewater streams and for the exploitation of industrial wastes for the production of biopolymers and bulk chemicals, in the scope of circular economy. Within this research area, published more than 300 papers in scientific journals with peer review. Is co-author of 4 National patents and 6 International patents. Coordinated 20 national and international projects out of which 18 European and participated as team member in 22 research projects. Elected as IWA Fellow, September 2010. She is Editor of the Water Research (Elsevier).

***Talk: Biological Removal and Recovery of Micro/plastics***

**Marisa Almeida**

Portugal

**Senior Researcher, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR)**

Marisa Almeida is a senior researcher (PI of the Environmental Chemistry and Recovery team PhD) at Interdisciplinary Centre of Marine and Environmental Research (CIIMAR) with ca. 150 international peer review publications. Her main research area is bio- and phytoremediation, being actively involved in advancing the application of this biotechnology for the remediation of aquatic environments contaminated with different pollutants. She is also actively engaged in science outreach initiatives and is teaching at the Faculty of Science, University of Porto.

***Talk: Nature-Based Solutions - Natural and Constructed Wetlands to Remove Pollutants and Potentiate Water Reuse***

## CFD, LCA/LCC and Digitalization

**Susana González Blanco**

Spain

Water Digitalization Expert, Centro Tecnológico del Agua (Cetaqua)

Susana González, PhD in Environmental Chemistry, is currently working in Cetaqua (Water Technology Centre) as Technical responsible in the programme of drinking water production. Her research activities range in different topics within the integrated water cycle such as sensor validation for real time control of physico chemical parameters or microorganisms, monitoring of emerging contaminants or environmental risk assessment.

***Session Chair/Talk: Digitalization in the Water Sector: Development of a Reliable Real-Time Virtual Trihalomethane Sensor Solution for Drinking Water Facilities***

**Domenico Santoro**

Canada

Research Director, USP Technologies

Dr. Domenico Santoro is Research Director at USP Technologies, a Veralto company. His research interests include numerical modeling, disinfection, advanced oxidation, and filtration. His work on the kinetics of peracetic acid demand and its implications on wastewater disinfection is highly regarded. He has also developed detailed models for chemical disinfection of secondary effluent wastewater. With over 2,200 citations, Dr. Santoro's research continues to influence the field.

***Session Chair/Talk: Seeing the Light, the Microbes, and the Dead Zones: Computational Fluid Dynamics (CFD) for Advanced Disinfection and Oxidation Process Analysis***

## CFD, LCA/LCC and Digitalization

**Rafael Laurenti**

Sweden

**LCA Expert, IVL Swedish Environmental Research Institute**

Rafael's primary area of expertise resides in applied Life Cycle Assessment (LCA) and method development, particularly within the domain of durable consumer goods and circular consumption. His educational background covers a bachelor's degree in industrial engineering, a master's degree in Product Development from the University of São Paulo, and a PhD in Industrial Ecology from KTH Royal Institute of Technology.

***Talk: Life Cycle Thinking Applied to Drinking Water Treatment***

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**Lydia Vamvakeridou-Lyroudia**

United Kingdom

**Senior Researcher, KWR Water Research**

Dr Lydia S. Vamvakeridou-Lyroudia is the Director of Watershare (www.watershare.eu) and a Senior Researcher in KWR (www.kwrwater.nl) since June 2019. She has an engineering background, with expertise and research interests focusing mainly on computational modelling and hydroinformatics across a wide range of topics: Water Supply/Distribution Systems, System Dynamics Modelling, the Water-Energy-Food Nexus, Circular Economy and Artificial Intelligence for Water Systems. Before joining KWR Lydia was, since 2003, a Senior Research Fellow at the Centre for Water Systems, University of Exeter, where she is still maintaining a part-time position, working on EU-funded projects. Over the course of many years, Lydia has also developed an extensive track record and expertise in international and EU-funded projects. She is in the leading group, coordinating the ICT4WATER cluster (www.ict4water.eu), and has been playing an active role in Water Europe (https://watereurope.eu/), where she is a member of the Vision Leadership Team for Digital Water.

***Talk: Digitalization in the Water Sector***

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## Workshop on Wastewater Treatment and Reuse - Part I

**Maria João Rosa**

Portugal

Principal Researcher, National Laboratory for Civil Engineering (LNEC)

Maria João Rosa, Principal researcher at LNEC, Head of LNEC's Urban Water Unit and coordinator of the R&D Group on Water Quality, Treatment, and Reuse. R&D and advanced consultancy projects for the water industry, water services regulator and governmental agencies, many on the control of contaminants of emerging concern in drinking water and urban wastewater treatment (LIFE Fitting, LIFE Impetus). B-WaterSmart Lisbon Living Lab mentor, international expert on water reuse (ISO, IWA).

***Session Chair***

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**Célia M. Manaia**

Portugal

Associate Professor, Catholic University of Portugal

Célia Manaia is an Associate Professor at Escola Superior de Biotecnologia at Universidade Católica Portuguesa (ESB/UCP). Her research combines interests in bacterial systematics and ecology at human-environment interfaces, with particular focus on antibiotic resistance. She has a broad network of international and multidisciplinary collaborations and the recognition of her contributions has been acknowledged through invitations to projects, evaluation panels, invited lectures, or the Clarivate™ Highly Cited Researcher (2020-) award in the category Environment and Ecology. She is the President of the Committee of Ethics in Technology, Social Sciences and Humanities at the UCP (2022-), Vice-President of the Portuguese Society of Microbiology (2017-) and Vice-President of the International Committee on Systematics of Prokaryotes (2023-), responsible for the naming of prokaryotes.

***Session Chair/Talk: AWARE - Aquaponics from Wastewater Reclamation***

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## Workshop on Wastewater Treatment and Reuse - Part I

**Nuno Brôco**

Portugal

Chairman/CEO, Águas do Tejo e Atlântico

Nuno Brôco has 25 years of experience in private and public company management and is currently the Chairman and CEO of Águas do Tejo Atlântico, the AdP group largest company on wastewater management. He´s also board member of Water Europe. Previously he was Chairman and CEO of AdP VALOR, the AdP Group company responsible to foster innovation, digital transition and circular economy. During 11 years he has been Head of the Engineering Department of Águas de Portugal Group and also responsible for the Corporative Innovation in AdP Group. Starts his career with SUEZ Group, as specialist in water and wastewater treatment processes, then as Head of the Degrémont Portugal Production Department and finally as Degrémont Iberia Country Manager for Portugal.

***Talk: Water Reuse Strategies in Portugal***

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**Achim Ried**

Germany

Distinguished Engineer, Xylem

Achim Ried obtained his Diploma in Chemistry at the University of Marburg (Germany) in 1988 and his Ph.D. in Environmental Chemistry in 1992. He is member in different water related organisations e.g. IWA (Member of the German National Committee), International Ozone Association (past International President), Association of German Chemists (GDCh) and active member of working groups of German Water Associations (DWA, DVGW). His research interests are in the fields of water and wastewater treatment and Water Reuse.

***Talk: Status Implementation of EU Reuse Regulation 2020/741 in Germany - Wastewater Reuse for agriculture and urban irrigation***

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## Workshop on Wastewater Treatment and Reuse - Part I

**Paola Verlicchi**

Italy

Associate Professor, University of Ferrara

Degree in Chemical Engineering at the University of Bologna, Italy, PhD in Environmental and Safety Chemical Engineering. Assistant researcher at the University of Bologna and then of Ferrara. Associate Professor in Environmental and Sanitary Engineering at the University of Ferrara, Italy. Her main research fields include water and wastewater treatments and options for reuse, occurrence and removal of contaminants of emerging concerns (mainly pharmaceuticals) from (waste)water, hospital effluent management and treatment, environmental risk assessment, water and sanitation safety plans. Author and co-author of more than 140 peer-reviewed scientific publications. Editors of three books in Springer and Elsevier and one in Italian by Hoepli. Scientific Responsible of three European projects: H2020-SafewaterAfrica (2016-2019), H2020-MSCA Nowelties (2019-2023) and EraNET-JPI SERPIC (2019-2024). Editor of WST, special issue editor and Associate Editor in STOTEN, Coeditor in chief of ENMM.

***Talk: The Reuse of Reclaimed Water in Italy: Polishing Treatments, Destination, Risk Assessment***

## Workshop on Wastewater Treatment and Reuse - Part I

**Camila Amorim**

Brazil

Associate Professor, Federal University of Minas Gerais

Prof. Camila Amorim is an Environmental Engineer with a PhD degree in Sanitation, Environment and Water Resources (Federal University of Minas Gerais, Brazil). Since 2010, Dr. Amorim has been an Associate Professor at the Department of Sanitary and Environmental Engineering/UFMG where she is involved with teaching (undergraduate and graduate levels) and research activities. Dr. Amorim has been the head of the Research Group on Environmental Application of Advanced Oxidation Processes GruPOA since 2011. As a leader, she guides research on the development and application of different advanced oxidation processes applied to water and wastewater (domestic and non-domestic, including hospital effluents) treatment focusing on disinfection, removal of antimicrobial resistant bacteria and genes as well as contaminants of emerging concern (CEC) to improve effluent quality for reuse in agriculture. Her researchers also focus on environmental monitoring, water and wastewater treatment, and environmental assessment impact. She has coordinated the Aneel/CEMIG Research and Development project on the use of multispectral sensors to monitor water quality in hydroelectric reservoirs. Currently, she is the coordinator the Petrobras Research and Development Project on innovative strategies for management and recovery of aquatic ecosystems for the supply the oil and gas industry: diagnosis, monitoring, mitigation and prevention of anthropogenic pressures and hydrological risks.

***Talk: Challenges Associated with Wastewater Treatment and Reuse in Brazil***

## Workshop on Wastewater Treatment and Reuse - Part I

**Suresh Pillai**

Ireland

**Head of Nanotechnology and Bio-Engineering Research Group, Atlantic Technological University**

Suresh C. Pillai completed PhD from Trinity College Dublin, Ireland and then performed his postdoctoral research at the California Institute of Technology (Caltech), USA. He is the recipient of various awards, such as 'The Boyle-Higgins Award 2019', 'The Linus Pauling Lecture Award 2020', 'The Industrial Technologies Award 2011' and 'The Enterprise Ireland Research Commercialization Award 2009'. Currently, he is Executive Editor for the journals *Results in Engineering and the Chemical Engineering Journal.*

***Talk: Overview of the EU-India Collaboration on Water Treatment Technologies***

**Rui M.C. Viegas**

Portugal

**Assistant Researcher, National Laboratory for Civil Engineering (LNEC)**

Rui Viegas, PhD in Chemical Engineering, Assistant Researcher at LNEC in the Urban Water Unit. He has participated/led several EU and Portuguese projects and published work on: (i) water & wastewater quality, treatment & reuse; (ii) advanced water treatment modelling & optimization (membranes, adsorption, hybrid processes) for emerging contaminants control; (iii) Water quality & safety in distribution systems. ISO/TC 282 – water reuse expert.

***Talk: Reclaimed Water Distribution: Chlorine Decay Modelling and Case Study Application | B-WaterSmart - H2020***

## Workshop on Wastewater Treatment and Reuse - Part I

**Sérgio M. Castro-Silva**

Portugal

CEO, ADVENTECH

Sérgio Castro-Silva is the Founder and Chief Executive Officer of ADVENTECH - Advanced Environmental Technologies, Lda since 2008. He is also the Chief of R&D Department of this company. Coordinator of the development of new products and projects of WWTP's (WasteWater Treatment Plants). Graduate in Chemical Engineering by the University of Coimbra (1997).

***Talk: Innovative Strategies for Industrial Wastewater Reuse: A Case Study and Practical Approaches***

**Manuel Fernando Ribeiro Pereira**

Portugal

Full Professor, Faculty of Engineering of University of Porto (FEUP)

M. Fernando R. Pereira is Full Professor and head of the Chemical Engineering Department at the Faculty of Engineering, University of Porto (FEUP). He is the coordinator of the LCM (member of the LSRE-LCM research unit) from 2020, coordinator of the thematic line Environment at ALiCE – Associate Laboratory in Chemical Engineering. His main research interests are heterogeneous catalysis, carbon materials, advanced oxidation processes, environment and energy, biomass conversion, functional materials and smart textiles. In these areas, he has supervised 25 PhDs, coordinated 27 research projects, published 393 scientific papers, n° of citations is 24784, and the H-index is 80 (Scopus, 5/2024).

***Talk: An Overview of Project GIATEX - Intelligent Water Management in the Textile and Clothing Industry***

## Workshop on Wastewater Treatment and Reuse - Part I

**Beatrice Cantoni**

Italy

Junior-Assistant Professor, Polytechnic University of Milan

Since her PhD, obtained in 2021, she has been working on human and environmental risks and treatments of emerging contaminants in water. She grew her international network through two PhD visiting periods at KWR and German Environmental Protection Agency, and a Post-Doc at University of Western Ontario in Canada. Involved in several international and national research projects, she is Chair of the Italian Young Water Professionals network of IWA.

***Talk: Closed-Loop Water Systems in Textile Industrial Districts: Orchestrated Removal of Emerging Pollutants from Textile Wastewater***

**Despo Fatta-Kassinos**

Cyprus

Professor, University of Cyprus

She holds a Diploma and a PhD in Chemical Engineering from the National Technical University of Athens. Since 2003, she has attracted 14.4 million € as project coordinator/principal investigator. She is a Highly Cited Researcher since 2018. In 2022 she received the Noack Laboratorien Outstanding Science Career Award by The Society of Environmental Toxicology and Chemistry (SETAC).

***Talk: Advancing Water Purification: PANIWATER's Innovations in Tackling Contaminants of Emerging Concern for Safe Irrigation and Drinking Water***

## Workshop on Wastewater Treatment and Reuse - Part I

**Nicolás Morales**

Spain

**Project Manager at R&D Department. Aqualia**

Nicolás Morales is a Chemical Engineer. He holds a PhD in Chemical and Environmental Engineering from the University of Santiago de Compostela. In 2012 he joined Aqualia as a R&D technician at the innovation and technology department. Since 2016 he has been project manager for several competitive research projects subsidized by different national and international entities. He is the co-author of 7 book chapters, 1 international patent, and 50 communications in national and international scientific journals and conferences.

***Talk: Anaerobic Processes Combined with Membranes to Ensure Water Reuse and Net Energy Production***

## Workshop on Wastewater Treatment and Reuse - Part II

**Nuno Brôco**

Portugal

Chairman/CEO, Águas do Tejo e Atlântico

Nuno Brôco has 25 years of experience in private and public company management and is currently the Chairman and CEO of Águas do Tejo Atlântico, the AdP group largest company on wastewater management. He´s also board member of Water Europe. Previously he was Chairman and CEO of AdP VALOR, the AdP Group company responsible to foster innovation, digital transition and circular economy. During 11 years he has been Head of the Engineering Department of Águas de Portugal Group and also responsible for the Corporative Innovation in AdP Group. Starts his career with SUEZ Group, as specialist in water and wastewater treatment processes, then as Head of the Degrémont Portugal Production Department and finally as Degrémont Iberia Country Manager for Portugal.

***Session Chair***

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**José Luis Casas López**

Spain

Professor, University of Almería; Director, Solar Energy Research Center (CIESOL)

Professor of Environmental Chemical Engineering at the University of Almeria. Director of the Solar Energy Research Centre since 2022 and member of the research group "Bioprocess Engineering and Water Technologies" since its creation. Member of the Advisory Board of the Aqualia Chair of the Integral Water Cycle since 2022. He holds a degree in Chemical Sciences from the University of Almeria (1998) and a PhD in Chemical Engineering from the same institution (2004). He was awarded the Extraordinary Doctorate Award in 2004. He has participated in 23 research projects, mostly devoted to water treatment, in regional, national and European calls, directing six of them, three European, one national and two regional projects. He has also participated in 13 contracts with companies, directing four of them. He has supervised six doctoral theses since 2006. In the Scopus platform, he has 72 publications, with more than 2700 citations and an h-index of 31.

***Talk: Wastewater Regeneration by the Solar Photo-Fenton Process: From the Lab to the Plant. LIFE ULISES & LIFE PHOENIX Projects***

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## Workshop on Wastewater Treatment and Reuse - Part II

**Catarina Silva**

Portugal

Assistant Researcher, National Laboratory for Civil Engineering (LNEC)

Catarina Silva. Environmental Engineer (2006). PhD in Environmental engineering (2016). Assistant researcher at LNEC – the National Civil Engineering Laboratory, in the Urban Water division of the Hydraulics and Environment Dept. She has 17-years experience in performance assessment and benchmarking of water and wastewater treatment plants, with special focus on energy efficiency and control of contaminants of emerging concern, and strategic asset management.

***Talk: Demonstrating the Control of Pharmaceutical Compounds in Large Activated Sludge Wastewater Treatment Plants - LIFE Fitting***

**Francisco Omil**

Spain

Full Professor, University of Santiago de Compostela

Full Professor in the Dept. of Chemical Engineering of the University of Santiago de Compostela (Spain) since 2010. My research activities are focused on the development of processes based on bioreactors for the treatment of urban and industrial wastewater (removal of conventional and emerging pollutants such as organic micropollutants, drugs, recalcitrant compounds). Besides, I have been deeply involved in university management: ViceDean of the School of Engineering (2012-2018) and Coordinator of the MSc in Environmental Engineering since 2008. I have spent around 3 years in private companies (1991-1993).

***Talk: Potential of Decentralized Wastewater Treatment for Preventing the Spread of Antibiotic Resistance, Organic Micropollutants, Pathogens and Viruses (PRESAGE Project)***

## Workshop on Wastewater Treatment and Reuse - Part II

**Patricia Quintas Pérez**

Spain

Technician of the Control and Management of the Marine Environment Department, Centro Tecnológico del Mar – Fundación CETMAR

Dr. Patricia Quintas Pérez. Technician at the Technology Centre of the Sea (Centro Tecnológico del Mar- Fundación CETMAR) - Dept. Control and Management of the Environmental and the Marine Resources - as project manager of the BlueWWater project focused on emerging pollutants in the aquatic environment. She holds a PhD in Marine Science (University of Vigo) focused on benthic communities and a Master's Degree in "Social Communication of Scientific Research" (International University of Valencia - VIU). Before joining CETMAR, she worked as project manager (UVIGO, 2017) and as technician at the Spanish Institute of Oceanography (IEO, 2019-2022) where she promoted the creation of the Scientific Culture and innovation Unit (UCC+I IEO). Her professional background as researcher was focused on two research lines: benthic communities (UVIGO) and seahorse culture (Institute of Marine Research, IIM-CSIC).

***Talk: Control, Treatment and Reduction of Microplastics and Emerging Pollutants in Urban Wastewater and the Transboundary Coastal Environment – The BlueWWater Project and Rede NOR-WATER - POCTEP***

## Workshop on Wastewater Treatment and Reuse - Part II

**João M.M. Araújo**

Portugal

Senior Researcher, NOVA School of Science and Technology

Doctor in Chemical Engineering (PhD Dec. 2009), Senior Researcher (since 01-03-2015). Author of 75+ publications in international peer reviewed journals (Index H = 33, H10 = 62, 4383 citations), 73 proceedings in national/international conferences, 225+ contributions in national/international conferences (24 invited oral communications, 72 oral communications and 130 poster communications). He has participated in 25 funded projects (4 of them EU, as coordinator/co-coordinator). His research experience encompasses areas from liquid chromatography field, mainly in the intensification of the simulated moving bed technology, to the development of ionic liquids and eutectic systems as novel, advanced, smart materials (critical evaluation in the field of green chemistry) and their study in separation/purification processes, aqueous biphasic systems, solubilisation and aggregation mechanisms, biomass valorisation, drug delivery, as well as the development of pharmaceutically active ionic liquids and eutectic systems. Additionally, it focuses on the development of technologies for the removal and implementation of circular economy for fluorinated compounds (greenhouse fluorinated gases (F-gases) and PFAS).

***Talk: ALERT-PFAS: Transnational Strategy for the Detection and Prevention of Water Pollution by PFAS***

## Workshop on Wastewater Treatment and Reuse - Part II

**Domenico Santoro**

Canada

**Research Director, USP Technologies**

Dr. Domenico Santoro is Research Director at USP Technologies, a Veralto company. His research interests include numerical modeling, disinfection, advanced oxidation, and filtration. His work on the kinetics of peracetic acid demand and its implications on wastewater disinfection is highly regarded. He has also developed detailed models for chemical disinfection of secondary effluent wastewater. With over 2,200 citations, Dr. Santoro's research continues to influence the field.

***Talk: Advancing Municipal Wastewater Disinfection with Novel Disinfectants and Advanced Process Control Strategies***

**Jan Mante**

Germany

**International Senior Expert Water treatment, Air Liquide**

Jan was born in Berlin, where he also studied process engineering as well as environmental engineering. In 2007 he joined the Air Liquide team of application specialists dealing with the use of technical gases such as oxygen, $CO_2$ and ozone in the field of water treatment. Today as International Senior Expert he has led numerous large-scale ozonation projects and was substantially involved in the development of the Ozone Strong Water technology.

***Talk: Effluent Ozonation in Urban Wastewater Treatment Plants – A Growing Opportunity to Exploit Synergies in the Activated Sludge Process***

## Workshop on Wastewater Treatment and Reuse - Part II

**Arnaldo Oliveira Araújo**

Portugal

International Senior Expert Pulp&Paper/Water Treatment, Air Liquide

Arnaldo was born in Lisbon, where he studied Chemical Engineering and did an MBA. After 6 years working in a pulp mill, in 1995 he joined the Air Liquide team of application specialists dealing with the use of industrial gases such as oxygen, $CO_2$ and ozone in the field of Pulp&Paper and water treatment. As an Air Liquide International Senior Expert he led large-scale white liquor oxidation projects and ozone projects and is also involved in developing effluent treatment technologies involving industrial gases. He wrote also several patents relating to the application of industrial gases, from the agro-food sector, environmental area and pulp and paper.

***Talk: The Issues of Using Oxygen from Electrolysis for Ozone Generation***

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**Camilla Khrulova**

Sweden

Head of Food, JC Environment AB, Arrow Lake AB

Camilla Khrulova, MBA. Advancing controlled ozone solutions in the food industry for over 10 years. ESG goal 12.3 champion, ensuring the reduction of product loss, while preserving the water resources. Founder of JC Environment Head of food and beverage at Arrow Lake AB. Patent holder System and method for treating a food item" (EP3987939A1).

***Talk: Preserving Fresh Produce Quality: The Crucial Role of Process Water***

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## Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I and Part II

**Rui C. Martins**

Portugal

Associate Professor, University of Coimbra (UC)

Rui C. Martins, PhD in Chemical Engineering is an Associate Professor at the University of Coimbra, specializing in Chemical Engineering with a focus on environmental remediation through Separation and Reaction Engineering. Martins has significant contributions in water treatment including 9 book chapters, 147 articles in international peer-reviewed journals, and a patented innovation. He co-founded Adventech, a spin-off from the University of Coimbra, and in 2019, he co-founded Envitecna, both dedicated to environmental technology development. Martins has been involved in 21 funded projects and has coordinated several, including the Horizon Europe project - H2OforAll: Innovative integrated tools and technologies to protect and treat drinking water from disinfection byproducts (DBPs)

***Session Chair/RoundTable Moderator***

***Talk: ZeroPollution4Water Cluster – Goals, Challenges and Projects Involved***

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**Maria José Farré**

Spain

Senior Researcher, Catalan Institute for Water Research (ICRA)

Dr. Maria José Farré (PhD 2007 UAB, Spain) is a research scientist and former MSCA (EC, 2014-2017) and Ramon y Cajal fellow (AEI-MICIU, 2017-2022) at the Catalan Institute for Water Research (ICRA, Spain). She has been working in the field of disinfection by-products since 2008, first at the Advanced Water Management Center (UQ, Australia) and since 2014 at ICRA. María José investigates water treatment with a multidisciplinary approach and in close collaboration with the water industry, focusing on public health, civil and environmental engineering, and analytical chemistry. She is the scientific coordinator of the Horizon Europe project intoDBP "Innovative tools to control organic matter and disinfection byproducts in drinking water"

***Session Chair/RoundTable Moderator***

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## Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I and Part II

**Loïc Charpentier**

Belgium

Water Policy Manager, Water Europe

Loïc Charpentier is the manager of the advocacy program of Water Europe, the European association of the innovative water sector. He also contributes to the communication of EU research & innovation projects on behalf of Water Europe to the European institutions and manages the MEP Water Group's secretariat. He is also involved in different European research clusters and the chairman of the Policy working group of the ZeroPollution4Water cluster. He is a member of the Brussels Sustainability Club. With a background in law and a master in European studies, Loïc worked previously at the European Association of Research and Technology organisations as policy assistant. In 2017, he received the College of Europe – Arenberg European Prize for its master thesis, a comparative study of the European integration and the creation of the federal states of Indonesia.

***Talk: ZeroPollution4Water Cluster – Goals, Challenges and Projects Involved***

***RoundTable Speaker***

**Luís Simas**

Portugal

Board Adviser, ERSAR

He has a degree in Biochemistry from the Faculty of Sciences of the University of Lisbon and a postgraduate qualification in Water Quality and Pollution Control from the Faculty of Sciences and Technology of the University of Coimbra. Between 1995 and 2004 he was a laboratory technician for the control of water quality for human consumption at the Municipal Services of Santarém and since 2004 he has worked at ERSAR (the Portuguese regulator of water and waste services) and is currently an advisor to the Board of Directors of this regulatory body.

***Talk: The Regulatory Approach to Disinfection By-Products***

***RoundTable Speaker***

## Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I and Part II

**Paolo Roccaro**

Italy

Full Professor, University of Catania

Paolo Roccaro is full Professor of Sanitary and Environmental Engineering at the University of Catania (Italy). He has been Fulbright Scholar at the University of Arizona, Tucson and Visiting Scientist at the University of Washington, Seattle. His research is focused on formation and control of DBPs, removal and control of CEC in water and wastewaters systems, wastewater reuse, modeling trace contaminants in water by spectroscopy, real-time monitoring of CEC.

***Talk: Upgrading Water Treatment Plants to Comply with the DBPs Standards Introduced by the Directive (EU) 2020/2184***

***RoundTable Speaker***

**Vincenzo Rocca**

Portugal

Areas Sales Manager, Lutz-Jesco GmbH

Chemical process engineer (Italy), now in Lutz-Jesco GmbH as area manager for Portugal and Spain, and Legionella Water Treatment advisor. Previously in s:can GmbH: as area manager for Portugal, Central East Europe, Israel, Russia, Brazil; in Grundfos as dosing & disinfection program manager for Europe, Middle East, Africa and Russia; also in Envambien SA (founder), in Pirelli HQ in Italy (R&D), Tupperware, other multinationals industrial groups.

***Talk: The Perfect Balance on Improving Water Quality by Reducing Bioproduct, while CAPEX Drops Down and Operations in Disinfection Benefits***

***RoundTable Speaker***

## Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I and Part II

**Cristian Carboni**

Italy

**Business Development Manager, De Nora Water Technologies Italy, S.R.L.**

25 years of experience in water and wastewater treatment technologies, particularly concerning disinfection.

Author of numerous scientific publications and reviewer of scientific journals.

Member of the scientific committee of Polo Agrifood; Board of Directors of the International Ozone Association; Board member of the Lombardy Energy Cleantech Cluster (LE2C). External expert of the European Innovation Council and Executive Agency for SMEs (EISMEA).

***Talk: $O_3$+BAF (Biological Activated Filter) to Make Fewer Disinfection Byproducts***

***RoundTable Speaker***

**Jan Mante**

Germany

**International Senior Expert Water Treatment, Air Liquide**

Jan was born in Berlin, where he also studied process engineering as well as environmental engineering. In 2007 he joined the Air Liquide team of application specialists dealing with the use of technical gases such as oxygen, $CO_2$ and ozone in the field of water treatment. Today as International Senior Expert he has led numerous large-scale ozonation projects and was substantially involved in the development of the Ozone Strong Water technology.

***Talk: Ozone Strong Water, an Innovative Side-Stream Injection Technology for Ozone Applications as Micropollutant Abatement and Disinfection***

***RoundTable Speaker***

## Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I and Part II

**Daniela Meilmann**

Israel

International Business Development Director, DHVMED

Daniela has over twenty three years' experience in the field of environmental engineering and sustainability, with particular focus on compliance and operational management. An Environmental engineer by training, Daniela managed many projects worldwide covering Brazil, USA, Finland, Israel and across Europe, covering a variety of industries: Construction, Hospitality, Electronics, Housing, Manufacturing, Oil and paper industry, ICT and Telecoms in the areas of corporate sustainability, risk assessments, auditing and reporting. Over the years, she has developed rounded expertise, while working with large corporations local and national governments, SMEs, NGOs, in developing practical tools and world-class scientific methods for the assessment of KPIs that promote innovation and sustainability. Daniela (MSc from the University of Edinburgh, Scotland) is a Chartered Environmentalist and a Member of the Institute of Environmental Management and Assessment (England).

***Talk: DBPs - A Showcase from Around the World: Prevention Measures and Practices***

***RoundTable Speaker***

## Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I and Part II

**Evangelos Pournaras**

United Kingdom

Professor, University of Leeds

Dr. Evangelos Pournaras is Professor of Trustworthy Distributed Intelligence in the School of Computing at University of Leeds. He is also a UKRI Future Leaders Fellow (£1.4M), a Research Associate at the UCL Center of Blockchain Technologies and has also been an Alan Turing Fellow. Evangelos has more than 5 years of research experience at ETH Zurich after having completed his PhD studies at Delft University of Technology. Evangelos has also been a visiting researcher at EPFL and has industry experience at IBM T.J. Watson Research Center. Evangelos has won the Augmented Democracy Prize, the 1st prize at ETH Policy Challenge as well as 5 paper awards and honors, including the listing of two of his project within UNESCO IRCAI Global Top-100 as `outstanding' and `promising'. He has published more than 100 peer-reviewed papers in high impact journals and conferences. Evangelos has extensive leadership experience and raised funding for national and EU projects such as H2OforAll, ASSET and SoBigData.

***Talk: Unravelling Consumers' Awareness and Engagement with Residential Water Quality: The Case of Disinfection By Products (DBPs)***

***RoundTable Speaker***

## Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part II

**Luísa Durães**

Portugal

Associate Professor, University of Coimbra, CERES

Luisa Durães concluded her PhD in Chemical Engineering in 2008, and is currently Associate Professor at the University of Coimbra. She is also full member of CERES research unit. She specialized in the design, synthesis and surface modification of nanostructured materials (aerogels, core-shell and/or porous nanoparticles, films), by sol-gel technology and other soft solution approaches for multiple applications in the environment, energy and biomedical areas. She participated in 26 research projects, many of them aiming the development of modified and reinforced silica aerogels for thermal insulation and environmental remediation, which she coordinated. Her scientific record of publications was already recognized by its high citation impact by journals and the University of Stanford. Her innovative ideas were also distinguished in several technology competitions.

***RoundTable Speaker***

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# ABSTRACTS

## Invited Speakers

# Workshop on Publishing Perspectives: Q&A in Chemical and Environmental Engineering Publishing

## How to Become a Successful and Responsible Author: Editor Perspectives

**D. Fatta-Kassinos**. University of Cyprus, Nicosia, Cyprus, *dfatta@ucy.ac.cy*


In this talk, we'll explore the journey of publishing scholarly work, from initial ideation to ethical considerations. Understanding the importance of publication in advancing one's career and contributing to knowledge, we'll delve into practical steps: selecting the right journal, defining authorship criteria, and upholding research integrity. We'll discuss typical article structures and the peer review process, emphasizing the importance of clarity and rigor. Additionally, we'll touch on open access publishing and ethical guidelines to ensure credibility and transparency. This talk aims to equip researchers with the necessary tools to navigate the complex publishing landscape with integrity, ultimately fostering the advancement of scholarship and the dissemination of reliable scientific information.

## Elsevier´s Article Transfer Service and Its Impact on Environmental and Chemical Engineering Journals

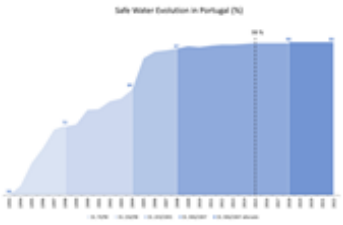
***G. Palmisano[1], L. Coelho[2]. (1) Department of Chemical and Petroleum Engineering, Research and Innovation Center on $CO_2$ and Hydrogen (RICH), Khalifa University, Abu Dhabi, United Arab Emirates,*** giovanni.palmisano@ku.ac.ae***. (2) Elsevier, Environmental Science and Chemical Engineering Journals, The Netherlands.***

The talk will discuss the steps following the rejection of a submitted article in Elsevier journals, with a particular focus on Chemical and Environmental Engineering journals. The role of executive editors, editors, and scientific managing editors will be discussed, along with the different options provided to authors whose papers have been rejected either pre- or post-review.

# Workshop on European Directives on Drinking Water, Water Reuse and Urban Wastewater Treatment

## EU Directive on Drinking Water: News and Challenges

***S. Rodrigues. Entidade Reguladora dos Serviços de Águas e Resíduos (ERSAR), Lisbon, Portugal,*** *susana.rodrigues@ersar.pt*



Safe drinking water indicator in Portugal, improved 39% between 1933 and today, resulting on a 99% complying with the quality control frequencies and parameters according to the European requirements, including all water supply zones, despite their size. Decree law No. 69/2023, 21 august, transposed the Directive (EU) 2020/2184, introducing challenges to the drinking water quality control: i) updating quality standards at EU level (e.g. PFAS, microplastics, endocrine disruptors), ii) implementing risk-based approach along the entire system, from the catchment areas to the tap (including Legionella and lead in priority facilities), iii) products in contact with drinking water regulation, iv) water leakage levels assessment and v) access to water and consumer information requirements, established the need to promote a strong coordination between stakeholders on different requirements and Directives implementation (DWD, WFD, UWTD). Emerging compounds and precautionary principle application, at the root of this directive, makes the balance on monitoring efforts the biggest challenge.

## Water Reuse in EU: Regulation on Minimum Requirements and JRC Guidelines on Risk Management Plan

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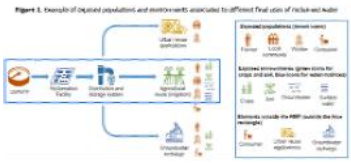

This presentation will present the European policy debate around water reuse and the current legislative architecture for water reuse in the European Union. Providing guidance for the establishment of the Risk Management Plan (Article 5 of the Water Reuse Regulation), the JRC Guidelines on risks management provide is the main document to advise on the development of a Risk Management Plan for a water reuse system. Updated in 2022, the document also includes recommendations related to disinfectants by-products. In line with the ZeroPollution4WaterCluster activities, the presentations will zoom on the potential benefits of the projects to leverage water reuse in Europe.

# EU Directive on Urban Wastewater Treatment: News and Challenges

*M.J. Rosa, M. Campinas, C. Silva. LNEC – Laboratório Nacional de Engenharia Civil, Urban Water Unit, Av Brasil 101, 1700-066 Lisbon, Portugal,* mjrosa@lnec.pt

UWWTD recast: what's new?


Last January 2024, the European Commission, the European Parliament and the Council agreed on the new text of the Urban Wastewater Treatment Directive (UWWTD), whose final voting/approval is planned for late 2024. The revision of the 33-year-old UWWTD considers a phased implementation until 2045 and was based on a risk approach, i.e. larger agglomerations/facilities first (≥ 100,000 or 150,000 p.e.), smaller (≥ 10,000 p.e) only where there is a risk. As expected, it introduces many, big changes, both in terms of water quality/treatment level required/polluter-pays principle and on energy/climate & circular economy. Highlights include energy audits, energy neutrality and GHG monitoring, water reuse as a water resilience strategy, sludge valorisation and resource recovery (nitrogen, N, and particularly phosphorus, P), integrated management of stormwater and wastewater, secondary treatment for smaller agglomerations (from 2000 to 1000 p.e.), reinforced tertiary treatment/lower N and/or P targets (one or both, depending on the plant size and the trigger nutrient for eutrophication), quaternary treatment for micropollutants control, co-financed by the pharmaceutical and cosmetics industry through the extended producer responsibility mechanism, monitoring of PFAS and microplastics, vigilance of viruses & relevant pathogens and of antibiotic resistance. The UWWTD recast raises many challenges but, at the same time, opportunities for the water sector and for the economy & society in general, as will be discussed.

# On the Overall Situation of Poly-or Perfluoroalkyl substances (PFAS) including Fluoropolymers

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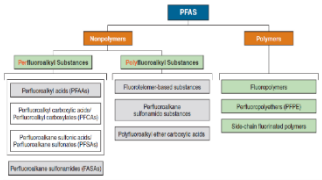
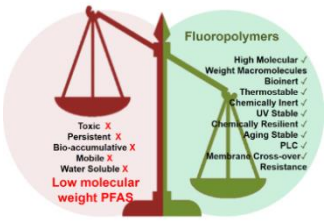


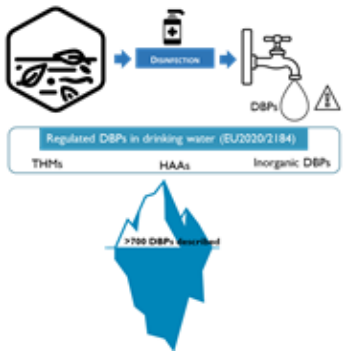




Poly- or perfluoroalkyl substances (PFASs) are divided into two main families, differentiated by their molecular weights (MWs) (graphical abstract). The first one deals with non-polymers, oligomers or specific polymers bearing fluorinated side moieties. They have undergone major issues of bioaccumulation, persistency, toxicity and mobility, either intrinsically because of their low MW-structure or after some degradation (e.g., hydrolytic hydrolysis of ester functions in poly[(meth)acrylate]s releasing polyfluorinated groups). These specific PFASs are under severe restricted (several of them being banned) and drastic regulations are currently proceeding. In contrast, fluoropolymers (FPs), endowed with outstanding properties and involved in High Tech applications are not prone to face such hazardous limitations. They have high molar-masses and are non-mobile, non-bioaccumulative, non-toxic and do not cross the human cellular membrane, hence fulfilling the PLC criteria. Indeed, though the global production of FPs is only ca. 0.1% of plastics, its growth rate is 6-8%. Much progress has been made in the last decade where several FP manufacturers have modified their production using non-fluorinated polymerization aids (or surfactants) and reducing their aqueous and gaseous emissions drastically. In addition, major actors working on the energetic transition are taking FPs more and more into account (fuel cell membranes, binders for Lithium-ion batteries, backsheets for PVs, and electroactive FPs as key-examples), as well as their recycling.

## High-Throughput Methodologies for the Determination of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

### Targeted and Non-Targeted Analysis of Disinfection ByProducts in Drinking Water

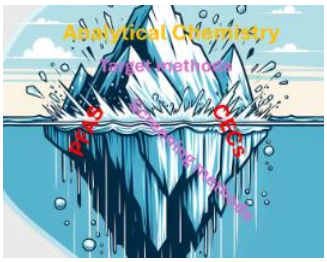
*M.J. Farré. ICRA, Emili Grahit, 101, Girona Spain.*




Unintentional formation of disinfection byproducts (DBPs) through interactions of water constituents with chemical reagents used for treatment are emerging as hazardous chemical risks that affect human health. The Drinking Water Directive states that Member States shall take all measures necessary to ensure that any contamination from DBPs is kept as low as possible without compromising disinfection, and regulates few species. However, many non-regulated DBPs may pose a greater health risk than regulated DBP species. Hence, there is a need for understanding DBP formation and find better indicators for their presence; this should be combined with an improved real-time monitoring strategy to cater to the diversity of possible DBPs generated by in different treatment approaches. This presentation will present different analytical methodologies to investigate DBP formation in drinking water samples though targeted and non-targeted strategies.

## Analytical Methodologies for Contaminants of Emerging Concern (CECs), including Per-/Poly-Fluoroalkylated Substances (PFAS)

*J.B. Quintana. Aquatic One Health Research Center (iARCUS), Department of Analytical Chemistry, Nutrition and Food Chemistry, Universidade de Santiago de Compostela, Santiago de Compostela, Spain.*




The number of micropollutants that impair the quality of water resources seems to be continuously growing. This is just a consequence of the improved analytical capabilities and recently proven effects over environmental and human health. Such chemicals have been named as contaminants of emerging concern (CECs), referring to those chemicals not (sufficiently) regulated. Yet, some of them have reached the regulatory level and gained particular attention, as it is the case of per-/poly-fluoroalkylated substances (PFAS). In this talk, I will discuss the different targeted and non-targeted approaches for the analytical determination of CECs and PFAS in the water environment. Concepts related with their extraction and preconcentration, determination by chromatographic methods hyphenated to low-resolution and high-resolution mass spectrometric techniques, as well appropriate validation and quality control will be covered. Besides, current and upcoming regulatory framework (e.g. water-framework and wastewater directives) will also be considered.

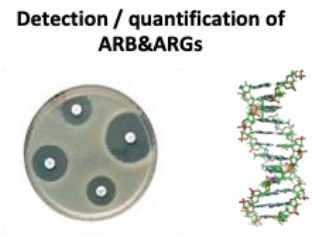
## Challenges and Methodologies for Sampling and Determination of Microplastics in Wastewaters, Inland Surface Waters, and Marine Waters

***Juan Santos-Echeandía[1], Maria Augusta Sousa[2]. (1) Spanish Institute of Oceanography (IEO-CSIC), Subida a Rafio Faro 50-52, Vigo, Spain,*** *juan.santos@ieo.csic.es.* ***(2) Águas e Energia do Porto, Rua Barão de Nova Sintra, 285 / 4300-367, Porto, Portugal.***


Microplastics (MPs) are tiny plastic particles, that measure less than five millimeters across. They are extremely persistent and have an ubiquitous distribution. The need to determine their concentrations in the environment, in the face of growing concern, has led to sampling methodologies and protocols that are not homogeneous and standardized. In this work, two complementary analytical methodologies will be employed to characterize different water matrices, in terms of MPs' content. Laser Direct Infrared (LDIR) Chemical Imaging System brings unprecedented speed of analysis and ease of use to analytical challenges, such as microplastics in environmental samples. It gives information on particle sizes, distribution, and identification (polymer) of microplastics. Pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS) is another technique, that provides both qualitative and quantitative data on microplastic mixtures. A new method has been developed for the determination of twelve types of synthetic polymers, and further automated with the use of F-Search MPs software, in order to establish a standardized procedure for MPs' analysis.

## Methodologies for the Determination of Antibiotic-Resistant Bacteria (ARB) and Antibiotic-Resistance Genes (ARGs) in Environmental Samples

***O.C. Nunes. LEPABE, Faculty of Engineering of Uiniversity of Porto, R. Dr. Roberto Frias, Porto, Portugal,*** *opnunes@fe.up.pt*




Detecting and quantifying ARB&ARGs is critical within the One Health continuum, which recognizes the interconnectedness of human, animal and environmental health. Understanding the prevalence and distribution of ARB&ARGs in different sectors provides valuable insights into the dynamics of antimicrobial resistance transmission, mitigating public health risks, preserving antibiotic efficacy and promoting collaborative efforts to address this global health threat. This presentation will discuss the methods currently used to detect and/or quantify ARB&ARGs in the urban water cycle.

### Real-Time Monitoring

***R. Nogueira. Instituto de Telecomunicações, Portugal,*** *rnogueira@av.it.pt*

This talk will discuss different approaches for real-time monitoring in liquids to detect multiple physical and chemical parameters. Different real-world scenario implementations will also be presented.

## Environmental and Health Impacts and Prevention Measures

### Ecotoxicology of Contaminants of Emerging Concern: Key challenges and Approaches

***M.M. Santos [1,2]. (1) CIMAR/CIIMAR, LA- Interdisciplinary Centre of Marine and Environmental Research, Group of Endocrine Disruptors and Emerging Contaminants, University of Porto, Matosinhos, Portugal,*** *miguel.santos@fc.up.pt****. (2) FCUP - Department of Biology, Faculty of Sciences, University of Porto, Porto, Portugal.***

The Contaminants of Emerging Concern (CECs) include a vast diversity of environmental chemicals with distinct chemical structures and effects in non-target organisms. Therefore, from an ecotoxicological perspective, this brings many challenges, particularly considering the vast diversity of organisms with different physiology and genomic constitutions.

Here, we will explore the major challenges of the ecotoxicity of CECs, address the key ecotoxicological approaches and its integration with current regulation frameworks.

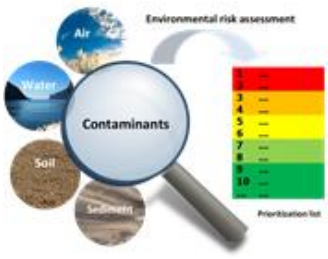
## Understanding DBPs: Ranking, Environmental Impacts and Associated Health Risks

***D. Meilmann. DHVMED, Israel,*** danielame@dhvmed.com

Over 600 DBPs have been reported in drinking water treatment. Despite significant research efforts, the knowledge about formation of different categories of DBPs remains incomplete. Understanding which DBPs are the most important, widespread and hazardous, and associating their presence in different quantities with risks for human health under certain climates and environmental scenarios is paramount for securing clean and healthy drinking water. Further, the Multi-Criteria Decision Making (MCDM) technique and the Toxicology Priority Index (ToxPi) are used to rank and prioritize the identified DBPs. The application of these techniques and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is expected to facilitate the prioritization of DBPs according to their environmental and health risks. This can help with better management of drinking water, developing and applying new water treatment techniques and supporting technological development.

## Back to Basics: Key Principles and Approaches in Environmental Risk Assessment

***V. Homem[1,2]. (1) LEPABE – Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal,*** *vhomem@fe.up.pt****. (2) ALiCE – Associate Laboratory in Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal.***




In an era of complex environmental challenges, such as the contamination of water sources or degradation of soil quality due to agricultural practices, it is essential to revisit the fundamental principles that underpin effective Environmental Risk Assessment (ERA).

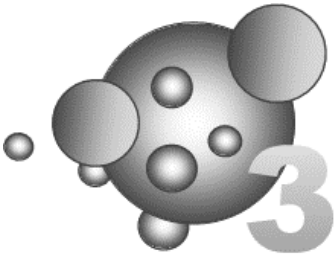
This presentation provides a comprehensive exploration of essential concepts and methodologies, emphasising a 'back to basics' approach. Using examples and case studies, it will offer practical insights into how to identify, assess and manage environmental risks more effectively.

Drawing on established frameworks and best practices, this presentation aims to provide the tools necessary to understand the complex landscape of environmental risk assessment.

# Technologies for Control of DBPs, CECs, PFAS, Microplastics, ARB and ARGs

## Ozone Fundamentals

***S. Baig. Suez International, Paris La Défense, France,*** *sylvie.baig@suez.com*



Ozone is a powerful oxidant used in various application fields for decades. This overview will particularly introduce the different aspects relevant for application in water treatment: properties, chemistry, mass transfer, contactor, applications, safety, etc. The International Ozone Association is the only association gathering all working and interested in ozone and related advanced oxidation processes. www.ioa-ea3g.org

## Ozone and Advanced Oxidation Processes – Key Features

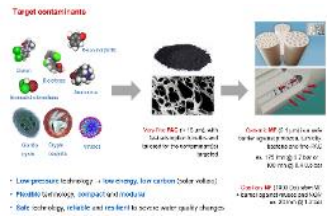
***S. Baig, Suez International, Paris La Défense, France,*** *sylvie.baig@suez.com*


Advanced Oxidation Processes (AOPs) are characterized by common principle and goal of creating an extremely powerful oxidant, mainly the hydroxyl radical in order to obtain high removal efficiencies for pollutants resistant to conventional oxidation. Although known for more than thirty years for some of them that combines ozone, UV radiation and hydrogen peroxide, they are currently receiving renewed interest for enhanced removal of micropollutants. The full panel of technologies also now include electro-oxidation, sonolysis, plasma, electron beam etc., at various development stages. The extent of the application field and complexity of the oxidation processes involve a large knowledge and require a real implementation of a process engineering approach to make them the most efficient and therefore technically and economically viable. Special emphasis is made on the suitable approach for their next application at full scale by considering the related key parameters.

# Hybrid Adsorption/Membrane Processes for Controlling Organic Contaminants of Emerging Concern in Urban Water Treatment

***M.J. Rosa, M. Campinas, C. Silva, E. Mesquita, R.M.C. Viegas. LNEC – Laboratório Nacional de Engenharia Civil, Urban Water Unit, Av Brasil 101, 1700-066 Lisbon, Portugal,*** *mjrosa@lnec.pt*

Hybrid adsorption/membrane process



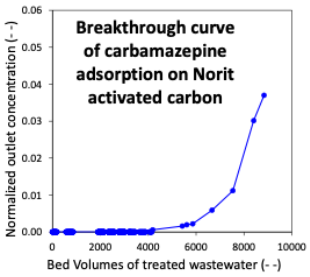
**Rosa et al. 2024**

https://doi.org/10.2166/9781789063783_0141

Climate-change driven water scarcity and population growth and ageing are calling for a reinforced control of organic micropollutants and contaminants of emerging concern (CECs) in the urban water cycle, as reflected by the recent developments in the EU and Portuguese legal framework on drinking water, urban wastewater treatment and water reuse. Hybrid powdered activated carbon (PAC)/low pressure membrane processes have proven a huge potential as multibarrier, low-energy, physical solutions (minimizing carbon footprint and byproducts formation) producing fit-for-purpose water(s). Their potential for controlling CECs in drinking water production, urban wastewater treatment, and water reclamation will be comprehensively discussed based on our last decade's results.

## Adsorption Processes for the Removal of Contaminants of Emerging Concern and Disinfection By-Products

*D. Frascari, D. Pinelli, E. Girometti. University of Bologna, Department of Civil, Chemical, Environmental and Materials Engineering, Via Terracini 34, Bologna, Italy,* dario.frascari@unibo.it




Adsorption represents a very promising process for the removal of contaminants of emerging concern and disinfection by-products from wastewater, groundwater and drinking water. The talk will start with an introductory presentation of the adsorption technology in general, covering adsorption isotherms, continuous flow adsorption and regeneration, assessment of investment and operational costs, types of adsorption materials, principles of the scale-up of adsorption processes. The talk will continue with the presentation of research studies and full-scale applications relative to the most recent and innovative applications of adsorption, such as: removal of PFAS, pharmaceuticals and pesticides; comparison between different adsorption materials (activated carbon, polymeric resins, molecularly imprinted polymers); innovative approaches of on-site desorption with green solvents; optimization of the design of adsorption processes; integration of adsorption with micropollutant biodegradation processes.

## Biological Removal and Recovery of Micro/plastics

*M.A. Reis. Associate Laboratory i4HB - Institute for Health and Bioeconomy, NOVA School of Science and Technology, Universidade NOVA de Lisboa, 2829-516 Caparica, Portugal. UCIBIO – Applied Molecular Biosciences Unit, Department of Chemistry, NOVA School of Science and Technology, Universidade NOVA de Lisboa, 2829-516 Caparica, Portugal,* amr@fct.unl.pt


Plastic pollution poses a major threat to global ecosystems, prompting the exploration of various removal methods. While physical and chemical technologies are commonly used, recent research has focused on biological approaches utilizing enzymes and microorganisms as green alternatives for degradation and recovery. This process typically involves breaking down polymers into smaller particles, followed by further degradation into oligomers, dimers, and monomers. In this overview, we will explore biological processes for plastic removal and conversion into biodegradable biopolymers with improved properties in the scope of a circular economy approach.

## Nature-Based Solutions - Natural and Constructed Wetlands to Remove Pollutants and Potentiate Water Reuse

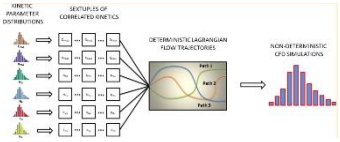
*C. Marisa R. Almeida[1,2]. (1) CIIMAR - Interdisciplinary Centre of Marine and Environmental Research of University of Porto, Matosinhos, Portugal. (2) Chemistry and Biochemistry Department, Sciences Faculty, Porto University, Porto, Portugal,* calmeida@ciimar.up.pt

Natural wetlands, have long been used as uncontrolled discharge sites for wastewaters due to their recognition for water quality improvement. The high organic load of wetland soils along with wetland vegetation (and their rhizosphere microbial communities) are the key players of the physical, chemical and biological processes responsible for pollutants removal. Using the Lima river estuary as a case study, the saltmarsh potential to remove different contaminants (e.g., metals, microplastics, contaminants of emerging concern (CECs)) from the aquatic environment will be presented. Saltmarshes might prevent pollutants from spreading in the area and from reaching coastal areas and/or eventually contaminating underlying aquifers. Constructed wetlands (CWs) are low-cost engineered systems designed to mimic natural wetland processes, that can be used to treat wastewater. Reusing treated wastewater represents an important part of sustainable water resource management and circular economy, reducing the use of freshwater. Current presentation will show CWs potential for pollutants removal, including metals and CECs, and its potential application for water reuse.

## CFD, LCA/LCC and Digitalization

### Seeing the Light, the Microbes, and the Dead Zones: Computational Fluid Dynamics (CFD) for Advanced Disinfection and Oxidation Process Analysis

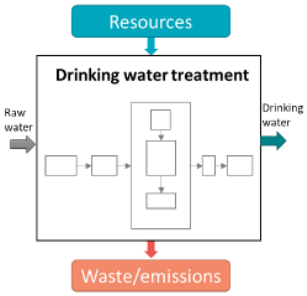
***D. Santoro. USP Technologies & Western University, London Ontario, Canada,*** *dsantor@uwo.ca*



Wastewater disinfection and advanced oxidation processes are often design neglecting interactions among wastewater quality, reactor hydraulics, and inactivation or oxidation kinetics. In this lecture, the importance of CFD for managing these interactions will be presented with three examples of application. The first example will entail the use of CFD to predicted Escherichia coli inactivation by peracetic acid (PAA) in municipal contact tanks. In the second example, UV-based Advanced Oxidation Processes (AOPs) will be analyzed with CFD coupled with detailed photodegradation kinetic to enhances understanding of complex photochemical processes. Finally, a fluoropolymer tube photoreactor using external UV lamps will also be analyzed, showing how important sizing information can be derived from CFD in case of complex optics phenomena occurring at the material interfaces.

### A Life Cycle Thinking Approach for Drinking Water Treatment Process

***R. Laurenti. IVL Swedish Environmental Research Institute, Valhallavägen 81, 114 28 Stockholm, Swdeden,*** *rafael.laurenti@ivl.se*

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# Digitalization in the Water Sector: Development of a Reliable Real-Time Virtual Trihalomethane Sensor Solution for Drinking Water Facilities

***S. Gonzalez, A. Serra, M. Sarrias. Cetaqua Barcelona Crta. Esplugues, 75 08940 Cornellà de Llobregat, Spain,*** *susana.gonzalez@cetaqua.com*


Drinking water facilities deal with strict quality control regulations that oftentimes rely on data coming from expensive real-time sensors. One of the parameters that should be controlled in drinking water is the total amount of Trihalomethanes (THMs). Within this context, facilities such as Water Treatment Plants (WTP) as well as Water Distribution Networks (WDN), need to keep total THMs levels of tap water well below a legal threshold of 100 µg/L. This fact pinpoints the necessity to develop cheaper, autonomous and reliable solutions capable of monitor real-time quality drifting events, not only in transiting water within a plant, but also at larger network-wise scales. To tackle these issues, we developed an accurate virtual THM sensor that quantifies with high accuracy, real-time THM levels at two different locations allowing us to validate the scalability of the solution. The algorithm powering the sensor is based on a simple neural network that predicts THM levels based on metrics from less costly sensors.

### Digitalization in the Water Sector

*L. Vamvakeridou-Lyroudia. University of Exeter, United Kingdom, lyroudia@kwrwater.nl*

The EU with the Green Deal is engaging in a challenging transition towards an environmentally sustainable society and economy where water represents a critical factor in a climate change context, while the rising impact of digital technologies is transforming societies and economies. Digital transition aims to exploit digital technologies for sustainability and societal wealth, and to support citizens and business. To this end, effectively managing the green and digital twin transitions for the water sector is basic for ensuring a sustainable and just future and a Water-Smart Society. The twin transitions need be run and accomplished simultaneously and with a systemic approach. This seminar, will discuss solutions and barriers that can foster or hinder the water digital transition for a Water-Smart Society as enabler of the EU Green and Digital twin effort, based on the collective experience of the 70+ projects of the ICT4WATER cluster (www.ict4water.eu).

## Workshop on Wastewater Treatment and Reuse - Part I

### Water Reuse Strategies in Portugal

*N. Brôco. Águas do Tejo Atlântico, Fábrica de Água de Alcântara, Av. de Ceuta, 1300-254 Lisboa, Portugal, n.broco@adp.pt*


Águas do Tejo Atlântico (AdTA) traced since 2017 its linear pathway to reach Water Circularity, an environmental requirement that must be urgently responded. Through an objective Leadership, we contributed to a "Structural Transformation" by evolving concepts, creating a registered Trademark “água+” (water plus / plus water to non-potable uses) to support engagement with community and generated a impactful communication to involve the community and generate collective ambition. Through Dynamic Partnerships, with the scientific community, municipalities, and NGOs, we generate achievable goals to respond to our strategy 2023/25 “Inspired from the Future” that gave sustainability and credibility to our Pathway.

# Status Implementation of EU Reuse Regulation 2020/741 in Germany - Wastewater Reuse for Agriculture and Urban Irrigation

***A. Ried, Xylem Services GmbH, Herford Germany,*** *achim.ried@xylem.com*

The German Federal Ministry of Education and Research (BMBF) initiated a program to develop flexible and reliable concepts for sustainable water reuse. This program is supporting the implementation of the Regulation (EU) 2020/741 of the European Parliament and of the Council on minimum requirements for water reuse (the Water Reuse Regulation). Which shall apply from 26 June 2023 in the member states. In the development program are 4 projects evaluating the water source municipal wastewater for reuse: Flextreat; HypoWave+; Nutzwasser and PU2R. The program started in 2021 and ends in 2024. All 4 projects are focusing on the topic reuse of municipal wastewater but have specific objectives and goals. PU2R is developing decentralized systems for domestic wastewater. FlexTreat and Nutzwasser are investigating at centralized wastewater treatment plants. HypoWave+ is implementing a hydroponic system as sustainable solution for resource efficient agricultural reuse. The results from the projects give an overview of different investigated treatment technologies and solutions. The investigated technologies include e.g. membranes, oxidation- and disinfection technologies and media filtration. To achieve the requested treatment goals single treatment steps and different treatment trains are investigated. Beside the technology evaluation the project objectives also focusing on risk management, disinfection validation, digital solutions and implementation of regional regulatory aspects. The overall goal is to generate experiences and knowledge to support the implementation of the EU Regulation in Germany.

## The Reuse of Reclaimed Water in Italy: Polishing Treatments, Destination, Risk Assessment

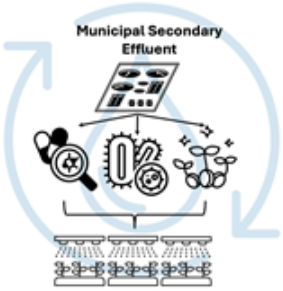
***P. Verlicchi. University of Ferrara, Department of Engineering, Via Saragat 1, 44122 Ferrara Italy,*** *paola.verlicchi@unife.it*

Case studies: each color corresponds to a specific polishing treatment

The talk will present and discuss case studies of reuse of reclaimed water in Italy for different needs (mainly irrigation and industrial purposes). It will focus on the ongoing national regulations and agreements for the reuse, the adopted treatments to guarantee the required quality of the effluent. It will also report the main results of the sanitation safety plans which are under development in Italy.

## Challenges Associated with Wastewater Treatment and Reuse in Brazil

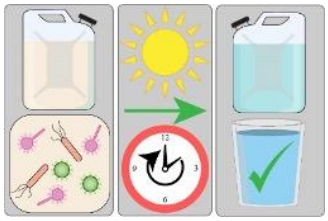
***C.C. Amorim. Federal University of Minas Gerais, Research Group on Environmental Applications of Advanced Oxidation Processes (GruPOA), Av. Presidente Antônio Carlos, 6627, Belo Horizonte - MG, Brazil,*** *camila@desa.ufmg.br*




Wastewater reuse for crop irrigation presents a sustainable solution to address agricultural water demands and reduce reliance on synthetic fertilizers. However, safe practices necessitate careful consideration of potential environmental and human health impacts. While studies have shown no significant increase in microbial risks associated with municipal secondary effluent irrigation, the presence of contaminants of emerging concern (CECs) in this water source requires attention. Global regulations for wastewater reuse vary considerably with no consideration regarding CECs standards. Brazil lacks national regulation, with only five states establishing their own, often with significant discrepancies in quality standards. Advanced oxidation technologies offer promise for removing CECs from municipal secondary effluent prior to reuse practice. Therefore, advancements in treatment technologies, comprehensive regulations, and further research on the long-term impacts of CECs are crucial for harnessing the potential of wastewater reuse while mitigating environmental and human risks.

## Overview of the EU-India Collaboration on Water Treatment Technologies

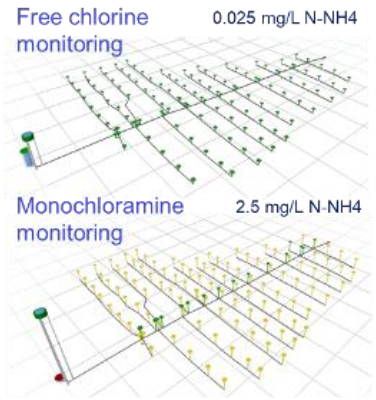
*K. O'Dowd, S.C. Pillai. Atlantic Technological University, ATU Sligo, Ireland,* Suresh.Pillai@atu.ie



Globally, over 2 billion people lack access to safe drinking water, with approximately 160 million relying on surface water sources for their daily needs. This crisis is especially severe in water-stressed regions such as India. In India alone, there are about 700 million people living in rural areas, and out of these, several million do not have access to clean and safe water. The scarcity of clean water in such regions poses severe health risks and impacts the overall quality of life for millions of individuals. Compounding the issue is the growing presence of Contaminants of Emerging Concerns (CECs) in wastewater effluents worldwide. CECs are pollutants that include substances like pharmaceuticals, personal care products, and endocrine-disrupting chemicals. These pollutants can have harmful effects on aquatic life and human health. Addressing these challenges will require a coordinated global effort, significant investment in sustainable water management practices, and the integration of new technologies to safeguard water quality.

## Reclaimed Water Distribution: Chlorine Decay Modelling and Case Study Application

***R.M.C. Viegas[1], J. Costa[2], E. Mesquita[1], D. Figueiredo[3], S.T. Coelho[4], P. Teixeira[5], M.J. Rosa[1]. (1) Urban Water Unit, Hydraulics and Environment Department, LNEC—National Laboratory for Civil Engineering, Av. Brasil 101, Lisbon, Portugal,*** *rviegas@lnec.pt****. (2) EPAL, Av. de Berlim 15, 1800-031 Lisbon, Portugal,*** *joanaramiraocosta@gmail.com****. (3) Águas do Tejo Atlântico, Wastewater Utility, Avenida de Ceuta, 1300-254 Lisbon, Portugal,*** *david.figueiredo@adp.pt****. (4) Baseform, Software house, Lisbon, Portugal,*** *sergio.coelho@baseform.com****. (5) Lisbon Municipality, Lisbon, Portugal,*** *pedro.teixeira@cm-lisboa.pt*




Keeping an effective disinfectant residual concentration in reclaimed water distribution systems (RWDSs) is a critical control point in urban water reuse but is still a challenge, due to its often high levels of ammonia and organic matter when compared to drinking water. The implementation and calibration of an advanced mechanistic model of chlorine decay in RWDSs will be presented. The model accounts for chlorine bulk decay, via reactions of monochloramine formation and auto-decomposition, and chlorine depletion by a parallel second-order mechanism involving fast and slow organic matter reactive fractions. Despite its complexity, the model, further incorporating chlorine wall decay, was successfully implemented in the hydraulic modelling open-source EPANET-MSX and in the licensed Baseform software and calibrated in two real RWDSs. The model allowed predicting adequate chlorine dosing and simulations showed the major impact of ammonia concentration on the disinfection optimization and that water quality models (advanced, mechanistic) must play a central role in planning, design, and operational control of RWDSs for managing water reuse risks.

## Innovative Strategies for Industrial Wastewater Reuse: A Case Study and Practical Approaches

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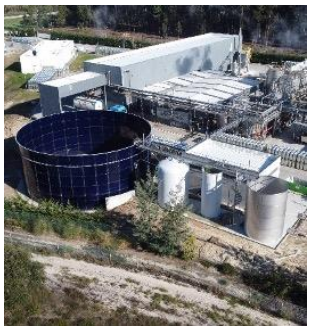

The reuse of industrial wastewater is a critical component in sustainable water management, addressing both environmental and economic challenges. This presentation explores the use of advanced oxidation processes (AOPs), specifically photocatalysis, and membrane technologies such as ultrafiltration, nanofiltration, and reverse osmosis, as innovative solutions for industrial wastewater treatment and reuse.

The presentation will offer a case study and a practical approach to integrating AOP's and membrane technologies into existing wastewater treatment systems. This approach will include considerations for cost, scalability, regulatory compliance, and environmental impact, providing a roadmap for industries seeking to adopt sustainable wastewater reuse practices.

## An Overview of Project GIATEX - Intelligent Water Management in the Textile and Clothing Industry

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The GIATEX project addresses the critical issue of high water consumption in textile finishing companies. This initiative aims to develop a comprehensive toolkit to help these companies significantly reduce their water usage. Key strategies include adopting less water-intensive finishing technologies and implementing advanced treatment methods that facilitate water reuse. Additionally, GIATEX seeks to enhance decision-making regarding water management by integrating process monitoring and control systems with a novel water management support tool. The project is led by the textile company ADALBERTO with technical coordination from CITEVE. This talk aims to present an overview of the project, with special emphasis on Work Package 4, led by FEUP, which is dedicated to wastewater treatment technologies for water reuse in the textile sector.

## Closed-Loop Water Systems in Textile Industrial Districts: Orchestrated Removal of Emerging Pollutants from Textile Wastewater

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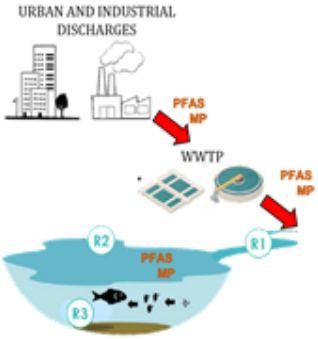


The LIFE CASCADE project aims at developing analytical procedures and wastewater treatment technologies meant to detect and remove two very critical categories of micro and emerging contaminants for the textile sector: Microplastics (MPs) and poly- and per-fluorinated substances (PFAS). The composite output of the project includes three layers: standardized and multi-lab validated analytical protocols to detect and quantify PFAS and Microplastics contaminants in heterogeneous textile wastewaters (WW); a modular set of WW treatment units to be installed at factory- and central treatment plant-levels; an orchestrating risk-based methodology to support the design and implementation of the best combination of treatment modules according to the textile district configuration and WW characteristics. Besides, the exposure and effects of PFAS and MP on aquatic ecosystem in "natural" conditions and after specific treatments will be elucidated. The project demonstration solutions will be installed and tested in Como textile district (Italy) in cooperation with CITEVE textile district (Portugal).

## AWARE – Aquaponics from Wastewater Reclamation

***C. Manaia. CBQF, Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina –Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal,*** *cmanaia@ucp.pt*

The increasing demand for freshwater fish in Europe, due to declining marine catches, creates an opportunity for freshwater aquaculture. However, freshwater aquaculture faces challenges such as limited water resources and strict environmental regulations. The AWARE project aims to integrate reclaimed water aquaculture with aquaponics, a sustainable system that combines fish farming and plant cultivation. AWARE, a multidisciplinary European Project joining 20 Institutions from 8 countries, will demonstrate technical solutions, increase wastewater recycling, create new value chains and lay the groundwork for supportive regulations.

## Advancing Water Purification: PANIWATER's Innovations in Tackling Contaminants of Emerging Concern for Safe Irrigation and Drinking Water

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Globally, ca. 2.1 billion people lack access to safe water, with about 159 million individuals relying on surface water sources for their drinking water needs. This issue is particularly acute in water-stressed regions, such as India, where approximately 63 million people in rural areas lack access to clean water. Furthermore, Contaminants of Emerging Concerns (CECs) are increasingly being detected in wastewater effluents worldwide, including in India. Within the framework of the PANIWATER project, six technologies for water treatment for the removal of CECs have been developed, representing significant advancements in addressing the challenge of water contamination. This talk will provide an overview of the project and the technologies developed and applied in peri-urban and rural areas in India, including technologies to produce irrigation water, and drinking water from unsafe water.

## AnMBR-Based Resource Recovery in Urban Sanitation: Integrating Food Waste into the Wastewater Stream

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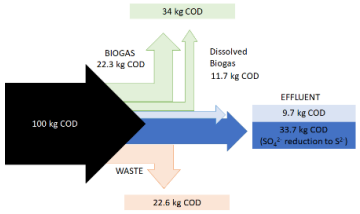


The LIFE Zero Waste Water project consists of an innovative and cost-effective solution for the combined treatment of wastewater and OFMSW in small populations (less than 50,000 inhabitants equivalent). At its demonstration plant, located at the El Bobar WWTP (Almería), up to 50m³/day of wastewater and OFMSW will be treated, using a combination of advanced technologies, such as the Anaerobic Membrane Bioreactor (AnMBR), the Partial Nitrification/Anammox process, and a nutrient recovery module, all controlled by an intelligent monitoring and control system. These technologies allow high efficiency in of organic matter removal, biogas production, nutrients recovery, and the production of water suitable for fertigation or environmental purposes, allowing for a positive energy balance, contributing to sustainability and reducing the carbon footprint in wastewater treatment.

## Workshop on Wastewater Treatment and Reuse - Part II

### Wastewater Regeneration by the Solar Photo-Fenton Process: From the Lab to the Plant. LIFE ULISES & LIFE PHOENIX projects

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Over the past three years, there has been a notable advancement in the application of the solar photo-Fenton process for wastewater regeneration at a demonstration scale. The most significant achievement has been the demonstration of the technical and economic viability of the process in a real environment. This has been made possible by the Life Ulises and Life Phoenix projects, both funded by the European Commission and coordinated by Aqualia. The projects have involved the process design, the scale-up, the control system design, and the construction and plant operation, not only for the disinfection of effluents from activated sludge (LIFE Ulises) or microalgae (LIFE Phoenix) secondary treatments, but also for the removal of micropollutants, with an efficacy over the 80%. The results demonstrate that the technology is approaching commercialisation with a competitive cost.

# Demonstrating the Control of Pharmaceutical Compounds in Large Activated Sludge Wastewater Treatment Plants – LIFE Fitting

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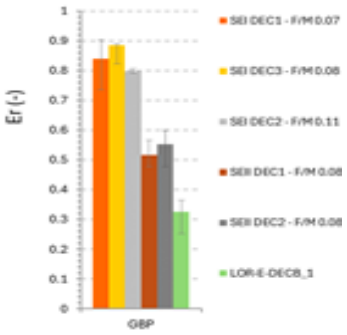


It is important to prepare cost-effective measures for enhancing the control of pharmaceutical compounds (PhCs) and other contaminants of emerging concern (CECs) in wastewater treatment plants (WWTPs) and protect the aquatic environment, water resources and human health. In this communication, the results obtained for 54+ PhCs in full-scale campaigns, in three large WWTPs, under controlled values of food/microorganisms ratio, coagulant and ozone doses will be presented, as well as the new tool to forecast CEC control in activated sludge WWTPs, based on their biodegradation (kbio) and solid–water distribution (Kd) constants - CEC ForecasTool. These results allow establishing/improving operation practices towards an enhanced CEC control in urban and urban/industrial WWTPs with activated sludge systems (the most widely used biological treatment) and ozonation of heavily coloured effluents.

# Potential of Decentralized Wastewater Treatment for Preventing the Spread of Antibiotic Resistance, Organic Micropollutants, Pathogens and Viruses (PRESAGE Project)

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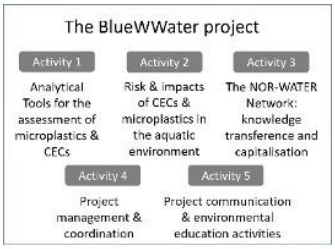
PRESAGE is focused on innovative decentralized wastewater treatments, based on aerobic and anaerobic compact systems in order to reduce the emission of contaminants of emerging concern (CECs), comprising organic micropollutants, antimicrobial resistances and pathogens (bacteria and viruses). The consortium (formed by 6 partners from universities belonging to 5 European countries and Brazil and holding a background on different disciplines) was able to work together in order to assess the efficiency of pilot plants, treating real wastewater in 4 demosites, to remove selected CECs. To do so, we had to work in cooperation in order to establish common protocols and objectives, define a sampling monitoring and transportation procedure, exchange researchers, meet virtually or onsite etc. The innovative technologies proposed, based mainly in compact membrane bioreactors designs, were at different demosites treating black and grey water, and effluents from hospitals and an antibiotic production industry, in close collaboration with the industrial sector. We have gathered a relevant set of operational and monitoring data concerning all CECs targeted. It is noticeable the operational stability of the pilot treatment plants and their good performance in terms of conventional pollutants, such as organic matter and nutrients, but also in the case of the organic micropollutants selected (antibiotics).

In the case of pathogens, we monitored both bacterial pathogens and viruses and the data obtained so far indicate a substantial reduction (higher than 95% in most samples) in bacteria but also, which is quite remarkable, in the case of most of the viruses targeted. Other important point is the analysis of antimicrobial resistances in these real wastewaters and the treatment schemes proposed. After a first HT-PCR screen to check the relative abundance of ARGs present at the demosites, a selected list of target ARGs was agreed. The results gathered so far show that most of the ARGs are extensively removed from the water in all tested technologies. Effluents from the demosites where also characterized in terms of ecotoxicity. For that, we had to organize the delivery of big samples of treated water (around 30-40 L) from the location of demosites to Toulouse. The results obtained indicate an absence of toxicity for wastewater treated in the Spanish demosite and a strong efficiency in the case of IFAS pilot treatment system treating hospital wastewater in Copenhagen (Denmark).

# Control, Treatment and Reduction of Microplastics and Emerging Pollutants in Urban Wastewater and the Transboundary Coastal Environment – The BlueWWater project and Rede NOR-WATER - POCTEP

*P. Pérez[1], R. Diez[1], M. Fernández[1], B. Pungín[1], and the BlueWWater consortium. (1) Centro Tecnológico del Mar – Fundación CETMAR, Eduardo Cabello S/N, Vigo, Spain.* rdiez@cetmar.org




The BlueWWater project, funded by the Interreg VI-A Spain-Portugal Program (POCTEP) 2021-2027, aims to improve the quality of the water masses of the Galicia-North Portugal transboundary region through the assessment, monitoring and evaluation of the emissions of microplastics and contaminants of emerging concern (CECs) to the aquatic environment. The main objectives of the project are: 1) to develop and optimize analytical methodologies to facilitate the assessment of these contaminants, 2) to study the efficiency of urban wastewater treatment plants (WWTP) in both regions and test pilot tertiary/quaternary treatments through chemical and ecotoxicological approaches, 3) to carry out experimental studies to assess the potential for reuse treated water for agricultural purposes, 4) to promote and consolidate the NOR-WATER Network to foster collaboration of involved stakeholders and facilitate the capitalisation of the project results, and 5) to raise awareness about the impacts of these contaminants on the aquatic environment and the public health and develop environmental education activities in both regions.

## ALERT-PFAS: Transnational Strategy for the Detection and Prevention of Water Pollution by PFAS

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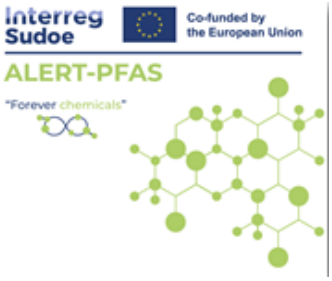
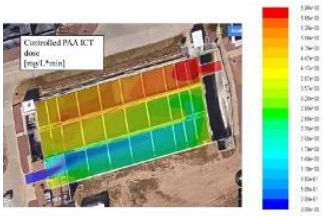



ALERT-PFAS project, co-financed by the Interreg SUDOE cooperation program, has as its main objective to design and implement a transnational strategy to detect, prevent and mitigate PFAS (perfluoroalkyl and polyfluoroalkyl substances) contamination in the natural spaces of the SUDOE region. ALERT-PFAS focuses on addressing the serious problems associated with the presence of PFAS in natural ecosystems. These highly polluting substances not only pose a risk to biodiversity and human health, but also contribute to climate change by polluting the air, soil, and water. To achieve its objectives, the project will offer an innovative solution that will allow PFAS to be detected and monitored in real-time, thus preventing their accumulation and dispersion in the environment. In this project, several pilot actions will be carried out in natural parks and protected areas in Portugal, Spain, and France, especially those affected by recent fires. The project not only focuses on the implementation of advanced technologies, such as optical sensors, adsorption and degradation processes, polymeric materials, nanotechnology, and artificial intelligence but also aims to train and sensitize all actors involved in the value chain, including the local population.

# Advancing Municipal Wastewater Disinfection with Novel Disinfectants and Advanced Process Control Strategies

***D. Santoro. USP Technologies & Western University, London Ontario, Canada**, dsantor@uwo.ca*




In the realm of wastewater treatment, the use of chemical disinfectants plays a crucial role in mitigating the spread of waterborne diseases. This lecture will delve into the comparative study of two potent disinfectants: Peracetic Acid (PAA) and Performic Acid (PFA). The disinfection mechanism of PAA involves direct oxidation and destruction of the cell wall, leading to leakage of cellular constituents. It has been found effective against a wide range of microorganisms, including gram-positive and gram-negative bacteria, fungi, and yeasts. On the other hand, PFA, a strong oxidant with a higher oxidation potential than PAA, is gaining attention for its rapid, efficient, and safe disinfection properties. It has been found effective against various microbial contaminants in municipal secondary effluent4. The disinfection mechanism of PFA involves oxidation of the outer cell membranes of microorganisms. Both PAA and PFA have their unique advantages and considerations. The lecture will further explore their applications, effectiveness, and the latest research findings in the context of wastewater disinfection. The goal is to provide a comprehensive understanding of these disinfectants and their implications for future wastewater treatment strategies. This lecture aims to shed light on these advanced disinfection methods, contributing to the ongoing efforts to enhance the safety and efficiency of wastewater treatment processes. It is hoped that this knowledge will guide future research and application in the field of wastewater disinfection.

## Effluent Ozonation i Urban Wastewater Treatment Plants – A Growing Opportunity to Exploit Synergies in the Activated Sludge Process

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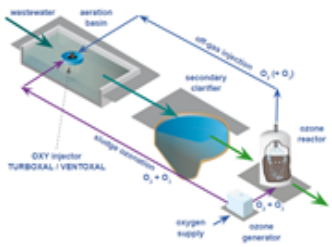



The use of ozone and other technical gases such as oxygen and $CO_2$ is well known in the production of drinking water and the treatment of industrial wastewater. In comparison, the large-scale use of e.g. ozone in urban wastewater treatment plants (UWWTP) for the elimination of micropollutants or for wastewater disinfection is still quite new. Based on full-scale case studies, this presentation focuses on synergy effects for the use of technical gases in UWWTP in conjunction with effluent ozonation. E.g. the oxygen-rich off-gas can be injected into the aeration basin to save energy and/or increase the aeration capacity. Further, in case of floating and bulking sludge, ozonation of the activated sludge kills filamentous as well as free-swimming bacteria and the sludge flocs become more compact. These effects improve the sedimentability and prevent sludge losses. In summary, these and further add-ons can sensibly increase the utilization of an effluent ozonation, save operation costs of the upstream activated sludge process and avoid case-specific investments for upcoming expansions.

## The Issues of using Oxygen from Electrolysis for Ozone Generation

***A. Araujo[1], J. Mante[2], B. Veiga, E. Palacio[3], I. Pajolli[4]. (1) Arlíquido Lda, R. Dr. Ant. Loureiro Borges, 4, Algés, Portugal,*** *oliveira.araujo@airliquide.com*. ***(2) Airliquide Deutschland GmbH, Fuetingsweg 34, Krefeld, Germany. (3) Air Liquide España SA, Calle Agustín de Foxá 4 Madrid, España, (4) L'Air Liquide S.A., 75 quai d'Orsay, Paris, France.***

With the current need to establish a Green Economy, part of the future energy infrastructure will be based on the generation of hydrogen through electrolysis. At the same time large quantities of oxygen will be produced. The production of 1 ton of hydrogen requires 40-80 MWh of electricity and is linked to the generation of 8 tons of oxygen. Wastewater treatment plants offer the possibility of using the oxygen directly and are therefore becoming a focal point in the search for potential locations for electrolyzers. For example, electrolysis oxygen can be used to aerate the aeration basins and/or for the production of ozone for effluent ozonation. Taking into account that the use of ozone for the elimination of trace substances and/or for disinfection for agricultural wastewater reuse is increasingly being implemented in wastewater treatment plants, this presentation will take a closer look at the suitability of electrolytic oxygen for ozone production. Not only safety aspects but also qualitative specifications and quantitative availability play a decisive role here.

## Preserving Fresh Produce Quality: The Crucial Role of Process Water Standards

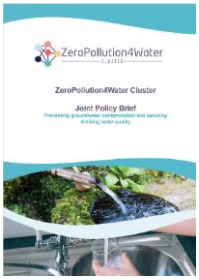
***C. Khrulova, Bischhaus. JC Environment AB, Löddeköpinge, Sweden,*** *Camilla@jc-environment.se*

Water is an essential resource for the food industry, particularly in agriculture, which is one of the largest users of water. In food production, water serves multiple roles: as an ingredient, a cleaning aid, and a processing aid. This work addresses two critical questions: 1) How can we ensure that water resources are managed and treated properly, safely, and sustainably given the industry's significant water consumption? 2) What is the impact of process water quality on the quality and perishability of fresh produce? Drawing from a decade of experience, we present our findings on the pivotal role of water treatment, demonstrating how controlled and regulated application of high concentration ozone can preserve product quality.

# Co-creation Workshop: Future Challenges in Drinking Water Sector - Public Engagement, Communication and Raising Awareness - Part I

## ZeroPollution4Water Cluster – Goals and Challenges and Projects Involved

***L. Charpentier. Water Europe, Bld A. Reyers 80, 1030 Brussels, Belgium,***
*loic.charpentier@watereurope.eu*




Water is an essential resource for the food industry, particularly in agriculture, which is one of the largest users of water. In food production, water serves multiple roles: as an ingredient, a cleaning aid, and a processing aid. This work addresses two critical questions: 1) How can we ensure that water resources are managed and treated properly, safely, and sustainably given the industry's significant water consumption? 2) What is the impact of process water quality on the quality and perishability of fresh produce? Drawing from a decade of experience, we present our findings on the pivotal role of water treatment, demonstrating how controlled and regulated application of high concentration ozone can preserve product quality.

## H2OforAll: Innovative Integrated Tools and Technologies to Protect and Treat Drinking Water from Disinfection ByProducts (DBPs)

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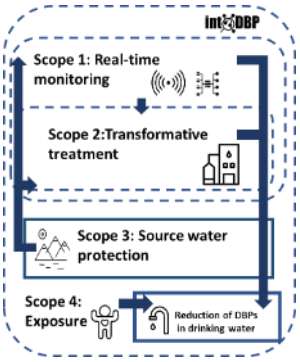
H2OforAll project aims to assess main Disinfection ByProducts (DBPs) sources through the development of fast, cost-effective, and accurate sensor monitoring devices and by modelling their spread through drinking water distribution systems. DBPs toxicity and environmental impact will be studied, and measures will be proposed to protect drinking water chain.

Breakthrough water treatments to remove DBPs or avoid their formation during water disinfection processes will be developed, paying attention to their life cycle analysis, costs, and risks. A Central Knowledge Base with reliable data on the occurrence of DBPs in the EU and their effects will be created to increase awareness and engagement of society and governmental organizations about these drinking water contaminants and favour new policy responses and guidance.

This talk will give an overview on H2OforAll objectives and methodologies and will open the floor for the co-creation workshop on DBPs.

## intoDBP: Innovative Tools to Control Organic Matter and Disinfection ByProducts in Drinking Water

*M.J. Farré. ICRA, Emili Grahit, 101, Girona Spain.*




IntoDBP is an EU-funded project that will develop, test, scale-up, validate, and benchmark innovative tools and strategies to protect catchments and minimize human exposure to disinfection by-products (DBP) under current and future climates, without compromising disinfection efficacy, and which could be applied at the global scale. The project will develop its cross-cutting solutions on 4 complementary case studies (CS) combining rural and dense urban areas, from 3 European countries where disinfection by-products are a scientific, technological, and political challenge. This presentation will show the progress made during the first two years.

## SafeCREW: Climate-Resilient Management for Safe Disinfected and Non-Disinfected Water Supply Systems

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Despite long-term experience with the reliable operation of disinfected and non-disinfected drinking water supply systems (DWSS), a number of challenges around microbial stability, the (future) need for disinfection and the consequences of disinfection by-products (DBPs) formation for human health remain open, directly deriving from climate change impacts such as increasing water temperature and higher levels of natural organic matter (NOM). SafeCREW aims to support the novel EU DW Directive by generating advanced knowledge and developing tools and guidelines for disinfected and non-disinfected DWSS, including: (I) reliable methods to evaluate microbial stability, characterise NOM, detect DBPs and account for DBP human health toxicity, (II) protocols to select proper materials in contact with water, (III) monitoring and modelling tools, also exploiting machine learning, for real-time optimisation of DWSS management, and (IV) an integrated risk assessment framework to guide future interventions which ensure safe DW in the face of climate change.

## The Regulatory Approach to Disinfection By-Products

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The regulation of the quality of water for human consumption must ensure that its regulatory instruments use the most up-to-date scientific and technological information, bearing in mind that the mechanisms for controlling the quality of water for human consumption must be capable of being implemented on a routine basis by the entities that manage the water supply systems. This balance requires the regulator to have a vision that allows it to always be "one step ahead" of the procedures that are routinely implemented. This approach, which applies to all parameters that can be controlled in water for human consumption, including disinfection by-products, must be a driving force behind regulation that is capable of monitoring water quality control based on the established scientific and technological knowledge and, at the same time, maintaining close links with all those who promote the development of scientific knowledge. In this way, the regulator can anticipate the regulatory instruments of the future in the medium and long term.

## Upgrading Water Treatment Plants to Comply with the DBPs Standards Introduced by the Directive (EU) 2020/2184

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The EU Drinking Water Directive (2020/2184) adds standards for new disinfection byproducts (DBPs) such as haloacetic acids, chlorite, and chlorate, in addition to trihalomethanes and bromate. Therefore, the upgrade of water treatment plants (WTPs) to meet the new standards may be necessary. The objective of this paper is to assess approaches for enhancing conventional WTPs to minimize the formation of these just regulated DBPs. Three key strategies are identified: (1) enhanced precursors removal, (2) alternative disinfection/pre-oxidation, and (3) removal of already formed DBP. The advantages and disadvantages of such strategies are discussed considering also the formation of other emerging unregulated DBPs. Guidelines are presented to select the most appropriate treatment trains that are proposed to upgrade the conventional WTPs.

# The Perfect Balance on Improving Water Quality by Reducing Bioproduct, while CAPEX Drops Down and Operations in Disinfection Benefits

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Chlorates and chlorites BPD's (bioproducts of sodium hypochlorite and chlorine dioxide, respectively) limits in drinking water, are set in EU directive (2020/2184), and nowadays a major concern in Portugal (DL 69/2023) as in Spain. Those biocides must stay along water distribution network, keeping water safe from contamination, but they already contain BPD prior dosage, and therefore, dosage of biocide brings to BPD dosage also. One key points to also consider is that higher climate temperature (like in Portugal and Spain, when compared with countries in central and north Europe) demands higher dosage of biocide in distribution network due to bacteriological grow, and that the more the decay is, the more BPD's will be dosed for the same quantity of free active biocide. Best in class solution to keep same amount of free active biocide with less BPD is dosage of fresh product made at lowest possible concentration by in-situ generators, meaning less BPD prior dosage, meaning less BPD in treated water as final results. Moreover, reducing decay has positive impact in saving money.

## $O_3$+BAF (Biological Activated Filter) to Make Fewer Disinfection Byproducts

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Combining ozone with a biologically active filter (BAF) in a drinking water plant is a cost-effective way of dealing with contemporary drinking water sources without using membranes or other technologies that produce difficult-to-dispose concentrate streams. Ozone mainly breaks down the large organic molecules in the source water and is then followed up with a biologically active filter to remove the remaining contaminants.

A medium-sized drinking water plant in the United States evaluated the combination of ozone and biologically active filters (BAF) to treat settled surface water. Their current surface water supply was experiencing a high level of organic contamination, and the plant was concerned about generating disinfection products (DBPs) with its conventional treatment system. The Ozone-BAF effluent averaged 47% TTHM removal throughout the pilot study compared to the current plant's performance.

## Ozone Strong Water, an Innovative Side-Stream Injection Technology for Ozone Applications as Micropollutant Abatement and Disinfection

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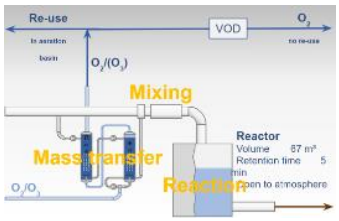


In the ozone strong water (OSW) system, ozone is pre-dissolved in a partial water stream. In contrast to conventional side-stream injection, the off-gas is already separated at this point and the dissolved ozone is stabilized by lowering the pH using $CO_2$. In this way a gas-free ozone solution with up to 300 $g(O_3)/m^3$ is obtained – OSW. The OSW is then injected into the main water pipe and mixed within < 2 sec. with the entire water flow. Although greater effort is required to produce the OSW, the technology offers decisive process advantages over conventional side-stream injection: - There is no gas phase in the main pipe. - Immediately after injection, the entire ozone is homogeneously distributed and available for the reaction. - Unwanted reactions, such as the formation of bromate, are reduced due to the decreased pH in the side-stream and the rapid ozone depletion in the main pipe. These advantages enable degrees of freedom for the design of the downstream reactor and allow the implementation of further mitigation techniques against the formation of toxic transformation products.

## DBPs - A Showcase from Around the World: Prevention Measures and Practises

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What can we learn about prevention measures? How do we minimize the spread of DBPs? What has been done so far?

DBP quality standards in drinking water were compared in all selected countries (USA, Israel, Netherlands, Portugal, Spain, Australia), showing the most regulated DBPs are THM, HAA, chlorite and chlorate, bromate and residual chlorine. EU countries are aligned with the DWD standards, which recently adopted HAA standards. The Netherlands has stricter THM and bromate standards. The main prevention measures against drinking water quality deterioration found in all reviewed countries were based on risk assessment and risk management throughout the whole supply chain, from the catchment to the end-consumers. The responsibility for performing these practices lies with one entity in some of the reviewed countries and with several entities in others. In most countries these risk assessment and risk management measures are obligatory by virtue of law or several laws and regulations. The methodologies used for performing these tasks and for achieving high quality management of all drinking water installations are relatively similar.

## Unravelling Consumers' Awareness and Engagement with Residential Water Quality: The Case of Disinfection By Products (DBPs)

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This talk will provide a comprehensive systematic review of the sources of exposure of residential consumers to Disinfection By Products (DBPs) and their mitigation actions to improve water quality. This review results in a ranking of residential actions that have the largest impact based on several studied criteria including the effect on health, the type of DBPs they are linked to and the cost/complexity of the actions. These insights can be used to build more effective incentives, policies and regulations that will improve the awareness of consumers about DBPs and will effectively engage them to tackles this challenge.

# ABSTRACTS

## Poster Communications

## PC 1: Design of an Ozone Side Stream Injection Scheme: Assessment of the Influence of Nozzle Length on Mixing Efficiency

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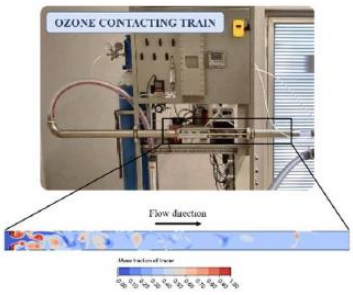


This work studied the influence of nozzle length on the mixing performance of a side stream nozzle injection scheme whose function is to mix an ozone-enriched liquid stream with the main water stream. Computational Fluid Dynamics (CFD) tools were employed to simulate tracer experiments in a bidimensional representation of the main tube incorporated with lateral built-in nozzles. The Large Eddy Simulation (LES) turbulence model was adopted. Mixing was quantified in terms of intensity of segregation and mixing length. Results showed that, for all values of nozzle length studied, efficient mixing occurred as concentrations of tracer close to homogeneity were obtained in all cases. Nonetheless, it was verified that increasing nozzle length resulted in an enhancement of the mass transfer between water and tracer. At last, mixing is promoted due to the interaction of the jets issuing from the lateral nozzles with the main flow, which leads to the occurrence of vortex shedding downstream of the nozzles.

## PC 2: Design of a Contact/Reaction Tank for Ozone Sidestream Injection Systems using Computational Fluid Dynamics

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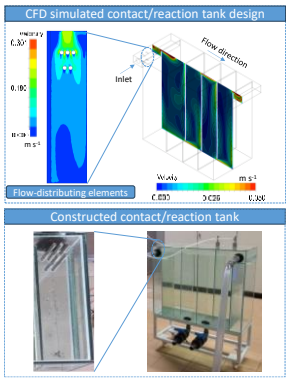


A computational fluid dynamics (CFD) approach has been employed for the design and development of a contact/reaction tank to be incorporated in a sidestream ozone injection system. In addition to the number and spatial configuration of baffles, the deployment of a set of flow-distributing elements at the tank's inlet have also been evaluated. Based on a three-dimensional geometry and the k-ε turbulence model, tracer experiments were performed to study the distribution of chemical species inside each chamber, as well as to calculate the dead volume fraction. It was found that, for a 75 cm x 75 cm x 40 cm tank (length, height and width, respectively, resulting in a 225 $dm^3$ volume), three baffles guaranteed minimum dead volume. Moreover, five cylindrical pins with 1 cm diameter – three placed at 2 cm from the inlet, and two at 6 cm – greatly reduced the heterogeneity at which the fluid is distributed towards the contacting chambers. Hereafter, the developed CFD approach can also be utilised to create strategies for the enhancement of contact/reaction tank designs aimed for applications in ozone sidestream injection systems.

## PC 3: Cutting-Edge Ozone Technology for Water Treatment

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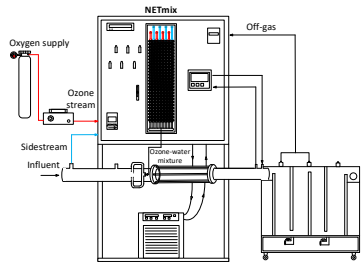


A sidestream ozone injection system based on a novel design of a pressurized micro/meso-structured NETmix static mixer has been developed for the pre-oxidation of freshwater for human consumption. A fraction of the main water flow was directed into the NETmix unit and efficiently mixed with an ozone gas stream generated by a corona discharge ozonizer. Thereafter, the stream exiting the NETmix is rapidly blended into the main water flow utilizing re-entrant mixing nozzles in the pipeline, enabling a rapid blending of the $O_3$ enriched sidestream with the main plant flow, providing the stable dissolved $O_3$ residual required to obtain the oxidation/disinfection credits in the contact/reaction chamber. The system was installed at Lever water treatment plant, making possible the direct comparison with the full-scale sidestream system using a Venturi injector. Various conditions of operating pressure and applied ozone doses ranging from 0.8 to 1.3 g $m^{-3}$ were tested, unraveling a potential for lower ozone dosage requirements to achieve appropriate water disinfection/oxidation and maximize the subsequent coagulation/flotation treatment unit.

## PC 4: Multi-Barrier Approach for the Treatment of Secondary Urban Wastewater Targeting CECs Removal and Disinfection: Integration of Membrane Nanofiltration with UVC/Persulfate Oxidation

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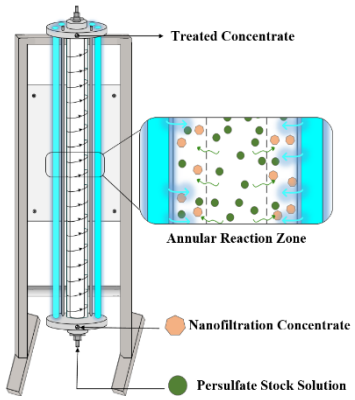


The innovative multi-barrier treatment approach for tertiary treatment of urban wastewaters, based on membrane filtration (nanofiltration-NF) and light-driven electro-chemical process, delivers two streams of water with minimized CECs and bacteria content: i) route A – disinfected NF permeate with high quality to be used for irrigation of crops for high-quality food production; ii) route B – oxidized NF concentrate with particularly good water quality to be discharged into the aquatic system, allowing to minimize the spread of contaminants into the environment. NF permeate residual disinfection was achieved with low amounts of hypochlorite (1 mg $Cl_2$/L), avoiding the regrowth of E. coli for 3 days. A pilot-scale tubular membrane photoreactor was designed, constructed and validated for the treatment of the NF concentrate, using a photochemical UVC/persulfate process. Persulfate was generated electrochemically using sulfuric acid as electrolyte. CECs removal above 50% was achieved for 16 of the 21 CECs analyzed. Microbiological analyses corroborated the effectiveness of the proposed system.

## PC 5: Gaseous Toluene Removal by Application of an Activated Persulfate-Based Advanced Oxidation Process

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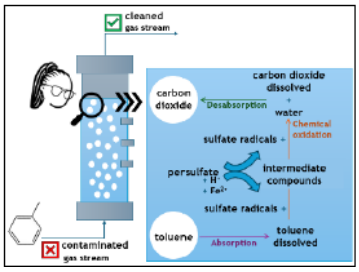


Volatile organic compounds (VOCs, among which is toluene) are reactive species that exhibit physical and chemical properties that allow them a great capacity for dispersion. These characteristics, allied to their high toxic properties, make VOCs responsible for several environmental and health problems. Therefore, it is crucial to treat toluene-containing gas streams efficiently, which can be achieved through the application of an activated persulfate-based advanced oxidation process. In this work, persulfate was activated through pH change and by the presence of metal ions as catalyst ($Fe^{2+}$), forming the sulfate radicals that are responsible for toluene's degradation. A bubble column reactor was used, to promote the contact needed between the pollutant present in the gas stream and the sulfate radicals present in the liquid phase; the treatment occurs through toluene's transfer from the gas to the liquid effluent, being degraded therein. In the end, it will be obtained a clean gaseous stream, free of toluene.

## PC 6: Design, Validation and 3D Printed Fabrication of an Innovative Electrochemical Flow Reactor Incorporating NETmix Mixing Technology

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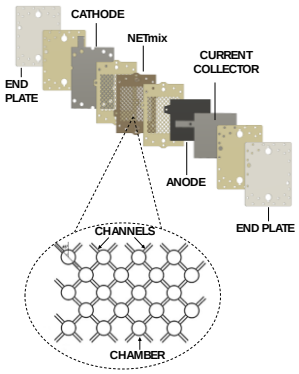


The current study focuses on the design, construction, and characterization of a novel electrochemical flow reactor incorporating a NETmix static mixer, which works as the fluid distributor. The NETmix static mixer consists of a network structure that combines cylindrical chambers interconnected by prismatic channels. The electrochemical flow reactor has a filter-press configuration and was designed and built using a combination of computer-aided design (CAD) and three-dimensional (3D) printing technology. Afterwards, it was characterized in terms of mass transfer by employing the limiting current technique. The results revealed a notable advancement in the volumetric mass transfer coefficients ($k_mA$~$10^{-2}$) compared to existing electrochemical reactors reported in the literature. The introduction of the NETmix static mixer in an electrochemical flow reactor presents a promising alternative for mass transfer-dependent processes, such as the conversion of liquid waste streams (e.g., crude glycerol) into value-added products (e.g., ketones), the conversion of gas streams (e.g., carbon dioxide, nitrogen oxides) into fuels and fertilizers (e.g., alcohols, nitrate), and the electrogeneration of oxidants (e.g., persulfate, hydrogen peroxide, ozone).

## PC 7: PDMS Membrane for $O_2/O_3$ Gas Separation Using a Spiral Wound Module

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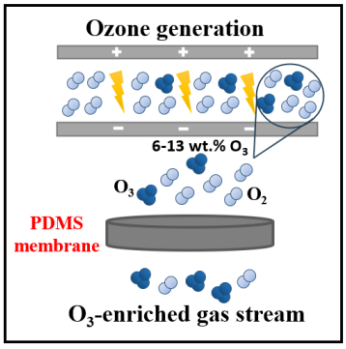


Ozone ($O_3$) gas is a powerful oxidizing agent widely used for disinfection and oxidation of water and wastewater. One major obstacle to a general wider use of ozone technology is its high associated ozone generation costs stemming from the fact that only a small fraction of the initial high-purity oxygen feed (10-15 wt.%) is able to be converted into ozone. To address this issue, ozone-selective membranes can be used to separate $O_2$ from $O_3$, purifying the generated ozone stream, yielding an $O_3$-enriched gas stream, and simultaneously the $O_2$ from the mixture of $O_2/O_3$ can be recovered and recycled back to the $O_3$ generator. A PDMS membrane with an effective area of 0.14 $m^2$ was employed in a spiral wound module to study $O_2/O_3$ separation. Single-component (with $O_2$) and multi-component ($O_2$ and $O_3$) experiments were carried out. The best result was obtained for nitrogen (used as a gas carrier) flow rate of 0.265 SLPM, with an $O_2$ and $O_3$ permeance of $9.05\times10^{-8}$ mol $m^{-2}$ $s^{-1}$ $Pa^{-1}$ and $3.45\times10^{-8}$ mol $m^{-2}$ $s^{-1}$ $Pa^{-1}$, respectively, and a real $O_2/O_3$ selectivity of 1.43.

## PC 8: Investigating the Influence of Temperature on Antibiotic Resistance Genes Removal in Activated Sludge Wastewater Treatment

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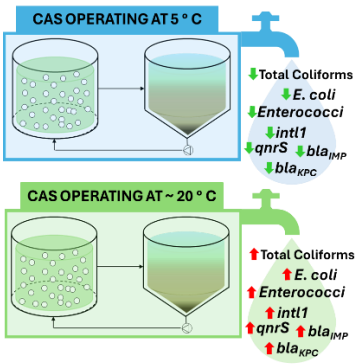


Climate change is heightening concerns over escalating water scarcity and the proliferation of infections caused by multidrug-resistant microorganisms. Hence, it is crucial to understand how variations in temperature influence the abundance and prevalence of antibiotic resistant bacteria and their genetic determinants (ARB&ARGs) during wastewater treatment. To achieve this goal, two pilot conventional activated sludge treatment (CAS) installations were set up and operated continuously for 147 days in a host UWWTP in the northern Portugal. Test CAS was operated at temperatures of 10 °C (day 1-56); 5 °C (day 57-91); 15 °C (day 92-113) and 28 °C (114-147). Control CAS operated at ~20 °C. Aside from temperature, all the remaining operating parameters were set equal in Test CAS and Control CAS counterpart. Test CAS operating at 5°C led to a more efficient removal of the fecal contamination indicators, intl1 and qnrS, blaIMP and blaKPC antibiotic resistance genes, suggesting that operation at low temperatures may minimize the risk of spreading ARB&ARGs in the urban water cycle.

## PC 9: Integrated Membrane and Adsorption-based Processes Applied to Wastewater Valorization

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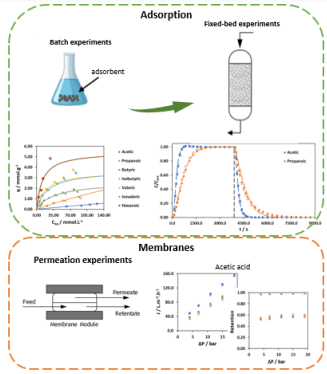


The purpose of this work is to optimize the separation of volatile fatty acids (VFA) formed during the acidogenic fermentation of fish canning wastewater (wastewater valorization), using an integrated process of membrane and adsorption-based methods. Nanofiltration and reverse osmosis commercial membranes were assessed in terms of permeate flux and acid retention, at different operating conditions (pressure, feed concentration and pH). From these essays, a membrane with high permeate flux and acid retention was selected for further evaluation. A mathematical model was also applied to the system and validated. As for the adsorption, the measurement of essential adsorption data (equilibrium and kinetics) on different adsorbents was analyzed, as well as the performance of a dynamic system and validation of a mathematical model. The equilibrium experimental data obtained allowed the selection of an adsorbent with a higher potential for VFA separation (a non-functionalized resin), which was used in the fixed-bed experiments for additional assessment of the adsorption process.

## PC 10: First Approaches for 3D-printing Carbon-based Catalysts through Direct Ink Writing for Oxalic Acid Ozonation

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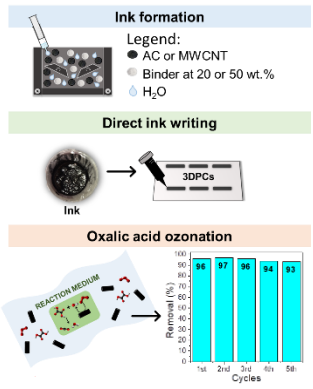


There has been a lack of studies reporting the use of macrostructured carbon-based catalysts prepared by additive manufacturing. Only 25 studies since 2015 have been found in Scopus using the keywords “3D-Printing” OR "Additive manufacturing" AND “catalysis” OR “catalyst” AND "carbon-based". The present study focused on the development of 3D printed carbon catalysts (3DPCs) of multiwalled carbon nanotubes (MWCNT) and activated carbon (AC) using two different binders: sodium carboxymethyl cellulose (CMC) and sodium alginate (ALG). By mixing both components with water, an ink was obtained which allowed the printing of 3DPCs using the direct ink writing technique. Different amounts of binders were tested in the preparation of inks, as schematized in the graphical abstract. The catalytic properties of 3DPCs were evaluated by performing oxalic acid (OxAc) ozonation essays in a semi-batch reactor. MWCNT + 20 wt.% CMC (MWCNT_20CMC) achieved an OxAc removal of 96% after 180 min of reaction and remained practically stable after 5 cycles of reutilization experiments (93%).

## PC 11: Development and Validation of a Multiresidue Analytical Method for the Determination of Emerging Contaminants in Wastewater Effluents

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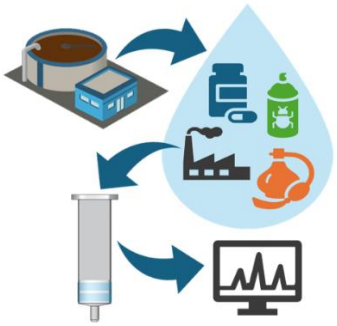

Over the past decades, a wide range of contaminants of emerging concern (CECs) have been found in wastewater effluents, due to their incomplete removal by wastewater treatment plants. The presence of CECs in the resulting effluents, in turn, allows these contaminants to enter waterbodies, raising concerns about their potential adverse environmental effects. Thus, CEC monitoring in wastewater effluents becomes a necessity.

In this work, a multiresidue analytical method to enable the determination of several pollutant classes (pharmaceuticals, pesticides, personal care products and industrial pollutants) was developed based on solid-phase extraction (SPE) followed by liquid and gas chromatography coupled to mass spectrometry (LC-MS/MS and GC-MS/MS quantification). This method has been validated with both simulated and real-world wastewater effluent samples, giving satisfactory results in terms of accuracy and precision (<10%), with appropriate detection limits for its intended use (ng/L range).

## PC 12: Disinfection of Bacteria In Ballast Water: Assessment Of Batch Ozone-Based Treatment

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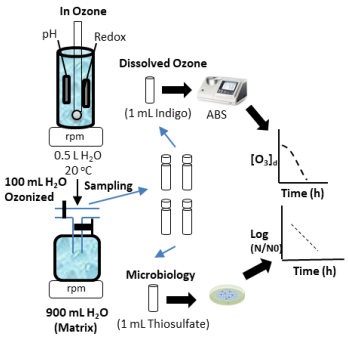


This study evaluated the effectiveness of ozone-based treatments for ballast water using two different microbiological indicators: Vibrio alginolyticus and Enterococcus faecalis. The disinfection process is conducted in discontinuous mode, within a glass reactor (1 L). Within this reactor, 100 mL of ozonated water was introduced into contact with 900 mL of either seawater or distilled water inoculated with the different target bacteria ($N_0$ = 104 or 106 CFU/100 mL), obtaining initial concentrations of dissolved ozone between 0.3 and 0.7 mg/L. Samples were extracted periodically to assess Total Residual Oxidant levels and the concentration of microorganisms over time. The optimized treatment with ozone concentrations was set at 0.7 mg $O_3$/L. Upon application of this ozone dosage, initial concentrations of *E. faecalis* and *V. alginolyticus* experience a reduction of 4 orders of magnitude in approximately 4 min of reaction. When ozone was combined with $H_2O_2$ or peroxymonopersulfate did not improve treatment. The treatment would comply with the D-2 standard adopted in the IMO.

## PC 13: Treatment of Reverse Osmosis Concentrates from Sanitary Landfill Leachate by Electrochemical Oxidation

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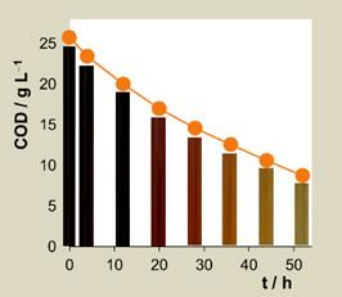


The electrochemical oxidation of reverse osmosis concentrate from sanitary landfill leachate, with an initial chemical oxygen demand (COD) of 26 g $L^{-1}$ and total nitrogen concentration of 8 g $L^{-1}$, was carried out in batch mode with recirculation, using 3 L of sample and an electrochemical cell equipped with a boron-doped diamond (BDD) anode, at an applied current density of 200 A $m^{-2}$. The results obtained showed that electrochemical oxidation with BDD anode, when performed at the experimental conditions applied, is an effective technology to remove the organic load and nitrogen-containing species from reverse osmosis concentrate of sanitary landfill leachate. After 52-h treatment, a clarified solution was obtained, with COD and total nitrogen removals of 17 and 6 g $L^{-1}$, respectively, being ammonia the main nitrogen source in solution, enabling its discharge into urban wastewater treatment plants with biological and/or membrane technologies.

## PC 14: Wastewater Electrochemical Treatment: Phosphorus Recovery as Struvite Using Different Magnesium Sources

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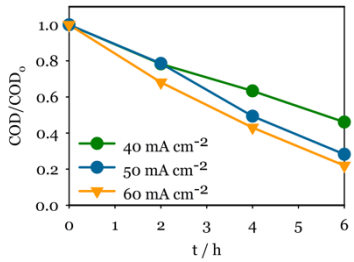


Processes based in a circular economy approach are essential to mitigate the shortage of natural resources and to contribute to a more sustainable world. Being phosphorus an essential element to the modern agriculture, several processes aiming its recovery from wastewaters have been investigated. In some of these processes, a magnesium dosage is required to recover phosphorus as struvite ($NH_4MgPO_4.6H_2O$). In this work, electrochemical processes were investigated to recover phosphorus from agricultural wastewaters and to remove its organic load, allowing the reuse of the treated wastewater. In a first step, electro-induced precipitation was employed, using different magnesium sources (e.g., seawater and magnesium anodes) to recover phosphorus. In sequence, electrochemical oxidation with a boron-doped diamond anode was applied to remove the organic load. Preliminary results showed 90% and 70% of phosphorus recovery and organic load removal, respectively, using a magnesium anode as magnesium source.

## PC 15: Polyaniline as a Potential Material for the Removal of Contaminants of Emerging Concern from Wastewaters

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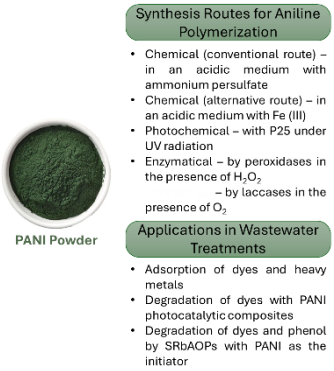


The supply of clean and quality water is a priority of the 21st century. Thus, the presence of contaminants of emerging concern (CEC) in water, with harmful consequences for the environment, is a problem that must be addressed. One of the strategies for their elimination is the use of advanced oxidation processes with conducting polymers, like polyaniline (PANI). PANI can be applied as an adsorbent, a photocatalyst, a photocatalytic composite and an initiator of sulfate radical based oxidation processes. Moreover, it can be produced by various routes, which affects its characteristics. Both the influence of synthesis conditions on material performance and the different roles of PANI in CEC removal will be discussed. As far as the authors are aware, such an extended review was not carried out. According to the literature, the reviews focus on the use of PANI particles, synthesized by the conventional method, as an adsorbent or a photocatalytic composite for the removal of dyes. In this work, other applications such as the potential to remove more complex pollutants and synthesis routes are explored.

## PC 16: An Integrated Approach Towards Agro-Industrial Wastewater Treatment: Advanced Oxidation Technologies and Membrane Distillation Optimisation

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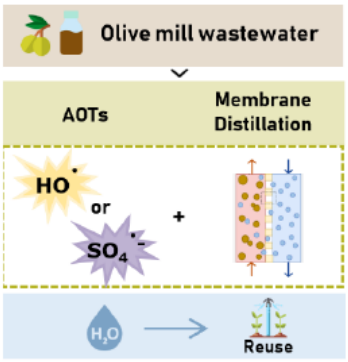


Agro-industrial activities, such as olive oil extraction, have a notable economic importance in the Mediterranean region. This activity generates large quantities of solid residues and liquid effluents with recalcitrant compounds. The complex nature of agro-industrial wastewater causes significant challenges to single-phase conventional treatments. However, the combination of processes has emerged as a promising alternative to meet the strict environmental discharge limits, adapt to varying wastewater characteristics, and achieve economic feasibility. This work aims to study the potential integration of direct contact membrane distillation and advanced oxidation technologies (AOTs) to enhance their advantages in the treatment of olive mill wastewater (OMW).

The removal of organic compounds was achieved using $H_2O_2$ and sodium persulphate at different temperatures in a batch reactor. The optimal conditions of AOTs were obtained according to an experimental design. The integration of oxidation technologies with the separation process was assessed to verify their efficiency for clean water recovery.

## PC 17: Disinfection By-Products in Drinking Water: Meeting the EU Drinking Water Directive Standards

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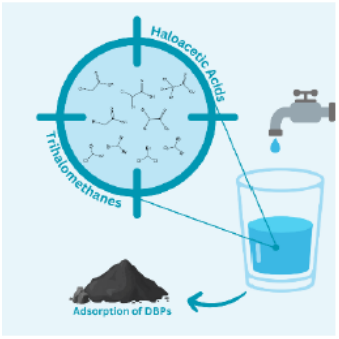


Following the implementation of the European Directive 2020/2184 on Drinking Water in 2020, member states of the European Union have had to adopt new standards, limiting the maximum allowable concentration of undesired species. These include disinfection by-products (DBPs), namely trihalomethanes and haloacetic acids (HAAs) that are detrimental to human health and whose parametric values under the new Directive are 100 and 60 µg/L, respectively. The recent literature (since 2022) reports that they have been found in Europe below the parametric values, but at much higher concentrations in other countries. Therefore, it is important to remove these classes of DBPs from drinking water, for which adsorption and membrane technologies have been proposed, among other approaches. In this work, the efficiency of adsorbents that are efficient to remove other micropollutants, is demonstrated.

## PC 18: Novel Functionalised Carbon-based Macrostructures for Water Purification

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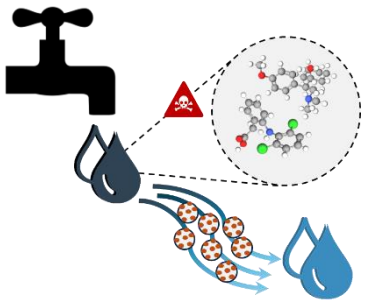

The development and optimisation of sophisticated technologies for water treatment is more and more needed, according to higher levels of organic micropollutants founds in drinking water sources. Particularly, the design of a simple one pot methodology for the synthesis of an effective adsorbent structure was investigated. In this work, the preparation and functionalisation of activated carbon was performed simultaneous to its *in situ* immobilisation onto three dimensional alumina macrospheres (0.3 – 0.5 mm). The resulting carbon materials had different chemical composition, according to the synthesis procedure and functionalisation mechanism (i.e., calcination atmosphere and amount of precursor). The adsorbents were employed for the removal of different contaminants in ultrapure and simulated mineral water matrices, with promising results (>90% removal in 1 h) for both batch conditions and continuous flow operation. The regeneration of the spent adsorbents was attempted by distinct advanced oxidation technologies and the formation of by-products was assessed.

## PC 19: Spirulina-Based Carbon Materials for Controlling Drinking Water Taste and Odor: Removal Efficiency and Evaluation of Cyto-Genotoxic Effects

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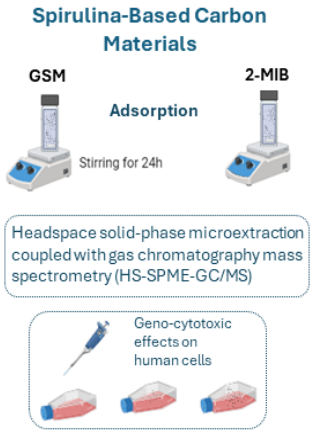


The taste and odor (T&O) of drinking water plays a significant role in consumers' perception of its quality. Traditional methods to manage compounds that cause unpleasant T&O are often ineffective or expensive. Therefore, a reliable process that can remove T&O compounds without additional concerns is highly desirable. This study aimed to evaluate the effectiveness of spirulina-based carbon materials in removing geosmin (GSM) and 2-methylisoborneol (2-MIB) from water. Headspace solid-phase microextraction coupled with gas chromatography mass spectrometry was used to investigate the removal of GSM and 2-MIB at realistic concentrations (ng $L^{-1}$). Additionally, the geno-cytotoxic effects of spirulina-based materials were evaluated to assess their safety for application in the treatment of water for human consumption. The findings suggest that spirulina-based materials hold promise for water treatment, showing both high efficiency in removing GSM and 2-MIB from water and no harmful effects on human cells.

## PC 20: Oxidant Encapsulation: Release and Enhancement of Treatment for Dye-Contaminated Water

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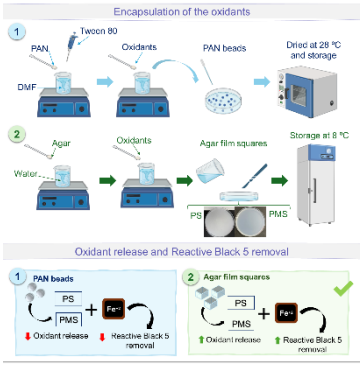


The increase in urban population leads to a widespread use of pharmaceuticals, which are released into wastewater and increase contamination levels in treated water. Their treatment by advanced oxidation processes must address the short lifetime of oxidants in aqueous media. Thus, a controlled release approach is emerging to solve this problem and improve the efficiency of these processes.

Persulfate (PS) and peroxymonosulfate (PMS) were encapsulated by various polymeric materials, catalyzing a Fenton-like process to remove a model dye such as Reactive Black 5. Initially, polyacrylonitrile (PAN) was used for immobilizing the oxidants, however, its unsustainable synthesis, low stability and release over time prompted the exploitation of agar, a biopolymer that gave promising results. Efficient oxidant release was demonstrated, achieving complete removal of Reagent Black 5 using PS and PMS after 120 minutes with 7 mg of iron (II). Future steps involve enhancing agar durability and optimizing iron retention, ensuring the removal of persistent compounds, including dyes and pathogens.

## PC 21: Layer Double (Hydro)Oxides as Fenton-like Catalysts for the Removal of Pharmaceuticals from Water

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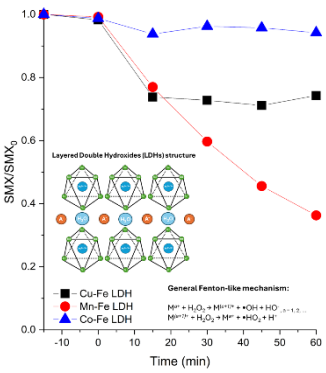


Layered Double Hydroxides (LDHs) were prepared by the Co-precipitation method, using Cu, Mn, and Co as $M^{2+}$ units and Fe as $M^{3+}$. The materials were posteriorly calcined in air at 600 °C (6 h, 10 °C/min) to obtain Layered Double Oxides (LDOs). Due to the presence of metals in their crystalline structure, the LDOs were used as heterogeneous Fenton-like catalysts to evaluate the removal of antibiotic sulfamethoxazole (SMX) and anticonvulsant carbamazepine (CBZ), both in an aqueous mixture at 1 mg/L each contaminant. These contaminants were selected since they are detected in water resources worldwide and are a threat to ecosystems and human health. The Fenton experiments were carried using [LDOs] = 250 mg/L, [$H_2O_2$] = 50 mg/L, pH = 3 during 60 min reaction. The SMX degradation was 6%, 26% and 64% for Co-, Cu- and Mn-LDOs, and the CBZ degradation was 8%, 29% and 83%, respectively. The optimization of operational conditions is further explored to improve the degradation of such contaminants.

# PC 22: Synthesis of g-$C_3N_4$/Zn Nanocomposites Obtained by Pyrolysis of Deep Eutectic Solvents and their Application as a Photocatalyst in the Treatment of Contaminated Water

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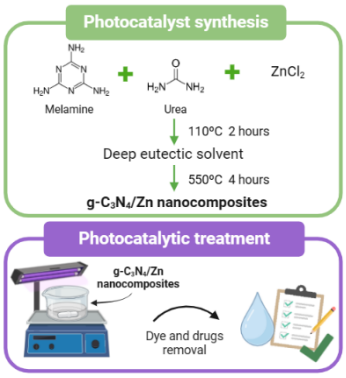


In recent years, there has been a growing interest in the use of environmentally friendly Deep Eutectic Solvents (DES) for the ecological synthesis of different nanoparticles. Their combination with Advanced Oxidation Processes (AOPs) for water treatment is emerging as a sustainable alternative to conventional methods.

This research focuses on the synthesis of g-$C_3N_4$/Zn nanocomposites obtained by pyrolysis of DES and their application as photocatalysis in the treatment of water contaminated with dyes and drugs. The synthesis was performed in two stages: first, the DES was prepared from a mixture of melamine, urea and $ZnCl_2$ followed by calcination to obtain g-$C_3N_4$/Zn nanocomposites. The yield and reusability of the material obtained were evaluated by the degradation of Rhodamine B, resulting in complete dye elimination in less than an hour and remarkable material reusability. To further this research, immobilizing the material using different techniques was proposed, with the subsequent testing of efficacy of the retained material in the elimination of different drugs.

## PC 23: Implementing and Scaling Electrochemical Techniques Integrated with Adsorption Processes for Water Decontamination

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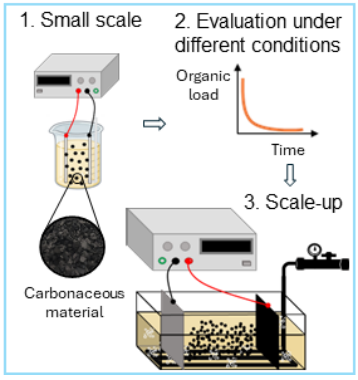


Conventional wastewater treatment processes have demostrated low efficiency in removing recalcitrant pollutants, characterized by high persistence and organic content. Adsorption and advanced oxidation processes have emerged as economical and sustainable techniques for reducing and/or eliminating the presence of these harmful organic compounds in polluted waters.

This work is focused on the design of a process for the treatment of water with different organic matter contents using a combination of the techniques mentioned above. Initially, the behaviour of a small-scale process (0.45 L) has been monitored using organic load as indicator and several operational parameters have been assessed. Then, two reactors designed to operate in a larger scale (7 & 18 L) have been evaluated for their suitability by electrochemical tests in the presence and absence of adsorbent material. The scale-up results confirmed those initially obtained for model and real waters, demonstrating its effectiveness in removing pollutants from waters of diverse origins.

## PC 24: Removal of Disinfection Byproducts from Drinking Water: Two Alternative Approaches

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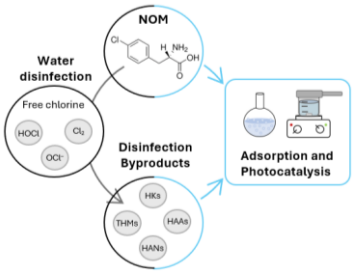


Disinfection byproducts (DBPs) are a major concern in drinking water, as they may lead to carcinogenic, teratogenic, and mutagenic effects on humans. These DBPs are a consequence of water disinfection performed by the addition of free chlorine to the water, as it contains natural organic matter and other organic compounds (DOM). These DBPs can be framed in several families, according with their chemical structure; the most incident are the trihalomethanes, haloacetic acids, haloacetonitriles and haloketones. To decrease the resulting DBPs, two alternatives can be applied, consisting of removing DOM prior to the disinfection or eliminating the DBPs at the end of the process.

Phenylalanine is one of the known precursors for formation of trihalomethanes, haloacetic acids and haloacetonitriles. Therefore, it is of great importance to develop techniques that remove or degrade not only the DBPs, but also the DOM that leads to their formation. In this work, adsorption and photocatalysis are explored to remove these substances from water.

## PC 25: Polymer Assisted Encapsulation of Selected Powdered Adsorbents for Beads Preparation and their DBPs Removal Performance

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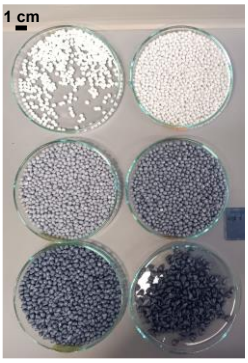


Since it has been shown that disinfection by-products (DBPs) in water present a health concern to both the environment and human health, the development of efficient methods for their removal is crucial. The removal of DBPs from the water was studied in this work through multi-walled carbon nanotubes (MWCNTs) encapsulated in polyethersulfone (PES) forming millimeter-size beads (Boix et al. 2021) as an adsorbent (please see the abstract image). According to first batch tests, bromodichloromethane (BDCM) was effectively removed from water at concentrations ranging from 200 µg/L to 20 mg/L using both pristine PES and PES/MWCNTs beads. Further research on the impact of MWCNTs on PES performance and the development of various encapsulated materials using PES, such as metal-organic frameworks (MOFs) for the removal of various DBPs including aliphatic (chloroacetic acids) and aromatic (chlorophenols), will be prompted by those findings.

## PC 26: Strategies for Reducing Disinfection Byproducts Formation at Llobregat River Drinking Water Treatment Plant in Barcelona

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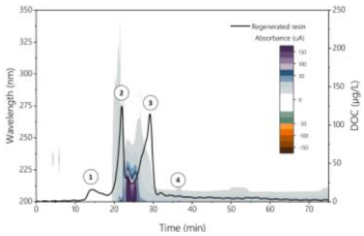


ATL is the public entity responsible for supplying drinking water to 5 million people in Barcelona and its metropolitan area through a large distribution network. Focused on Llobregat drinking water treatment plant (DWTP) and applying high-performance exclusion chromatography (HPSEC-DAD-OCD), the study assesses how disinfection byproducts (DBPs) precursors behave throughout the current treatment process, as well as the potential application of ion exchange resins (IEX) and its process optimization. Main results evidence that the intrinsic properties of NOM and the presence of inorganic content in various types of process waters seem to be the most relevant factors in THM-FP. The overall reactivity of the analyzed waters is not solely ruled by humic substances, but rather other fractions and bromide assume an important role. The current treatment at the Llobregat DWTP effectively removes THM precursors, mainly through GAC filters and EDR. However, incorporating IEX processes could further enhance NOM removal, and potentially reduce reagent consumption in the clarification process.

## PC 27: Enhancing Environmental Monitoring by the Development of Analytical Methods for Enantioselective Antimicrobial Analysis in Aquatic Environments

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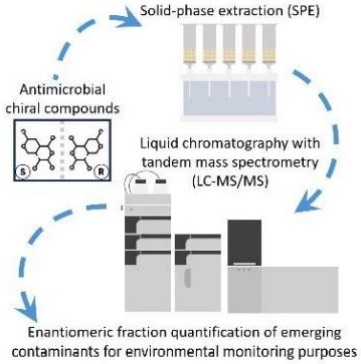


Antibiotics are present in aquatic ecosystems due to their widespread usage in veterinary and human medicine, causing environmental pressure on the microbial species and contributing to the antibiotic resistance problematic. This work aims to enantioseparate the enantiomers of chiral antimicrobial compounds and develop analytical method to assess their enantiomeric fractions in aquatic environments. A systematic method optimization was carried out by using liquid chromatography with tandem mass spectrometry (LC-MS/MS) coupled with off-line solid-phase extraction (SPE) to quantify the enantiomeric fractions of fluoroquinolones and some of their metabolites. Finally, an optimized analytical approach will be proposed for wide monitoring of these target compounds in waste and surface waters.

## PC 28: Drinking Water Treatment Residuals, from Waste to an Adsorbent Material of Antibiotics

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The presence of Compounds of Emerging Concern (CECs) in the aquatic environment is of global concern. The use of Drinking Water Treatment Residuals (DWTR) as an adsorbent for CECs may become a sustainable option for this waste that can become a by-product. The aim of this work was to study a DWTR with significant activated carbon content, without any activation process, as an adsorbent of two antibiotics: sulfamethoxazole (SMX) and trimethoprim antibiotic (TMP). The adsorbent dosage study showed that 2 g/L achieved adsorption capacity higher than 17 mg/g for both antibiotics. The adsorption kinetic study suggests an equilibrium time of 24 h with a maximum adsorption capacity around 18 mg/g for both antibiotics. The SMX adsorption kinetics followed the pseudo-second-order model, while the Elovich model was the one best fitted for TMP adsorption. The adsorption isotherms data were best fitted to the Sips model. The results achieved showed that DWTR has potential as a low-cost adsorbent for these two CECs.

## PC 29: Application of a Robust Analytical Method for Quantifying Progestins in Environmental Samples from Three Portuguese Estuaries

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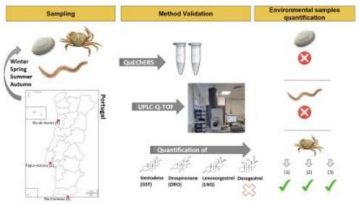


Synthetic progestins have raised particular concern due to their documented negative effects on aquatic species, but little is known about their environmental levels in surface waters and their bioaccumulation in the trophic web. The objectives of this study were 1) to adapt an extraction method called QuECHERS (Quick, Easy, Cheap, Effective, Rugged and Safe) for the quantification of progestins in freeze-dried matrices using the Ultra-High Performance Liquid Chromatography – Quadrupole Time – Of – Flight – Tandem Mass spectrometry, 2) to validate the analytical procedure for three matrices: bivalve, polychaete and crustacean, and 3) to characterise the levels of the four most prescribed synthetic progestins in key species in three Portuguese estuaries. Through the validated method, these compounds were only quantifiable in crustaceans. Levels were generally low, peaking with drospirenone in Ria de Aveiro (1.33 ± 0.26 ng/g ww) and Tagus estuary (1.42 ± 0.55 ng/g ww), while Ria Formosa showed the lowest progestin concentrations (< 1 ng/g ww). This study allowed the development of an accurate extraction and analysis method for the quantification of steroid hormones in three different biological matrices.

## PC 30: Defective-Engineered ZnO Encapsulated in N-Doped Carbon for Sustainable $H_2O_2$ Electrosynthesis: Interfacial Zn-N Bonds to Regulate Oxygen Reduction Reaction (ORR)

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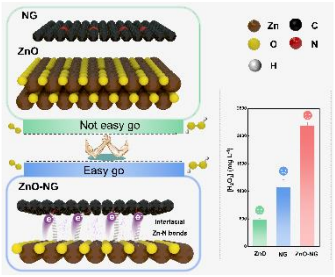


Zinc oxide (ZnO) is well known for its stability and safety, but it has shown limited catalytic activity in the two-electron oxygen reduction reaction (2$e^-$-ORR). In this context, a robust defective-engineered ZnO/N-doped graphene heterojunction (ZnO-NG), featuring abundant Zn-N bonds at the interface, has been synthesized. The engineered composite exhibited a remarkable $H_2O_2$ yield of 13.1 mg $h^{-1}$ $cm^{-2}$ at 25 mA $cm^{-2}$, with $H_2O_2$ selectivity of 85.0%, surpassing NG and ZnO counterparts. Furthermore, the exceptional long-term stability of ZnO-NG was validated through chronoamperometric measurements and ten successive runs, highlighting its great potential for larger scale $H_2O_2$ synthesis. DFT calculations and X-ray absorption near-edge structure (XANES) analysis revealed that interfacial bridging N regulated the local electron distribution, transferring the unpaired electrons from Zn sites to the adjacent N/C moieties. The configuration facilitated the hydrogenation step of $O_2$-to-OOH* and, more importantly, inhibited the O*-to-OH* conversion, thereby enhancing the ORR selectivity, which is promising for advanced water treatment.

## PC 31: Synthesis of Metal Organic-Framework Coated with Carboxymethyl Cellulose and its Application in Activating Peroxymonosulfate System for Wastewater Treatment

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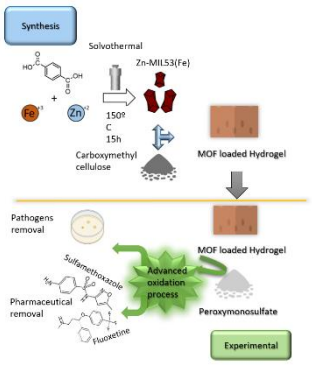


Bimetallic Metal Organic-Framework (MOF) Zn-MIL53(Fe) was successfully one-step synthesised and embedded in a CarboxyMethyl Cellulose polymer (CMC) matrix, resulting in a novel bio-based hydrogel. Its performance and stability as a heterogeneous catalyst were tested for activating PeroxyMonoSulfate (PMS) to generate sulfate radicals ($SO_4^{\cdot-}$), which completely removed 10 ppm of Rhodamine B from wastewater in 90 min. Several assays were done in order to optimize working conditions using the model organic pollutant Rhodamine B. Under optimal dosage of 10 g/L of hydrogel (which contains 2.88 g/L of MOF and 7.12 g/L of CMC), and 0.11 mM of PMS, pharmaceuticals such as Fluoxetine and Sulfamethoxazole, reached >99 and >95% removals from wastewater in 120 min, respectively. Moreover, it was also tested for the inactivation of pathogens, gram-positive and gram-negative bacteria, reaching complete inactivation for both bacteria in 60 min. Finally, the hydrogel was proven as a reusable material, capable of undergoing 6 complete cycles of PMS activation, which makes it a promising candidate for more efficient wastewater applications.

## PC 32: Novel Green Methodology for the Synthesis of Carbon-based Macrostructured Catalysts for Liquid Phase Heterogeneous Catalysis

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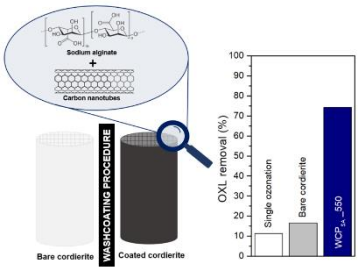


Carbon coatings have an important role in catalysis, mainly associated with the material immobilization in structured supports to be safely applied in several catalytic reactions. A novel and environmentally friendly synthesis methodology for carbon-coated macrostructured catalysts was developed using sodium alginate (SA) as dispersant. A comprehensive study of the synthesis methodology and optimal coating conditions was performed to produce active and stable carbon-coated macrostructured catalysts. The dispersant decomposition proved to be a key-step to promote the catalyst coating stability, and this was achieved by applying a thermal treatment at 550 °C (sample WCPSA_550) in order to guarantee SA adequate decomposition. The catalytic activity of these catalysts was tested for the catalytic ozonation of oxalic acid (OXL), a refractory model organic pollutant, and the obtained results showed a degradation of around 75 %, which was superior when compared with the results obtained with carbon-coated macrostructured catalysts synthesized using more conventional methodologies.

## PC 33: Removal of Microbial Contamination from Hospital Wastewater: Toward the PEM Electrolyzers Technology

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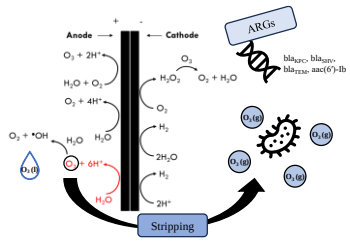


In this research, microbial decontamination of hospital wastewater is evaluated to mitigate the spread of antibiotic resistance in wastewater treatment plants (WWTPs). For this purpose, an electrochemical system capable of generating an ozone gas stream through a stripping process is evaluated using two Polymer Electrolyte Membrane (PEM). Firstly, the influence of the current density in the ozone gas concentrations is investigated. Gas phase ozone concentrations from 0.02 to 5.74 mg $L^{-1}$ are generated. Secondly, the inactivation of Klebsiella pneumoniae (*K. pneumoniae*) and the removal of four Antibiotic Resistance Genes (ARGs) by the ozone gas stream is evaluated. The results indicate a full disinfection and log removal values of 2.89, 3.04, 3.17, and 5.43 for blaKPC, blaSHV, blaTEM and, aac(6')-Ib, respectively, for contact times of 180 min. According to the results, the proposed technology is capable of mitigating the spread of antibiotic resistance in hospital wastewater.

## PC 34: Bioremediation of Wastewaters by Microalgae-based systems: Influence of N:P Ratio and Nitrogen Source on Treatment Performance

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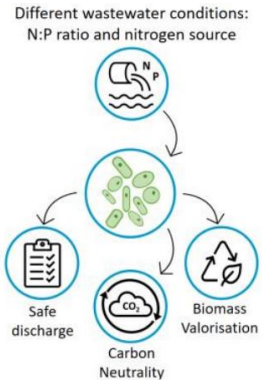


Microalgae are increasingly recognised for their potential in wastewater bioremediation, offering a sustainable solution for removing nutrients and other contaminants. Furthermore, after wastewater treatment, the biomass can be valorised for various applications thus contributing to economic circularity. However, the seasonally variation of wastewater interferes in treatment efficiency, as different conditions can affect microalgae growth and subsequently nutrient uptake. This study investigated the influence of N:P ratios and nitrogen sources on the microalgae growth, nutrient uptake, and biomass composition of Chlorella vulgaris. Four N:P ratios (9, 14, 20, and 27) and three nitrogen sources (100 mol% of nitrates, 50 mol% of nitrates and 50 mol% of ammonium, and 100 mol% of ammonium) were tested to simulate different wastewater conditions. The results showed that C. vulgaris grew in all the assays, with remarkable efficiency in nutrient removal. The final biomass composition demonstrated also promising outcomes. This study highlights the potential of microalgae-based systems as reliable and promising technologies for treating diverse types of wastewater.

## PC 35: Methylparaben as a Potentiator Environmental Contaminant of Bacterial Invasion of Human Cells

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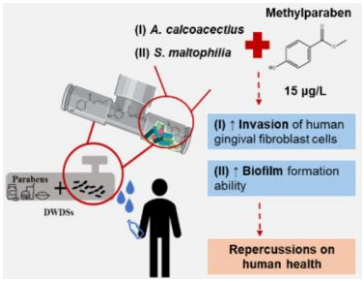


Parabens widely used as preservatives in personal care products, can adversely impact microbial communities, particularly in drinking water (DW) posing an emerging and global concern for public health. This study examines the effects of methylparaben (MP) at 15 µg/L for 7 days on *Acinetobacter calcoaceticus* and *Stenotrophomonas maltophilia* ability to internalize and invade (adhesion and internalization) human gingival fibroblasts and form biofilms. MP-exposed *A. calcoaceticus* showed enhanced invasion ability, with a 126% increase in invading culturable cells in comparison to non-exposed counterparts ($P < 0.05$). The ability of *S. maltophilia* to invade and internalize gingival fibroblasts seems not to be affected by MP exposure. However, it is clear that MP exposure enhanced the ability of *S. maltophilia* to form biofilms ($P < 0.05$). Results suggest increased bacterial virulence associated to MP-exposure and provide preliminary insights on the impact of MP exposure in bacteria infectious potential, raising concerns for possible impacts of MP presence in DW for public health.

# PC 36: Improvement of Electrokinetic Techniques for the Treatment of Trichlorobenzene Contaminated Soils: Extraction and Treatment of Gases by Electrochemically Assisted Technologies

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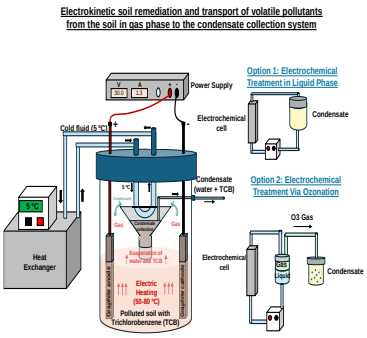


The development of effective technologies for the soil remediation contaminated with hazardous species is becoming a priority. In this regard, electrokinetic treatment (EK) has emerged as a good alternative, which involves applying electric fields between electrodes inserted into soil to transport pollutants through mechanisms such as electroosmotic flux or electromigration. However, in many full-scale applications, ohmic heating often becomes the primary removal mechanism, where organics are volatilized and subsequently need appropriate management. In this research, the applicability of EK techniques for the treatment of soil contaminated by trichlorobenzene (TCB) is evaluated employing an electric field ranging from 1.0 to 3.0 V $cm^{-1}$ between graphite electrodes inserted into the soil. Two strategies to treat volatilized organics are then evaluated: The condensate is treated electrochemically in electrodes where they are absorbed and degraded by oxidants such as $H_2O_2$; or they are directly treated using electrochemically generated ozone in the gaseous phase since it enhances the degradation capability via its high oxidation power.

## PC 37: Shedding Light on the Degradation of Polyethylene Microplastics by $TiO_2$ based Materials and Oxidizing Agents

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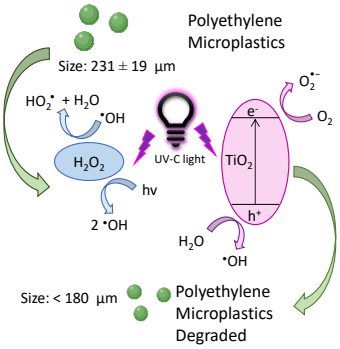


Microplastics (MPs) are contaminants of emerging concern that are ubiquitous presence in almost all types of environmental matrices. Water is one of the most important reservoirs of MPs, emerging as a public health issue which demands attention. Therefore, suitable treatments are needed to reduce the contamination of wastewater. Photocatalysis is a promising and sustainable technology to make possible the degradation of these pollutants from aqueous media. In this work, a preliminary analysis of the degradation of 231±19 µm polyethylene MPs was carried out using oxidizing agents such as $H_2O_2$ and photocatalysts based on $TiO_2$. The degradation of MPs was analyzed through the weight loss, particle size distribution, FT-IR spectrometry and carbonyl index (CI). Moreover, the influence of the concentration of photocatalyst and oxidizing agents, the type of light irradiation source and the contribution of the oxidation radicals in the degradation were evaluated. As preliminary results, using 0.5 g $L^{-1}$ of commercial $TiO_2$ P25, a 37% of weight loss and smaller particles with a size in the range of 150-180 µm were obtained after 2 hours of UV-C light irradiation.

## PC 38: Electro-Fenton Process Applied to the Treatment of Brines in a Context of Industrial Symbiosis

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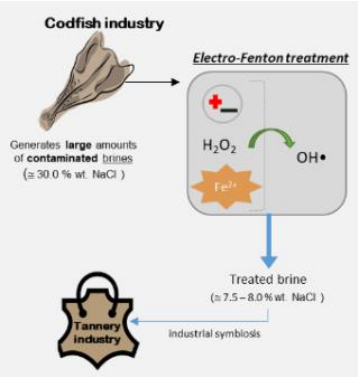


Traditionally, fish preservation methods have relied on drying and salting techniques, which, however, produce saline wastewaters as a byproduct. Conventional treatment processes are ineffective in reducing significative the organic load of these brines given their high salt content (~ 25 – 30 % wt. NaCl). This work aimed to employ the electro-Fenton process, using iron electrodes, to treat contaminated brine, envisaging its later use in the pickling stage of the tannery industry (industrial symbiosis). The operating variables - current density, electrolysis time and oxidant ($H_2O_2$) concentration - were optimized with the total organic carbon (TOC) as the response variable. Optimal operating conditions were determined to be: 275 A $m^{-2}$ current density, 6.2 min electrolysis time and 91 mM $H_2O_2$ concentration, resulting in a 68 % removal of TOC. Additionally, the quality of diluted treated brines (~ 7.5 – 8.0 % wt. NaCl) was tested in hide pickling trials. The quality of the hides was not compromised. Thus, the conditions are met to establish a symbiosis between the codfish and the tannery industry.

## PC 39: Study on the Effect of Bromine Functionalization on the Photodegradation of Pharmaceuticals using Graphitic Carbon Nitride Derivatives

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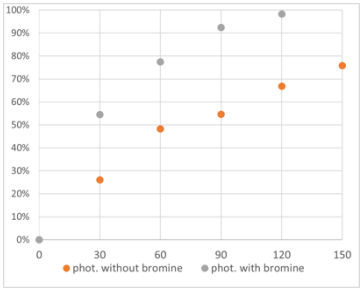


Graphitic carbon nitride (g-$C_3N_4$) is a promising non-metallic photocatalyst that features good properties, such as good chemical stability, non-toxicity, and simple preparation from abundant precursors. In the present work, bromine functionalized g-$C_3N_4$ derivatives were prepared and tested on the photodegradation of pharmaceuticals such as sulfamethoxazole, atenolol, benzalkonium chloride, and tetracycline. The selected materials were synthesized from melamine through different thermal treatment methods. Moreover, different methods for the doping of the photocatalyst where considered. In fact, the presence of bromine permits to reach almost complete removal of sulfamethoxazole after 90 minutes of solar light irradiation (see the graphics). On the other hand, pristine g-$C_3N_4$, prepared in the same conditions but with no functionalization, achieves a degradation of only 55%. The different synthetic procedures, functionalization, and photodegradation tests data will be presented.

## PC 40: FTIR Analysis of Microplastics: A Case Study from Pemba Bay Beaches, Mozambique

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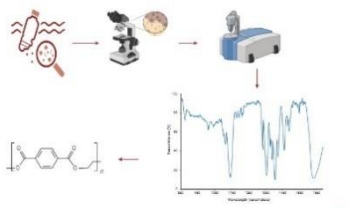

**Fig.1:** ATR-FTIR spectrum of MP sample showing polyethylene terephthalate (PET) Identification.

The production of plastic, which significantly contributes to the global plastic reservoir, poses a significant challenge for society in managing plastic waste and mitigating the environmental impact of microplastic (MP) pollution. In Mozambique, there is still no research information on MP debris in marine environments. In this study, the ATR-FTIR technique was used to characterize MP samples obtained from sand sieved samples with different mesh sizes (40 µm-1.00 mm) from Mozambique beaches. The fraction of 1.00 mm MP samples were studied using the FTIR technique and using the library, samples showed similarity percentages ranging from 69% to 79% for PP, PET and LDPE. Preliminary results of one of MP samples (fig. 1), showed the skeletal vibration of benzene at 1577-1505 and 1471 $cm^{-1}$ and the strong absorption bands characteristic of C=O and C-C (1712 and 1242 $cm^{-1}$). Additionally, the aromatic -C-H vibration bands at 1471-1408 $cm^{-1}$, the C-O vibration bands at 1339-1242 $cm^{-1}$ and 1096-1017 $cm^{-1}$, and the -C-O vibration bands, and 871-845 $cm^{-1}$ correspond to aromatic finger bending vibrations, The C-H vibration of methylene corresponds to band 2918 $cm^{-1}$ indicating the presence of aliphatic chain. It was concluded that the compound identified is PET with a similarity of 73%.

## PC 41: Study of Pre-Treatments to Maximize Methane Production by Anaerobic Digestion from Wastewater from the Olive Oil Industry

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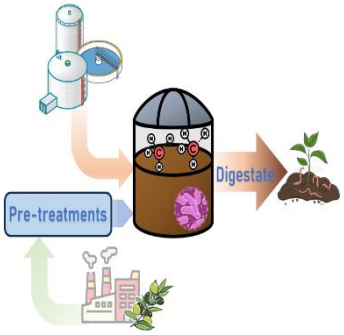


In recent years, olive oil consumption has increased due to its organoleptic and healthy properties. Due to the exponential increase in olive oil production, residues from this activity have also increased, causing major environmental impacts. Olive mill wastewater (OMW) is the liquid waste formed from this activity, with a significant environmental impact if not treated. Mediterranean countries generate about 30 $Mm^3$ of OMW annually. This region is characterized by long periods of extreme drought, and as such the recovery of water from polluted sources is essential to guarantee the sustainability of this resource. OMW is a complex effluent in terms of composition, and it is not possible to treat it using a single technology, and therefore biological processes are inefficient. Thus, the main objective of this work is to study possible pre-treatments (such as Fenton's process and ozonation) that make it possible to produce biomethane by anaerobic digestion with an acceptable efficiency.

## PC 42: Optimizing the Synthesis of Sustainable Composite Photocatalysts Based on $TiO_2$, Carbon Quantum Dots and Magnetic Nanoparticles for the Treatment of Antibiotic Contaminated Waters - A Central Composite Design

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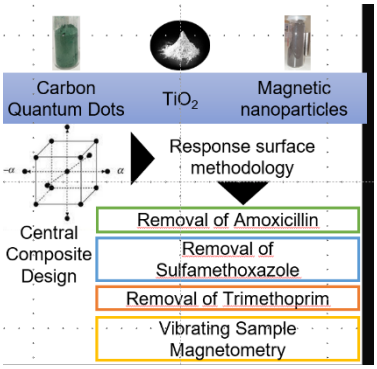


Antibiotics are a must in the world health system. However, their presence in the environment, which is largely related to wastewater treatment plants inefficiency in their removal, is well documented. In the search of efficiency, new treatments are being studied, including the application of solar-driven photocatalysis. This work aimed at the synthesis optimization of a novel photocatalyst constituted by $TiO_2$, Carbon Quantum Dots and magnetic nanoparticles using a co-precipitation methodology. For this purpose, a Central Composite Design (CCD) was used and the photocatalytic removal (%) of amoxicillin, sulfamethoxazole, and trimethoprim under simulated solar radiation, together with results from vibrating sample magnetometry were the selected CCD responses. The optimal procedure was determined using Response Surface Methodology and the so synthesized photocatalyst was further tested to determine the removal of the target antibiotics. Also, in view of assessing its practical application, the effects of photocatalyst dosage, pH and antibiotic concentration were evaluated.

## PC 43: Assessment of Urban Wastewater Reuse Potential in Hydroponic Plant Production

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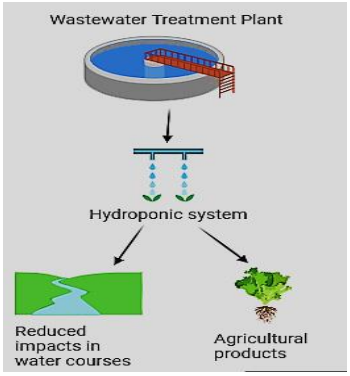


Environmentally friendly wastewater treatment and reutilization are focus approaches to achieve good qualitative and quantitative water status, thus hydroponic systems have been studied as tools to treat wastewater while offering the possibility to generate income through the commercialization of the produced crops. This study aims to promote the reuse of urban wastewater in the hydroponic cultivation of plants, contributing to combating water scarcity, and establishing sustainable patterns of water consumption and agricultural production, with a focus on (I) the production of plants without compromising public health safety (study of the risks of emerging contaminants, microbiological and others); (II) the production of crops with an economic value under sustainable environmental conditions; (III) and to promote the improvement of wastewater quality, through the removal of excess nutrients by plants, thus reducing the impacts associated with the discharge into watercourses.

## PC 44: Toxicological and Metabolomic Profiling of Target Nitrosamines Using Zebrafish Animal Model

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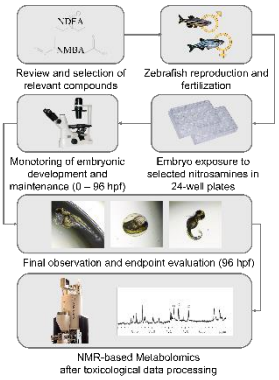


Disinfection by-products (DBPs) may originate from water treatment, formed through the reaction of chemical agents with organic matter and chemical precursors existent in raw water. Compounds such as Nitrosamines (N-DBPs) can arise from these reactions and consequently pose as a threat to safe drinking water consumption due to their high toxicity and carcinogenicity. In this study, we aim to assess the potential toxicity of two relevant nitrosamines [N-nitrosodiethylamine (NDEA), N-Nitroso-N-methyl-4-aminobutyric acid (NMBA)] through zebrafish embryo toxicity assays, and further elucidate their mechanisms of action through metabolomics studies. Toxicological results allowed the determination of NOEC values ranging from 0,075 µg/ml (NMBA) to 100 µg/ml (NDEA), and EC20 values, ranging from 0,311 µg/ml (NMBA) to 314,72 µg/ml (NDEA). Metabolomics studies using NMR (Nuclear Magnetic Resonance) were performed to obtain a comprehensive metabolic profiling of zebrafish and measure metabolic alterations due to target nitrosamine exposure.

## PC 45: Occurrence and Risk Assessment of Contaminants of Emerging Concern and Organic Pollutants in the Waters of Douro Basin (Bragança, Portugal)

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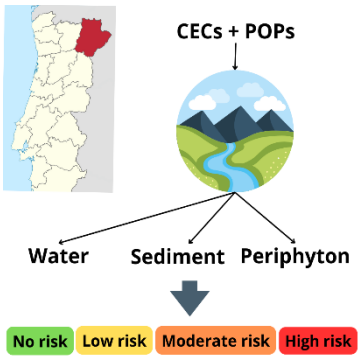


This study is an assessment of water quality from the point of view of the presence and possible impact of contaminants of emerging concern (CECs) and persistent organic pollutants (POPs) in the Portuguese part of the Douro River basin (Bragança, region; NE Portugal). Detailed analyses were carried out to assess the extent of contamination and its possible effects on the aquatic ecosystem. In addition, the ability of these contaminants to accumulate in sediments and periphyton was investigated, providing a more complete understanding of their distribution and persistence in the aquatic environment.

The data obtained were used to develop an environmental indicator system. This indicator system can serve as a valuable tool for assessing the environmental quality and health of the local ecosystem, providing key information for decision-making on management and conservation of the environment. Ultimately, it is hoped that this integrated approach will contribute to improved understanding and protection of water resources in the Bragança region and beyond.

## PC 46: Scale-Up of Photocatalytic Degradation of Disinfection By-Products in Water: Bridging the Gap from Laboratory Protocols to Pilot-Scale Implementation

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Disinfection by-products (DBPs) form during water treatment disinfection, posing health risks due to their carcinogenic and mutagenic properties. Efforts to mitigate DBPs include exploring removal methods, with photocatalysis showing promise (Chang et al., 2019). This study introduces a novel method: immobilizing $TiO_2$ nanoparticles on a porous $Al_2O_3$ matrix to create efficient photocatalytic layers. Firstly, photocatalytic measurements were conducted in a batch reactor containing a DBP solution, showing significant degradation of DBPs after 60 minutes of irradiation using an Xe lamp. Stability tests confirmed consistent effectiveness over five cycles. This study underscores the potential of $TiO_2$-based photocatalytic layers for efficient and versatile water treatment applications. Accordingly, a pilot-scale flow reactor, driven by low-cost UV LEDs and incorporating photocatalytic layers, was designed and retested to improve process economics and enhance mass exchange for degrading representative DBP compounds. The new technology has yielded satisfactory results and holds promise for real-world applications in the future.

## PC 47: Evaluation of Nature-Based Solutions for Water Treatment of a Eutrophic Lake Using Solar Photolysis

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The artificial lake in the municipalities of Ibirité, Betim, and Sarzedo in Minas Gerais, Brazil, is an eutrophic lake, compromising water quality, local biodiversity, and consequently, multiple water uses. Therefore, nature-based solutions (NBS) have emerged as an integrated approach for sustainable and resilient urban development. This project aims to evaluate the feasibility of NBS employing solar photolysis compared to UV-C photolysis, in the presence of nitrite and nitrate, thus analyzing the potential of these compounds to act as photosensitizers in the removal of contaminants of emerging concern (CECs) as sustainable and effective alternative for treating water from eutrophic lakes. For this purpose, water samples will be collected, and laboratory-scale CEC degradation experiments will be conducted, which be provide data for the development of a prototype to be used in this lake. The results are expected to select appropriate NBS under solar light for the treatment of eutrophic lake water, demonstrating the feasibility and efficiency in the removal of CECs and water quality improvement.

## PC 48: Optimization of Pig Wastewater Treatment by Vermifiltration and Hydroponics for Reuse of Treated Water in Irrigation

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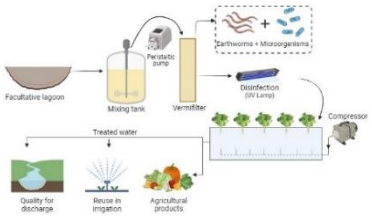


Despite its economic importance, pig farming has significant environmental impacts due to the discharge of inadequately treated wastewater. Given the territorial dispersion of farms, decentralized treatment solutions are essential to mitigate these impacts, with a focus on the reuse of treated water, in line with current European guidelines for dealing with water scarcity. Studies have shown that combining vermifiltration and hydroponics can be effective, however, success depends on factors such as controlled lighting, nutrient balance, and the absence of pathogens in the water. The main aim of the study is to optimize a laboratory vermifiltration and hydroponics system for the treatment of pig wastewater and the production of various crops that can be valued; to study strategies for eliminating the pathogen load and the removal of possible emerging pollutants from the wastewater, with the aim of raising the quality of the water treated, regarding its reuse, particularly in irrigation. The results will be used to develop a pilot treatment system with the prospect of being used in real conditions.

## PC 49: Carbon Materials for the Extraction and Monitoring of Azole Antifungals in Aquatic Environments

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The occurrence of organic micropollutants in the environment has been a global concern. Antifungal azoles are an emerging class of compounds listed in the more recent Watch List of EU-Decision 2022/1307. Their presence poses potential ecotoxicological risks to non-target organisms and plays a critical role in azole resistance in the environment, with consequent adverse effects on humans (e.g., infections caused by *Candida auris* and *Aspergillus fumigatus*). Therefore, efforts are urgently needed to collect high-quality monitoring data on the occurrence and distribution of azole antifungals in aquatic matrices. This research work aims to optimize and develop a sample preparation method using carbon materials as adsorbents for the extraction and monitoring of azole compounds in surface and drinking water samples, contributing to mitigate the ecological and human health risks. Several parameters were studied, including carbon materials, sample pH, and elution solvents. The results obtained indicate that the solid-phase extraction using carbon cartridges holds promise for application in this domain.

## PC 50: Solar Heterogeneous Advanced Oxidation Processes for Landfill Leachate Treatment

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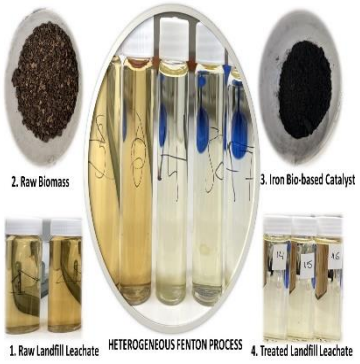


Landfilling is, worldwide, the main technique for municipal waste disposal. However, due to rainwater and waste decomposition, it results in landfill leachate, a complex mixture of organic and inorganic substances, including toxic compounds and heavy metals, with significant impacts on health and the environment. The current leachate treatment technologies have limitations such as low efficiency, high cost/benefit ratio, high energy costs and the formation of toxic by-products. To overcome these drawbacks, solar heterogenous photo-Fenton and persulphate-based processes using agro-industrial waste-based catalysts were tested to simultaneously reduce the formation of ferric sludge and remove the need for an extremely acidic pH, making it possible to reuse the water for irrigation, complying with European regulations.

## PC 51: Application of Iron Magnetic Nanoparticles for Microplastic Removal from Water

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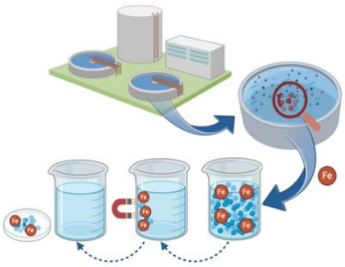

The continuous entrance of microplastics (MP) into the environment is a threat to the ecosystems and consequently to human health, due to environmental exposure, also their ageing causes physical and chemical changes that, amplify their ability to transport other pollutants. There are analytical challenges involving the monitoring of MP because there are no standard methods. The development of treatment processes to enhance their removal from the main sources, such as urban wastewater treatment plants, is needed. Although conventional treatment methods may remove MP, there is a need to develop efficient sustainable and cost-effective quaternary treatments. The use of magnetic materials has been used as a promising strategy to remove MP from water. Magnetic particles present high removal efficiencies, are considered environmentally friendly and can be reused. Preliminary results indicate that the removal efficiency was high, average of 88%, revealing promising results. Also, significant advances in the MP analysis were achieved.

## PC 52: Removal of Per- and Poly-Fluoroalkyl Substances (PFAS) and Pharmaceuticals onto Activated Carbon in Wastewater Effluents

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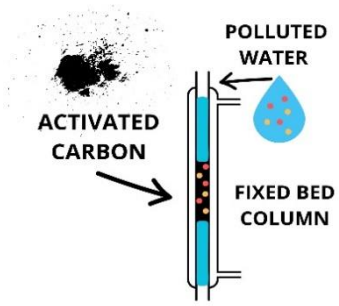


Per- and polyfluoroalkyl substances (PFAS) are long-lasting chemicals. Their presence is harmful due to their toxicity and bioaccumulation. High exposure to these compounds increases the risk of dangerous health issues for humans. Besides, pharmaceutical micropollutants are contaminants of emerging concern since they are continuously discharged into the environment, becoming a long-term problem for human health. Activated carbons (ACs) are efficient and versatile materials for pollutant removal. In order to implement adsorption processes on an industrial scale, this study involved the selection of 3 PFAS (perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS) and perfluoropentanoic acid (PFPeA)) and 3 pharmaceuticals (diclofenac (DCF), valsartan (VAL) and iopromide (IOP)) to evaluate their performance on fixed-bed columns using a powdered carbon (PAC) synthesized from biomass, their breakthrough curves were determined, and the results were compared with a commercial activated carbon. The tests were performed on synthetic water matrices and real water samples from a wastewater treatment plant effluent.

# PC 53: Enhanced Effects of Ultrasonic Cavitation on the Removal Efficiency of Ciprofloxacin and Cu(II) by Adsorption on a Kaolinite and Municipal Organic Waste Compost Adsorption Media

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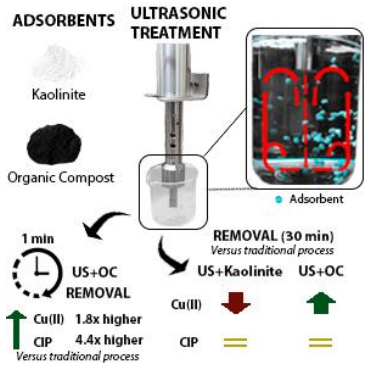


This study investigates the potential of ultrasonic-assisted (20kHz and 65±5 W) adsorption processes in wastewater treatment.

The enhanced effects of ultrasonic cavitation on Ciprofloxacin and Cu (II) removal efficiency by adsorption on a Kaolinite and municipal organic waste compost (OC) adsorption media were studied and discussed. Experimental results indicate that within the first minute, more than 95% of the maximum adsorption of Cu (II) and CIP was achieved with OC. Also, the maximum retention of Cu (II) by the assisted method outperformed the traditional adsorption process by 440% after 1 minute and 74% by 30 minutes.

These good results were not observed in the US-Kaolinite experiments, where the removal did not exceed the standard process. This work suggests that ultrasonic-assisted cavitation can enhance the adsorption of some environmental pollutants on an organic compost media, providing insights into new ways to provide control and/or retention of contaminants of emerging concern.

## PC 54: Sustainability Assessment of Sidestream Injection Systems for Ozone Water Treatment: Venturi *vs* NETmix Gas/Liquid Injectors

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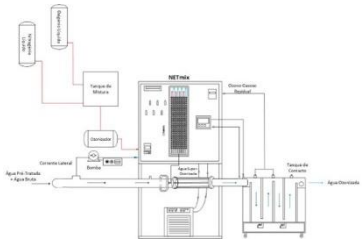

Sustainability in the treatment of water for human consumption has become a central concern in recent decades. The aim is to minimise its environmental impact through technologies that reduce energy consumption and limit the use of chemical products. This study aims to evaluate and compare the sustainability of two sidestream injection systems for ozone water treatment, where the main difference is the type of gas/liquid injector - Venturi (System A) vs NETmix (System B). System A is being used at full-scale at Lever Water Treatment Plant (WTP), while System B is still in the pilot phase. The sustainability evaluation was carried out through a Life Cycle Assessment (LCA), using SimaPro software, Life Cycle Costing (LCC) and Social Life Cycle Assessment (S-LCA). Regarding System A, the LCA study showed that the items with the greatest environmental impact are energy and net $O_2$, while the LCC study showed that CAPEX costs, are much lower than OPEX costs. A comparison of the systems shows that System B is more sustainable from a social point of view, as it obtained an Overall Social Index (ISG) of 97%, while System A obtained an ISG of 71%.

## PC 55: In-situ Electrochemical Regeneration of Antibiotic-Loaded Clay in a Continuous Reactor

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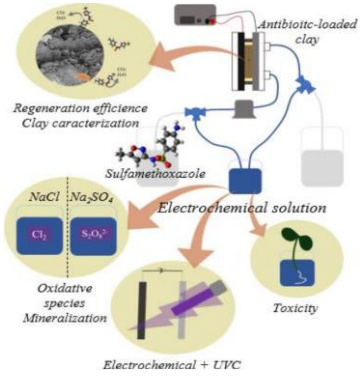


This study aimed to investigate the in-situ electrochemical regeneration of a clay-packed reactor in the removal/degradation of the antibiotic sulfamethoxazole (SMX) using two systems (NaCl/DSA and $Na_2SO_4$/BDD). The focus of this study was to investigate the regeneration process and analyze the quality of the solution generated. According to the results, clay regeneration was more efficient with the NaCl/DSA system, indicating that the contribution of active chlorine species plays an important role in SMX degradation. However, the treated solution generated revealed high toxicity to L. sativa when NaCl was used, in contrast to $Na_2SO_4$. On the other hand, the use of photolysis significantly reduced the toxicity of the electrochemical solution, promoting high regeneration efficiency. Furthermore, the absence of antibiotic in the electrolyte solution, combined with the results of the toxicity test, demonstrates the degradation of the antibiotic into by-products with less environmental impact in terms of the risk of inducing bacterial resistance.

## PC 56: Graphitic Carbon Nitride Doping and Chemical Modification to Improve PPCPs Mixture Degradation Using Photocatalytic Ozonation

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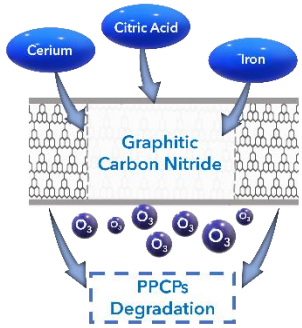


The application of graphitic carbon nitride (g-$C_3N_4$) has been increasingly explored in recent years. Its simple synthesis, typically through thermal polymerization of carbon and nitrogen-rich compounds, may also be easily adapted to improve the final catalyst photoactivity and performance. Moreover, the combination of g-$C_3N_4$ photocatalysis and ozonation may further boost the process efficacy and feasibility, with a higher production of radicals, faster degradation of pollutants, and a higher ozone decomposition, reducing the overall cost. Herein, the doping of g-$C_3N_4$ using cerium and iron, as well as a chemical modification using citric acid will be explored for the abatement of a mixture of pollutants (Methylparaben, Ethylparaben, Propylparaben, Sulfamethoxazole, Carbamazepine, and Acetaminophen) in photocatalytic ozonation tests. The concentration of dopants and citric acid in g-$C_3N_4$ synthesis will be evaluated and optimized.

## PC 57: Natural Organic Matter Removal for Disinfection By-Products Control in Climate Change Resilient Drinking Water Treatment

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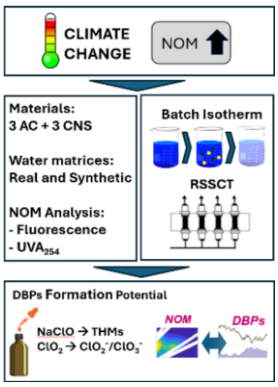


Despite extensive experience in disinfected drinking water supply systems, challenges related to disinfection by-products (DBPs) formation still remain, especially considering higher water temperatures and content of natural organic matter (NOM). As part of the EU project safeCREW (http://www.safecrew.org), this research focuses on NOM removal by adsorption, by both batch isotherms and rapid small-scale column tests (RSSCT), comparing 3 commercial activated carbons (AC) and 3 cellulose-based nanostructured sponges (CNS), and testing synthetic and real water samples. NOM was characterized by absorbance and fluorescence and treated samples were subjected to DBPs formation potential tests using sodium hypochlorite and chlorine dioxide. CNS were particularly effective in removing NOM, leading to a relevant decrease in DBPs formation potential. The results are validating through a full-scale monitoring campaign in 2 drinking water treatment plants, collecting samples at the inlet and outlet of the granular AC filters and downstream the disinfection process.

## PC 58: Disinfection By-Products and microbial occurrence in an Italian Drinking Water Distribution Network: Cluster Analysis for Sampling Point Selection

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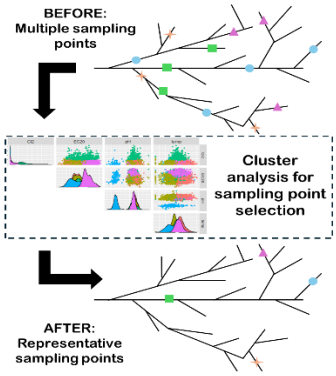


Drinking Water Distribution Networks (DWDNs) should be managed balancing chemical and microbiological risks. Our goal is to develop a model linking microbiological and chemical parameters to the disinfection operating parameters as support management tool. Since the case study we focused on comprises 27 drinking water treatment plants (DWTPs) feeding a unique DWDN, the number of sampling points to be monitored for the model is huge. To reduce the numerosity of the sampling points without losing information, we performed a cluster analysis to identify groups of DWTPs with similar characteristics, to be considered as representative. Data were preprocessed to identify two values for each DWTP, proxy of the microbial and chemical risks: (i) probability of indicator microorganisms' enumeration, and (ii) median of total trihalomethanes (TTHMs). Four clusters were identified, from which one DWTP was selected. Then, we planned the monitoring campaign, that will start in mid-June and last for 1-year. This work is carried out within the safeCREW project (http://www.safecrew.org).

## PC 59: Kinetic Analysis of NOM Fractions in DBP Formation Using Absorbance, Fluorescence/PARAFAC, and Size Exclusion Chromatography with OCD Detection

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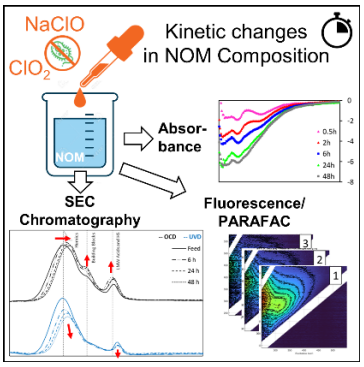


Natural Organic Matter (NOM) is widely recognized as the primary precursor of disinfection byproducts (DBPs) like trihalomethanes (THMs). This study examined specific NOM fractions contributing to DBP formation using absorbance, fluorescence with the PARAFAC algorithm, and size exclusion chromatography (SEC) with organic carbon detection. Novel insights into the kinetics of NOM changes over 48 hours, in relation to chlorine consumption and DBP formation, were analyzed. Fluorescence analysis revealed distinct correlations between fluorophores and THM formation. Notably, one fluorophore component increased after an initial decrease, indicating the formation of breakdown products. The SEC results showed humic substances as the main NOM precursors for THMs, with significant breakdown in the first six hours. Increases in other fractions, such as building blocks and low molecular weight (LMW) acids and neutrals, were also observed. These findings highlight the oxidative effects of NaClO and $ClO_2$ on higher molecular weight NOM fractions and enhance our understanding of NOM as a precursor during disinfection.

## PC 60: Determination of Antidepressant Drugs in Portuguese Wastewater

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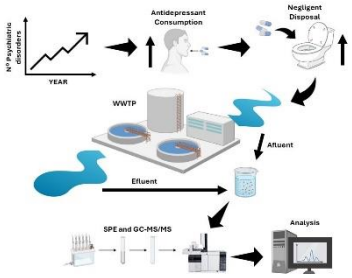


In recent years, the COVID-19 pandemic has led to a significant increase in psychiatric disorders and the use of antidepressants, posing a threat to public health and ecosystems. In addition, increased negligence has exacerbated the presence of these drugs in wastewater. The aim of this study was to develop a method for the quantification of antidepressants (fluoxetine, citalopram, sertraline, paroxetine, venlafaxine) using solid-phase extraction and GC-MS/MS. According to international guidelines, the method showed linearity with determination coefficients ≥ 0.99 and detection limits between 0.049 and 0.19 ng/mL. Precision and accuracy were within the guidelines. This is the first study in Portugal to determine these compounds nationwide and provides a viable alternative for monitoring antidepressants in wastewater. It highlights the environmental significance of the method and helps to assess consumption patterns. Acknowledgements: FCT references: UIDB/00709/2020, UIDP/00709/2020, SFRH/BD/148753/2019.

## PC 61: Spectroscopic Indexes Developed for Controlling DBPs Precursors in Drinking Water Processes

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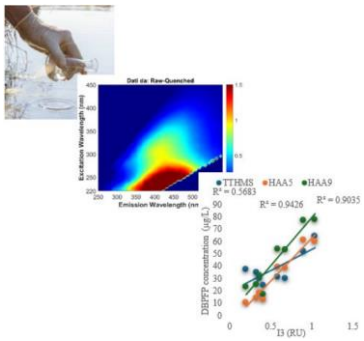


Introduced in the early 20th century, chlorination involves adding chlorine to water to kill harmful pathogens, making it safe to drink. However, chlorination is known to generate potentially harmful disinfection byproducts (DBPs) such as trihalomethanes and haloacetic acids. These compounds, formed by the reaction of chlorine with natural organic matter (NOM), pose health risks. Measuring NOM reactivity and DBP formation is crucial to balancing effective disinfection and minimizing DBPs. Spectroscopic methods, like absorbance and fluorescence, are essential for real-time monitoring of DBP precursors and byproducts. These methods provide valuable insights into DBP formation dynamics, helping optimize treatment processes. This study assesses the effectiveness of absorbance and fluorescence-based surrogates in predicting and controlling DBP formation during water chlorination, highlighting their utility for real-time, in situ monitoring. Notably, a high correlation was found between selected fluorescence indexes and the concentrations of HAA5 ($R^2$ = 0.94) and HAA9 ($R^2$ = 0.90).

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## PC 62: Development of Analytical Methods for Compliance with the Proposal of New European Wastewater Directive

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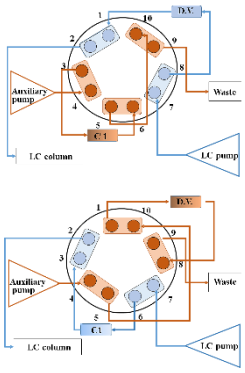


A proposal of new European Wastewater Directive (2022/0345 COD) has been recently approved by the EU Parliament, bringing to the scene more restrictive limits and establishing a set of 12 contaminants of emerging concern (CECs) that should be monitored and removed, as indicators of CECs removal. Therefore, it is necessary to develop and validate analytical methodologies that are able to determine them in a cost-effective and rapid analysis, ensuring quality standards accomplishment. In this work, a methodology is being developed, based on solid phase extraction (SPE) using two different approaches, i.e., offline and online combined with liquid chromatography-mass spectrometry. A comparison of these two method will be presented in terms of sensitivity, reproducibility and throughput.

## PC 63: Pharmaceuticals in Urban Streams: An Assessment of the Occurrence in European Cities Across a Latitudinal and Climatic Gradient

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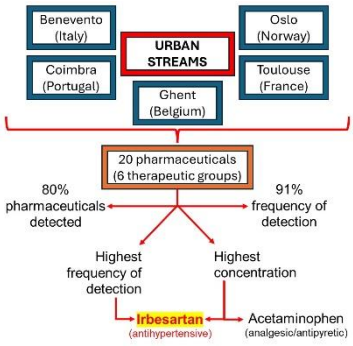


Pharmaceuticals are a type of Contaminants of Emerging Concern (CECs) present in wastewater and their fate is associated to freshwater ecosystems. This study evaluated the occurrence of pharmaceuticals in urban streams of European cities across a latitudinal and climatic gradient. Water samples of 102 urban streams of five cities were collected in Autumn 2022 and Spring/Summer 2023. Solid phase extraction (SPE) followed by UHPLC-ToF-MS were used to analyse 20 pharmaceuticals from six therapeutic groups. 80% of the pharmaceuticals were detected and the frequency of detection in the samples was 91%. Irbesartan (antihypertensive) had the highest frequency of detection (73%). The highest concentrations occurred for irbesartan (31,659 ng/L - Toulouse; 7,420 ng/L - Benevento; 1,690 ng/L - Coimbra) and acetaminophen (analgesic/antipyretic; 16,789 ng/L - Ghent; 788 ng/L - Oslo). European countries should apply preventive and mitigation measures to avoid possible impacts of pharmaceuticals in freshwater ecosystems, especially in highly urbanised areas.

## PC 64: $MoS_2$-$Fe_3O_4$ Nanomaterials as Adsorbents: Addressing Acetamiprid Contamination

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The agro-food industry generates non-reusable, acetamiprid-contaminated wastewater, commonly discharged into treatment facilities. However, conventional treatment methods frequently struggle to effectively remove this contaminant. To address this challenge, adsorption processes using nanomaterials such as molybdenum disulfide ($MoS_2$) have been proposed. The incorporation of magnetic particles into adsorbents is an advantageous approach that enable a faster and easy way to recover the used materials, using magnetic separation. In this work $MoS_2$-$Fe_3O_4$ hybrid materials were synthesized via a hydrothermal method and subsequently characterized. The magnetic, morphologic and textural properties were investigated. The adsorptive performance of the synthesized materials was evaluated in acetamiprid spiked-water, with HPLC employed to monitor the pesticide concentration. The results indicate that the produced materials can remove acetamiprid and can be collected using magnetic separation.

## PC 65: Photocatalytic Ozonization using BiOCl/Cuo as a Complementary Treatment System for the Removal of Pharmaceutical Waste Present in Wastewater

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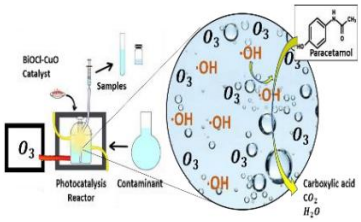


This study evaluates the efficiency of photocatalytic ozonation (PCO) using BiOCl/CuO heterostructure to remove pharmaceutical residue present in wastewater. CuO doped BiOCl heterostructures were synthesized by the co-precipitation method, varying CuO concentrations. Through synthesis and contaminant degradation evaluations using the HPLC analytical technique, it was determined that the optimum concentration in the study ranges of CuO was 0.6% with 0.1 g of PVP about the semiconductor BiOCl. Three methods were evaluated: (i) $O_3$ without catalyst or radiation, (ii) $O_3$ with BiOCl, and (iii) $O_3$ with BiOCl/CuO. Tests (ii) and (iii) were developed using simulated solar radiation. The degradation kinetics showed that with the method using ozone, BiOCl/CuO under simulated solar irradiation, a faster and more significant reduction of the paracetamol pharmaceutic residue (PCM) was achieved than the assay using only ozone, the use of PCO increased the degradation of paracetamol by 38.5%. This study provides strong evidence of the efficacy of using BiOCl/CuO heterostructure in PCO processes for treating wastewater containing pharmaceutical residues.

## PC 66: Calcium Ferrites: Innovative and Multifunctional Solutions for Wastewater Treatment

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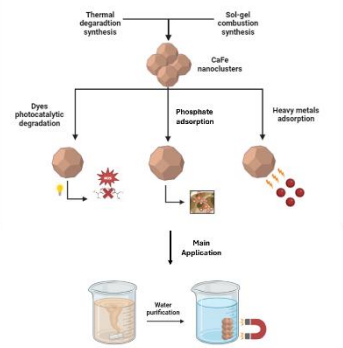


Environmental-friendly calcium ferrites were prepared by using different Ca:Fe molar ratios, different calcination temperatures as well as different synthesis processes. Colloidal, structural, and optical properties were consistent across samples from both synthesis methods. Materials obtained via sol-gel combustion method (SC) calcined under 600 °C exhibit Ms values ranging from 10 to 40 $Am^2$ $kgFe_3O_4^{-1}$. Additionally, low Hc and Mr values were found indicating superparamagnetic nanoclusters. They exhibited higher surface areas than thermal degraded samples (TD), ranging from 20 to 170 $m^2/g$. Samples obtained via both method showed high photocatalytic capacities against dyes, with maximum values of 343.2 $mg_{dye}$ $g_{sample}^{-1}$ for MB and 116.7 $mg_{dye}$ $g_{sample}^{-1}$ for MO. Also, phosphate adsorption capacities were excellent, ranging from 5 to 120 $mgPO_4^{3-}$ $mg_{sample}^{-1}$, especially for TD samples. Lastly, many samples showed great heavy metal adsorption capacity with values for $Cu^{2+}$ and $Fe^{3+}$ that arrive at 10 $mgM^+$ $g_{sample}^{-1}$ with a 100% removal.

## PC 67: Hybrid Materials for Water Treatment: Coupling microalgae with $TiO_2$ NPs

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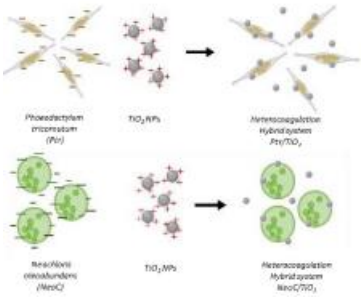

In this work, we combined the sorption qualities of different microalgae with the photocatalytic properties of $TiO_2$ NPs in order to develop technologies usable in the wastewater treatment. The coupling of microalgae biomass, Neochloris oleoabundans or Phaeodactylum tricornutum, with the inorganic phases based on $TiO_2$ NPs allowed us to explore a new challenging frontier in the design of hybrid materials. The activity aims at developing a multifunctional hybrid nano catalyst that combines adsorption capability with photocatalytic action. The nanocatalysts were prepared using a colloidal process and underwent extensive physicochemical characterization. As key functional performances, we evaluated the adsorption of heavy metals ($Cu^{2+}$) and phosphates and the photocatalytic activity, assessed for Rhodamine B (RhB). The results pointed out a positive synergistic effect for hybrid samples consistent with the enhancement of biosorption performances against $Cu^{2+}$. The $TiO_2$-$SiO_2$ hybrid sample exhibited the best photocatalytic performance, achieving complete conversion after 1h.

## PC 68: Development of Nano-Ag-Based Materials as New Sustainable Technology for Wastewater Filtration through a Safe-By-Design Approach

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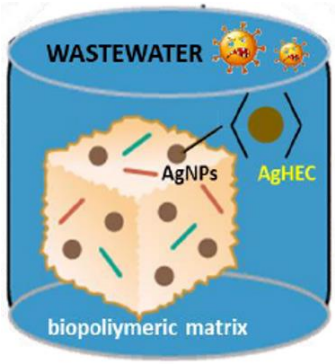


The uncontrolled release of pollutants into the environment because of urbanization and industrialization is a staggering problem of global concern. For this reason, research is moving toward the development of a new class of advanced materials for the advancement of sustainable wastewater filtration technologies in a safe-by-design perspective. With these evidences, in this work AgNPs were synthesized with eco-design and green chemistry principles in water solvent, at room temperature, using biogenic reducing/capping agents (curucumin, hydroxyethylcellulose) and incorporated into biopolymeric matrices (chitosan, agarose, alginate) to create multifunctional nanocomposites, that can be used in various fields, including water purification. An in-depth characterization was carried out on materials (ELS, DLS, XRD, UV-Vis, FT-IR, TEM, SEM-FEG, SEM-EDS) to confirm their chemical-physical properties. Finally, the functional performances of the nanocomposites were evaluated using antiviral, antibacterial and adsorption tests of model pollutants.

## PC 69: A novel $CO_2$-Responsive Micellar-Enhanced Ultrafiltration for the Removal of Emerging Contaminants from Water

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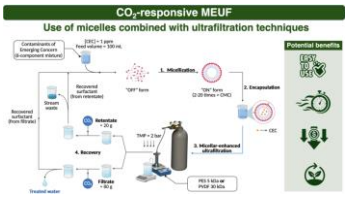


In this work, we present a sustainable approach that can efficiently remove neutral and cationic CECs from synthetic wastewater. The method involved the use of a micellar-enhanced ultrafiltration (MEUF) combined with the $CO_2$-switchable anionic surfactant sodium dodecanoate. The MEUF took place in dead-end mode with a 5 kDa polyethersulfone ultrafiltration membrane. When a 10 mg/L feed solution was used, the membrane alone rejected atenolol, sulfamethoxazole, and carbamazepine by 8-27%. The introduction of the surfactant noticeably improved CEC retention to >92%. Regrettably, 25–30% of the surfactant permeates into the filtrate stream, but the recovery is easily achieved when $CO_2$ is bubbled through the solution. The recovered surfactant is clean and can be reused in subsequent MEUF cycles. This new procedure allowed the facile reclamation of the surfactant without the need for aggressive chemicals or additional MEUF stages, thus showing the feasibility and environment-friendliness of the new method.

## PC 70: Evaluation of Chemical and Microbial Risk of Drinking Water for the Optimisation of AOP to Prevent DBPs Formation

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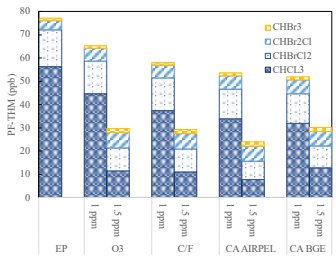
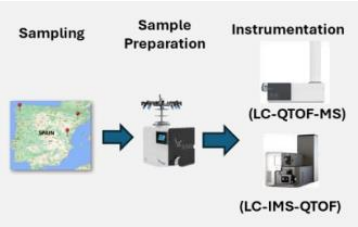



Natural organic matter (NOM) leads to disinfection by-products (DBP) formation during chlorination. This study evaluates the effects of ozonation, coagulation-flocculation, and activated carbon filtration on NOM removal, DBP reduction, and microbial risk in surface water. Ozonation, combined with coagulation-flocculation, showed significant reductions in turbidity and $UV_{254}$ absorbance. Activated carbon further decreased NOM, DBP precursors, and microbial activity, notably reducing the trihalomethanes potential formation (THM-PF) and assimilable organic carbon (AOC) levels. These results suggest that combining these processes enhances water treatment, minimizing both DBP risks and microbial regrowth potential.

## PC 71: Suspect Screening of 1100 Potentially Persistent, Mobile, and Toxic Substances in Spanish Water and Leachates Framed in the NePMTune Project

*M. Perin[1], S. Méndez[1], R. Rodil[1], L. Bijlsma[2], E. Pitarch[2], V. Acuña[3], J. Comas[3], R. Montes[1], J.B. Quintana[1]. (1) Department of Analytical Chemistry, Nutrition and Food Science & Aquatic One Health Research Center (iARCUS), Universidade de Santiago de Compostela, c/Constantino Candeira, 15782 Santiago de Compostela, Spain,* mauricio.perin@usc.es*. (2) Public Health and Environmental Analytical Chemistry, Research Institute for Pesticides and Water, University Jaume I, Castellon, Spain. (3) Catalan Institute for Water Research (ICRA-CERCA), Emili Grahit 101, 17003 Girona, Spain.*




The occurrence of persistent, mobile, and toxic substances (PMTs) in the water cycle represents a significant concern due to their inherent properties. A suspect screening strategy was developed for the analysis of the presence and origins of PMTs in aqueous samples across Spain. A database of 1100 chemical compounds were constructed for the purpose of suspect identification. A total of 47 samples, collected in 2023 from various regions of Spain, were analyzed. Following freeze-drying as a pre-concentration step, screening was conducted using mixed-mode liquid chromatography coupled to high-performance mass spectrometry (MMLC-HRMS), combined with ion mobility (IM) HRMS as a supplementary technique. A total of 98 PMTs were identified, distributed across the three confirmation levels: 53 at level 1, 30 at level 2, and 15 at level 3. Furthermore, of the PMTs identified at levels 2 and 3 in the samples, 29 were confirmed with an additional level of confidence using IM-HRMS. The most frequently detected compounds included *p* cumenesulfonic acid, 1,3-di-o-tolylguanidine, as well as pharmaceuticals such as N-desmethylvenlafaxine, tapentadol, and tramadol.

## PC 72: Wastewater Treatment and Pesticide Monitoring: Towards a Sustainable Water Reuse in Wineries

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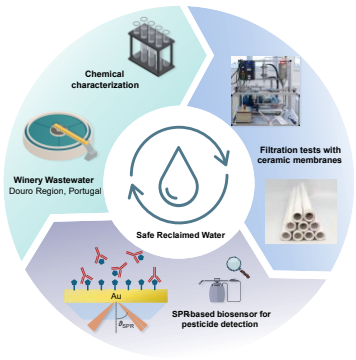


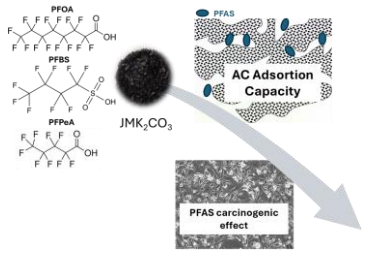

Water scarcity has a direct impact on the agricultural sector, reducing both crop yields and product quality. To address water shortage challenges, treated wastewater has been explored as an alternative in various non-potable applications. However, a significant concern with this approach is the presence of contaminants of emerging concern (CECs), such as pesticides, which often persist after conventional wastewater treatment, thus potentially accumulating in the environment when reintroduced.

In this study, winery wastewater was treated using $TiO_2$ ceramic membrane filtration to obtain Water for Reuse complying with Portuguese legislation quality standards for irrigation. Nevertheless, trace amounts of pesticides were detected in the permeate stream, emphasizing the importance of monitoring methods. To address this issue, a biosensor based on Surface Plasmon Resonance is being developed to provide data on real contamination levels. This will help optimize wastewater treatment processes and minimize the release of CECs into the environment.

This work was financially supported by project “Vine and Wine Portugal – Driving Sustainable Growth Through Smart Innovation” with reference number C644866286-00000011, co-financed by the Recovery and Resilience Plan (RRP) and NextGeneration EU Funds.

## PC 73: Perfluoroalkyl Substances (PFAS) Carcinogenic Capacity and their Effective Capture using Plant-based Activated Carbon

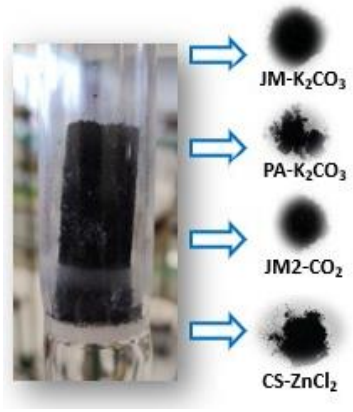
*Ida Soriente, Joana C. Bastos, Inês Matos, Maria Bernardo, João M. M.Araújo, Ana B. Pereiro. LAQV, REQUIMTE, Department of Chemistry, NOVA School of Science and Technology, NOVA University Lisbon, 2829-516 Caparica, Portugal,* anab@fct.unl.pt




Perfluoroalkyl substances (PFAS) persistence in the environment leads to their presence in drinking water, which is of high concern due to their potential human carcinogenic risk. Adsorption onto activated carbons (ACs) is a field-proven technology to remove long-chain PFAS, like PFOS and PFOA, from different water sources. Due to the rising concerns of emerging short-chain PFAS, new treatment technologies have recently been developed, investigated, and evaluated. The present work proposes an experimental strategy to prepare Juncus Maritimus-derived porous carbons using potassium carbonate ($K_2CO_3$). Adsorption isotherms were characterized for the developed biomaterial for both long-chain (PFOA) and shorter-chain PFAS (PFBS and PFPeA). The results showed higher selectivity for the PFAS removal. Also, the cytotoxic profiles of PFOA, PFPeA and PFBS were evaluated using the human breast cancer MDA cell line to evaluate their carcinogenic capacity up to the concentrations studied.

## PC 74: Production and Characterisation of Biomaterials for the Capture of Pharmaceuticals in Aqueous Effluents

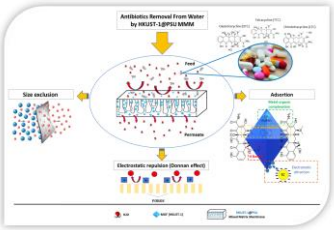
***Marta Dias, Inês Matos, Maria Bernardo, João M. M. Araújo, Ana B. Pereiro. LAQV, REQUIMTE, Department of Chemistry, NOVA School of Science and Technology, NOVA University Lisbon, 2829-516 Caparica, Portugal,*** *j.aguilar@campus.fct.unl.pt, anab@fct.unl.pt*




The increase in pollution levels across the globe is having a detrimental impact on the environment and human health, which is a matter of global concern. New effective techniques have been studied to capture and eliminate different emerging pollutants, such as pharmaceuticals, using promising activated carbons (AC). Plant biomass has been identified as a potential source for AC synthesis, offering the dual benefit of reducing AC production costs and promoting a circular economy. The pyrolysis process is employed in the production of ACs, which are then subjected to chemical (such as $K_2CO_3$ or $ZnCl_2$) and physical (such as $CO_2$) treatments to enhance their textual characteristics. Four activated carbons have been produced from different biomass sources (Phragmites Australis, Juncus Maritimus and Coconut Shell) using chemical and physical treatments. These ACs were characterized using elemental and textual analysis to determine their surface area and pore size. Besides, the thermal characterization was accessed by a thermogravimetric analysis (TGA). These four biomaterials were used for adsorption tests with three different pharmaceuticals (diclofenac, valsartan and iopromide) with the aim of defining the different adsorption capacities of these biomaterials and the time taken to reach equilibrium.

## PC 75: Advanced Membrane Technologies for the Removal of Contaminants of Emerging Concern: A One Health Perspective

*Célia M. P. G. Amorim[1,2], Edite Cunha[1,2], Ricardo A. L. S. Santos[1,3], Camille Kies[2], Diana I. S. P. Resende[2,4,5], Diana C. G. A. Pinto[1,3], Emília Sousa[2,4], Jaime E. Cevallos-Mendoza[1,2,6], Joan Manuel Rodríguez-Díaz[6], Maria Conceição B. S. M. Montenegro[1,2]. (1) LAQV-REQUIMTE, Portugal. (2) Faculty of Pharmacy, University of Porto, R. Jorge de Viterbo Ferreira 228, 4050-313 Porto, Portugal. (3) Chemistry Department, University of Aveiro, Campus Universitário de Santiago 3810-193 Aveiro, Portugal. (4) CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, Matosinhos, Portugal. (5) ICBAS, School of Medicine and Biomedical Sciences (ICBAS), University of Porto, R. Jorge de Viterbo Ferreira 228, 4050-313 Porto, Portugal. (6) Departamento de Procesos Químicos, Biotecnologia Y Alimentos, Facultad de Ingenierías Y Ciencias Aplicadas, Universidad Técnica de Manabí, Portoviejo, Ecuador.*



Contaminants of Emerging Concern (CECs) in aquatic systems pose a significant risk to public health and environmental sustainability. This study, rooted in the One Health framework, explores two approaches for CEC removal, focusing on antibiotics and metal ions. The first approach uses polysulfone membranes functionalized with HKUST-1 nanocrystals to efficiently remove tetracyclines, offering a sustainable water purification solution. The second approach targets iron [Fe(III)] removal with polymeric membranes functionalized with siderophores, using hydroxamic acids and catecholate moieties to enhance retention and reduce leaching. Both methods demonstrated effectiveness in removing organic and inorganic contaminants, highlighting their potential in mitigating health and environmental impacts. This work reinforces the need for advanced filtration technologies within a comprehensive One Health strategy for water resource protection.

## PC 76: Microplastics in Biogas Production: Unveiling the Impact of PLA, PET, PVC, and Their Mixtures on Anaerobic Fermentation

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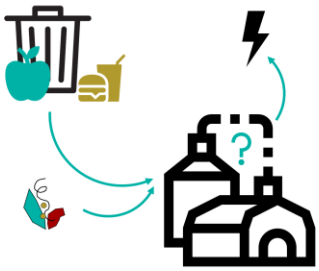


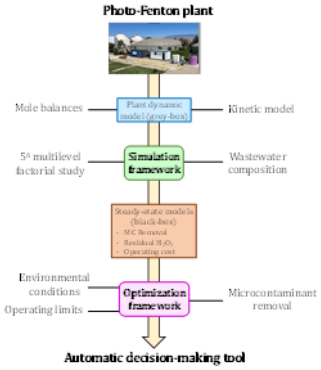
Anaerobic digestion, a critical process for biogas production as a renewable energy source, can be affected by the infiltration of microplastics. This study evaluates the impact PLA, PET, PVC, and their combinations on biogas production in anaerobic fermentation. Experiments were conducted using BMT under termophilic conditions over a 70-day period. Results showed significant differences in biogas production across the tested materials. PLA yielded the highest cumulative methane production at 0.416 $m^3$ $CH_4$/kgTS, indicating its superior biodegradability. PET and PVC produced lower cumulative methane yields, with values of 0.053 $m^3$ $CH_4$/kgTS and 0.095 $m^3$ $CH_4$/kgTS, respectively, likely due to their poor biodegradability and potential inhibition of microbial activity.

These findings provide valuable insights into the influence of microplastics on anaerobic digestion and highlight important implications for waste management strategies and renewable energy production.

This work was financially supported by the European Union under the REFRESH - Research Excellence For Region Sustainability and High-tech Industries, CZ.10.03.01/00/22_003/0000048via the Operational Programme Just Transformation. Experimental results were accomplished by using Large Research Infrastructure ENREGAT supported by the Ministry of Education, Youth and Sports of the Czech Republic under project No. LM2023056.

## PC 77: On the Automation of Solar Photo-Fenton Quaternary Treatment Plants: A Data-Based Optimization Approach

*D. Rodríguez-García[1], E. Gualda-Alonso[1], J.L. García Sánchez[1], J.L. Guzmán[1], J.L. Casas López[1], J.A. Sánchez Pérez[1]. (1) Solar Energy Research Centre (CIESOL) – University of Almería, Ctra. Sacramento s/n 04120, Almería, Spain,* drg975@ual.es




This work showcases the main design guidelines for implementing a data-based decision-making approach for the automatic operation of solar photo-Fenton treatment plants. The case study explores the removal of microcontaminants (MCs) from an urban wastewater treatment plant secondary effluent using a 100 $m^2$ raceway pond reactor. Automatic system design relied on the computational simulation of the plant using a kinetic model of the photo-Fenton process, previously validated in actual facilities. As a result, two data-based self-automatic procedures were obtained for 80-% and 90-% MC removal targets, operating cost minimization being the optimization target. Afterwards, the plant performance was evaluated for both clear and cloudy days. The simulation results showed the robustness and reliability of the automatic solution under adverse environmental conditions. These results highlight the potential of a reliable and easy-to-implement automatic operation strategy for immediate application in existing solar photo-Fenton plants, bridging the lack of real-time measuring equipment.

This work has been partially financed by the following research projects: INTEGRASOL project funded by MCIN, AEI & "NextGenerationEU"/PRTR (Grant Number TED2021-130458B-I00), LIFE PHOENIX project, funded by the European Union (Grant Number No. LIFE19ENV/ES/000278), and the University of Almeria (PPIT-UAL, Junta de Andalucía-ERDF 2021-2027. Programme: 54.A). D. Rodríguez-García acknowledges the Spanish Ministry of Universities for his predoctoral FPU research contract (FPU22/01465).

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- Efficient advanced oxidation processes
- Process-integrated water quality monitoring

**ENERGY**
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- Renewable and low-carbon fuels production
- Power-to-X applications
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**RESOURCE VALORISATION**
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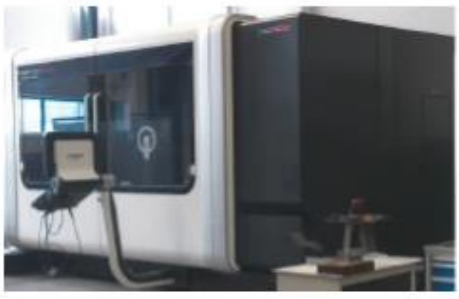

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# BMT MESSTECHNIK GMBH

## About

For over 35 years, BMT Messtechnik GmbH has specialised in the photometric measurement of ozone in air, oxygen, and water. As a technology leader in ozone measurement, we are dedicated to delivering measuring devices that boast the highest levels of accuracy, durability, and longevity on the market. We provide a comprehensive range of devices to address every conceivable issue.

Additionally, BMT offers compact and advanced air-cooled ozone generators suitable for ozone experiments and small-scale ozone systems. Our ozone instruments are globally utilised in various applications, including semiconductor, pharmaceutical, ballast water treatment, medical, and chemical industries.

For ozone treatment of water and wastewater, BMT provides complete solutions that cover all aspects of ozone measurement within a plant.

## Our products

- Ozone analysers for measurement in gas and water
- Ambient ozone monitors
- Air cooled ozone generators
- Ozone accessories

## Our services

- No preventive maintenance or recalibration required
- Long-lasting and very reliable
- Customised solutions
- Service available for minimum 20 years

### BMT 965 C

**FEATURES**

- 9 measurement ranges available: from 10 to 600 g/Nm³
- High accuracy, error less than 0.5 %
- Splash-proof housing (IP 65)
- Comes with throttle valve, flow meter, Purge Unit and Catalyzing Cartridge

**APPLICATIONS**

- Ozone measurement in hostile environment
- Potable water & waste water treatment
- Ballast water treatment

### BMT 803 BT-A

**FEATURES**

- More than 8 g/h of ozone @ 100 g/Nm ₃
- Ozone content up to 250 g/Nm ₃
- Complete control environment built in, including: check valves, thermal mass flow meter, particle filters, pressure gauges, power control selectable: manual or remote

**APPLICATIONS**

- Ozone generation in the laboratory
- Pilot plants for ozone processes

### Bubble Column BBC 4.1

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- Fine-pore bubble diffusor
- Counter-current gas-liquid flow
- Glass cylinder, volume 1.4 l
- Mounting option for sample gas dehumidifier DH6

**APPLICATIONS**

- Potable water treatment
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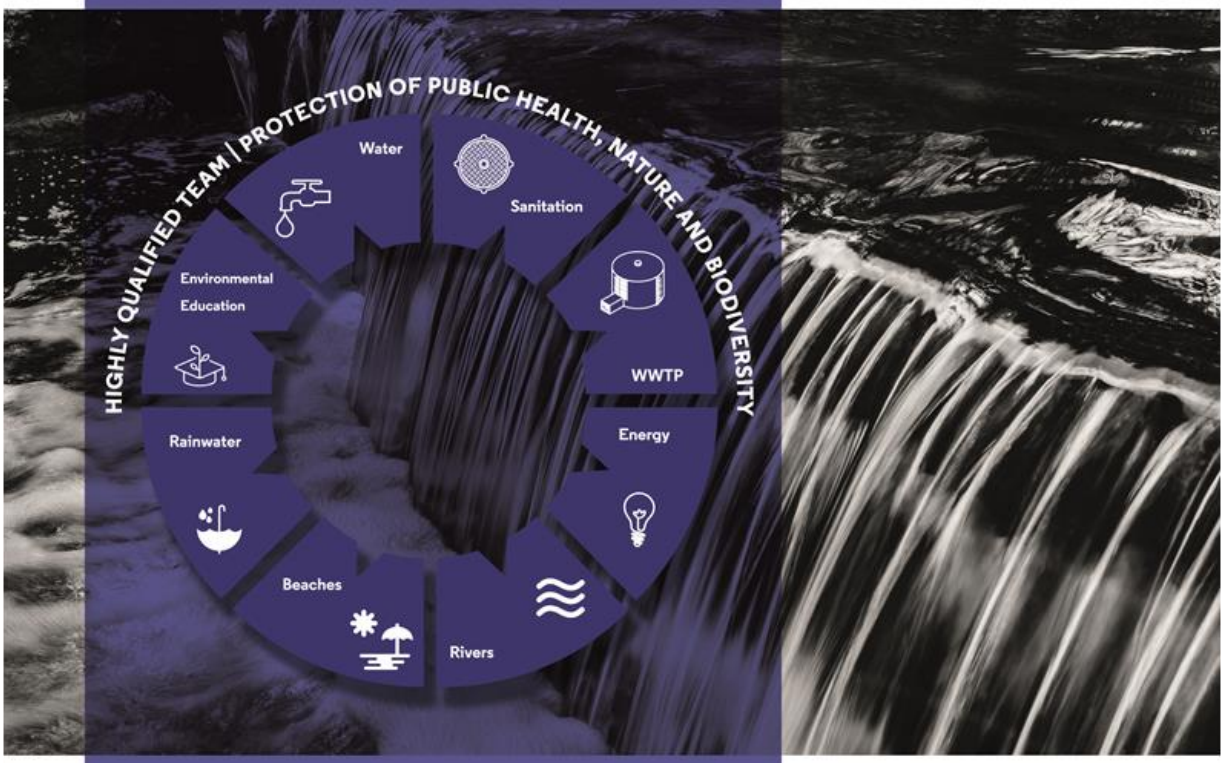


# WHATWEDO

Integrated and sustainable management of the entire **urban water cycle in the municipality of Porto**

**Water distribution**

**Wastewater drainage and treatment**

**Rainwater drainage**

Management of **urban rivers and streams**

**Seafront management**

Promotion of **environmental education and sustainability**

Analytical control of **water quality** throughout the urban cycle (**accredited Laboratory**)

Responsible for the **municipal energy management**

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a part of BEWG group

# Raising the standard in water management

## We are proud of who we are and what we stand for.

We have extensive experience in managing the urban water cycle in the different contracts we operate.

Currently, throughout Portugal, we serve more than 645,000 people, both as the managing entity of water and sanitation concessions, and as provider of infrastructure operation and maintenance services. Besides our contracts with municipal and multi-municipal systems, we have also a significant track record in operating and maintaining industrial systems.

We are proud to be a trustworthy and respected company in the eyes of our employees, customers and partners, but also in the eyes of the society. We are aware that we can only achieve this by promoting the right measures in our daily routines and by behaving with integrity in everything we do.

### Water Protection

At Be Water, we always strive to act according to principles of efficiency, non-pollution, durability and circularity, seeking to minimize the ecological footprint of our presence and inspire others to do the same.

### People and Community

Because we value the communities in which we operate, we are committed to give back value to everyone in these communities, with a responsible attitude and an educational message focused on good environmental practices among the population.

### Corporate sustainability

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AdDP is responsible for the design, construction and management of the collection, treatment and distribution of drinking water to the reservoirs of the 20 adherent municipalities, supplying a total of 1.8 million inhabitants, in an area of 2715 km².

The construction of AdDP's System of Water Supply is almost finished, since the Distribution System Network covers 100% of the 20 shareholders municipalities.

**Investment**

From the start of the concession in 1996, the company invested approximately 454.5M€, of which about 160 M€ were reimbursed by the European Cohesion Fund and 1.4 M€ by the Operational Program for Sustainability and Resource Efficiency.

**Main Infrastructures**

AdDP has 9 surface, underground and alluvial catchments and 5 Water Treatment Plants. It distributes drinking water through a pipeline network of more than 513 km which includes 28 Pumping Stations and 37 Reservoirs.

**Vision**

To be recognized by our efficiency, competence, sustainability and value creation for the region.

**Mission**

Manage the Water Supply System, ensuring efficiency, reliability, service quality, product safety and respect for the highest social and environmental values.

**Quality of the product**

AdDP seeks to systematically anticipate and meet the needs and expectations of its customers and other stakeholders, to increase the efficiency and effectiveness of the service provided to the consumers.
Therefore, the safety of the water supplied for human consumption is a core concern of the company, which pays constant attention to product conformity, consumer health protection and risk management at all stages of the supply system.

The results of the water quality control obtained under the Water Quality Control Plan are published quarterly on AdDP's website (www.addp.pt) and sent to the Health Authority, as well as annually to ERSAR.

The quality of the water provided by the management entities is evaluated and spread annually by ERSAR in its Annual Report of the Water and Waste Sector in Portugal. In 2023 AdDP conducted 71,418 water analysis with 99.98% conformity.


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