14 PhD positions available

for EU project (ITN-European Joint Doctorate)

NOWELTIES

NOWELTIES - Joint PhD Laboratory for New Materials and Inventive Water Treatment Technologies. Harnessing resources effectively through innovation is a Marie Sklodowska Curie Action European Joint Doctorate (EJD) project (programme Innovative Training Networks (ITN) of Horizon 2020). Its primary objective is to organize a platform that will provide cutting edge training opportunities for the education of tomorrow`s water treatment experts. The core activity is the research programme (composed of 14 individual research projects) aimed at development of inventive water treatment technologies (advanced biological treatments, innovative oxidation processes, hybrid systems) that allow catering for the varied treatment demands for a plethora of interconnected streams arising from recycling loops. These technologies will be able to control contamination by organic micropollutants (OMPs) and improve recovery of water across a diversity of scales enabling a smart combination of decentralized and centralised approaches. Besides a holistic training in the field of wastewater treatment dealing with state-of-the-art technologies, experimental techniques and knowledge management methodologies, NOWELTIES will provide a unique training approach to learning complex complementary skills leading to independent and critical thinking which seeks for originality and innovation.

Therefore, we are looking for **14 post-graduate researchers** (Early Stage Researchers - ESR), specialized in Chemistry, Chemical, Environmental, Hydrogeological or Materials Engineering, Biotechnology, Physics or similar.

Candidates should have a strong interest in (waste)water treatment and interdisciplinary research including bioprocesses for wastewater treatment, nanotechnology, and fate of organic and inorganic contaminants in engineered treatment systems.

The position is offered for **3 years** for the following individual research projects:

ESR	Title of PhD thesis	Host institution
1	Understanding biotransformation mechanisms of OMPs during anoxic biological wastewater treatment	University of Santiago de Compostela, Spain
2	Studying the bioavailability and biodegradability of OMPs during treatment	RWTH Aachen University, Germany
3	Coupling the new concept of sequential biofiltration with in situ electron acceptor delivery for enhanced OMP removal and effective attenuation of disinfection by-product precursors	Technical University of Munich, Germany
4	Design, development and characterization of atmospheric plasma system for wastewater treatment	Institute of Physics, Belgrade, Serbia

5	Understanding transformation of OMPs during plasma treatment and its ecotoxicological implications	Catalan Institute for Water Research, Girona, Spain
6	Application of UV LEDs AOPs for the efficient removal of OMPs from waste water	Faculty of Chemical Engineering and Technology, Zagreb, Croatia
7	Surface modification and functionalisation of adsorbent materials	Faculty of Technology and Metallurgy, Belgrade, Serbia
8	A green microwave - assisted synthesis of Au/TiO_2/graphene oxide nano-hybrids for visible light-induced photocatalysis	Faculty of Mechanical Engineering and Naval Architecture, Zagreb, Croatia
9	Removal of OMPs by nanophotocatalysts and nanobiocatalysts immobilized into magnetic supports	University of Santiago de Compostela, Spain
10	Novel TiO_2-based composite co-catalysts for solar driven water purification	Faculty of Chemical Engineering and Technology, Zagreb, Croatia
11	Studying the enhancement of the removal of OMPs from wastewater by adding powder activated carbon in an MBR	University of Ferrara, Italy
12	Design of hybrid nano-engineered reductive bioprocesses for wastewater treatment and biogas generation	Catalan Institute for Water Research, Girona, Spain
13	Development of hybrid treatment system by integrating nanocatalyst and adsorptive composites *in situ* in sequential biofiltration systems	Technical University of Munich, Germany
14	Hybrid ozone-ceramic membrane process: increasing hydroxyl radical yield and OMP reduction while reducing membrane fouling	Catalan Institute for Water Research, Girona, Spain

All hired researchers will compulsory enrol in Doctoral Programmes at two Universities (host institution and mobility host) and undertake **mobility** in order to implement the Individual Research Project, as well as to participate in a sustained training programme that will lead to awarding **double doctoral degree**.

- Remuneration according to [MSCA ITN rules]

Eligibility criteria

- Nationals from any country may apply
- **Mobility**: at the time of the recruitment, the researcher must not have resided or carried out his/her main activity (work, studies, etc.), in the country of the chosen host institution (recruiting beneficiary) for more than 12 months in the 3 years immediately prior to the date of the recruitment.
- **Research category** of *Early Stage Researcher (ESR):* researchers who, at the time of the recruitment, have not yet been awarded a doctorate degree and are in the first 4 years (full-time equivalent) of their research careers, including the research training period that would entitle them to a doctorate.

General evaluation criteria

- Educational background relevant for the chosen position (individual research project)
- For holders of an official university degree from the countries within the European Higher Education Area (EHEA): A minimum of 300 ECTS credits completed in official university studies are required, of which at least 60 must be at a master's degree level. For holders of a university degree obtained in another country, an equivalent degree that qualifies the holder to begin doctoral studies in the country in which it was issued (a certificated from the University may be required).
- Previous research experience, relevant to the chosen position.
- High proficiency in spoken and written English
- Networking and communication skills (to be evaluated in the interview).

Selection process

Pre-selection: will be based on CV, experience, skills and motivation letter.
Interviews: Short-listed candidates will be interviewed.

Start of contract: September 1st, 2019

How to apply

Applicants should send full application consisting of:

- **Curriculum Vitae** (Europass format recommended; Please specify your residence/work place in the last 3 years).
- **University transcripts** (grades)
- **A statement letter** addressing his/her research interests in relationship to the selected individual research project.
- Applicants **should indicate two individual research projects** in order of preference (1st and 2nd choice)
- 2 **recommendation letters**

to nowelties@icra.cat indicating ref. "NOWELTIES call for ESRs" in the subject of the email**.**

The deadline to submit the required documentation is 1 March 2019.

List of Individual Research Projects

Fellow code: ESR 1	
Title of individual research project	**Understanding biotransformation mechanisms of OMPs during anoxic biological wastewater treatment**
Host institution	University of Santiago de Compostela (USC), Spain
Double doctorate degree	1. University of Santiago de Compostela (USC), Spain 2. RWTH Aachen University (RWTH), Aachen, Germany
Brief description of individual research project	This project will address the following objectives: **(i)** Cometabolic biotransformation of selected OMPs, aimed to identify the relation between the primary anoxic metabolism in biological wastewater treatment processes and the simultaneous biotransformation (efficiency and rate). Lab-scale reactors will be set-up to study the co-metabolic biotransformation of OMPs under strictly controlled anoxic conditions. A synthetic medium, containing a carbon and a nitrogen source, as well as the macro and micronutrients for denitrifying biomass growth will be used as feed. **(ii)** The relation between the enzymes involved in denitrifying processes (functional genes) and OMP biotransformation will be assessed. The aim is to elucidate which of the enzymes/enzymatic activities that are active during these processes are responsible for the biotransformation of OMPs. Besides, enzymatic assays with commercial enzymes or cell lysate extracted from biomass of the lab-scale reactors will be considered. **(iii)** Finally, the removal mechanisms (sorption, biotransformation, mineralisation) of the selected target OMPs and key metabolites will be assessed by using ^{14}C-radiolabelled OMPs in order to determine and quantify their fate under each condition studied.
Mobility	Rheinisch-Westfaelische Technische Hochschule Aachen, Germany – 6 months University of Applied Sciences and Arts, Northwestern Switzerland – 4 months
Supervisory team	Francisco Omil (USC) Andreas Schaeffer (RWTH) Sonia Suarez (USC)
Educational requirements	Biotechnology, Chemical Engineering, Environmental engineering, or similar.
Other specific requirements	Knowledge about the application of microbial ecology molecular techniques to water treatment bioreactors will be favorably considered

Fellow code: ESR 2	
Title of individual research project	**Studying the bioavailability and biodegradability of OMPs during treatment**
Host institution	Rheinisch-Westfaelische Technische Hochschule Aachen, Germany
Double doctorate degree	1. RWTH Aachen University (RWTH), Aachen, Germany 2. University of Santiago de Compostela (USC), Spain
Brief description of individual research project	This project will develop polymer-based tools to measure and control the bioavailable dissolved concentrations of OMPs during their biological treatment for better understanding the key factors limiting bioavailability and thus OMP removal by microorganisms. The focus will be on two aspects: (i) using passive sampling to measure changes in the bioavailable dissolved concentrations in analogous reactors to those used for the biological treatment in ESR 1, and (ii) applying passive dosing to investigate whether there are threshold concentrations of OMPs that are required for induction of the catabolic pathways. By measuring the bioavailable dissolved concentrations, the role of factors influencing supply (e.g., chemical properties, matrix sorption) as well as removal (e.g., microbial growth in the presence of co-substrates) will be studied in order to identify bottlenecks in the biotransformation process. In addition, this data will be used as input into existing biodegradation models. By testing decreasing bioavailable dissolved concentrations, the hypothesis that there is a threshold concentration for OMPs biotransformation will be examined. OMP transformation will be examined at the cell level (i.e., enzyme activity) but also at the molecular level (i.e., protein and gene induction/repression).
Mobility	University of Santiago de Compostela (USC), Spain – 12 months
Supervisory team	Andreas Schaeffer (RWTH) Juan Lema (USC)
Educational requirements	Environmental chemistry or analytics, Environmental engineering,
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment and biological treatment processes will be considered a plus.

Fellow code: ESR 3	
Title of individual research project	**Coupling the new concept of sequential biofiltration with in situ electron acceptor delivery for enhanced OMP removal and effective attenuation of disinfection by-product precursors**
Host institution	Technical University of Munich (TUM), Germany
Double doctorate degree	1. Technical University of Munich, Germany 2. University of Girona, Spain
Brief description of individual research project	This project will develop targeted approaches to establish in situ concepts for electron acceptor delivery (e.g., H2O2, O2, ozone) in sequential biofiltration systems by employing gas-permeable membranes for efficient mass transfer using an existing pilot-scale biofiltration system in addition to lab-scale reactors for supplemental controlled experiments. Delivery concepts and in situ mass transfer of electron acceptors and establishment of oxic redox zones in a plug-flow biofiltration reactor will be investigated and modelled. The adaptation of the make-up and functionality of the microbiome to upregulate more suitable enzymes (i.e., monooxygenases) will be characterized using metagenomic and metatranscriptomic analyses. Kinetic studies will derive rate constants for a sequence of altered redox conditions to assess removal performance for OMPs. For select indicator chemicals, the degree of biotransformation will be characterized by determining OMP transformation products for sequential biofiltration using oxygen vs. ozone. In addition, since sequential redox zones can also affect biotransformation of bulk organic carbon (DOC), the formation potential of disinfection byproducts during subsequent disinfection of the effluent will be determined while employing different electron acceptors during sequential biofiltration.
Mobility	Catalan Institute for Water Research (ICRA), Girona, Spain – 9 months
Supervisory team	Jörg E. Drewes (TUM), Uwe Hübner (TUM) Maria Jose Farre (ICRA)
Educational requirements	Biotechnology, Chemical Engineering, Environmental Engineering, Hydrogeological Engineering, Environmental Science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment and biological treatment processes will be considered a plus.

Fellow code: ESR 4	
Title of individual research project	**Design, development and characterization of atmospheric plasma system for wastewater treatment**
Host institution	Institute of Physics, Belgrade, Serbia
Double doctorate degree	1. Faculty of Technology and Metallurgy, Belgrade, Serbia 2. University of Girona, Spain
Brief description of individual research project	Atmospheric pressure (AP) non-equilibrium plasma sources provide a chemically rich environment allowing various reactions between species at ambient temperature. Such plasma could be optimised and used as efficient tool for treatment of wastewaters with an ability to adjust the plasma produced mixture of reactive species to a variety of treatment objectives. In order to make an optimized device for water treatment two phases will be engaged: (i) design of an AP plasma source, including choice of the source type and electrode geometry and appropriate power input, and (ii) diagnostics of plasma properties produced by the device running in the realistic environment. The survey on the source type will help to construct the device which will be relatively technically simple and reliable and, at the same time, able to produce the plasma environment to be applied to treatment of liquids. The choice of power input is closely connected to the plasma source type, as well as, operational requirements regarding the plasma treatment. After technical development of the AP source, complete characterisation of plasma operating with different parameter settings will be performed by using different measurement techniques (electrical measurements of plasma power, mass spectrometry will measure densities of neutral and charged species, while optical measurements will deliver data on emission coming from the plasma). The last two techniques will gain detailed insight into the plasma chemistry which will consequently allow identifying crucial reactions involved in decomposition of water OMPs (chosen between the most common groups of pesticides, insecticides and pharmaceuticals). The analytical techniques will be complemented by an experimental plan including a selected choice of organic and inorganic matrix components influencing the propagation and lifetime of reactive species in the liquid environment. Optimisation of the device will be performed in order to achieve plasma conditions for efficient wastewater treatment for different types of OMPs.
Mobility	Catalan Institute for water Research (ICRA), Girona, Spain – 10 months
Supervisory team	Nevena Puac (IPB) Wolfgang Gernjak (ICRA) Dragan Povrenovic (TMF)
Educational requirements	Physics, Plasma physics, Physical Chemistry or similar.
Other specific requirements	Experience with experimental plasma physics and skills in electronics and electrical engineering are desirable.

Fellow code: ESR 5	
Title of individual research project	Understanding transformation of OMPs during plasma treatment and its ecotoxicological implications
Host institution	Catalan Institute for Water Research, Girona, Spain
Double doctorate degree	1. University of Girona, Spain 2. University of Ferrara, Italy
Brief description of individual research project	Non-thermal plasma in liquid and gas-liquid environments generates in situ oxidizing species, such as hydroxyl radicals, ozone, hydrogen peroxide, peroxynitrites etc., capable to degrade OMPs from the solution relatively quickly, and even using low power discharges. However, oxidative breakdown is influenced by the scavenging capacity of matrix components, resulting in the accumulation of transformation products (TPs) rather than complete mineralization. Knowledge regarding the degradation mechanisms of the investigated chemical compounds under plasma conditions and the evolution of reaction by-products are crucial from the point of view of practical application and optimization of treatment time and power discharges. The main objective of this project is to elucidate transformation pathways of selected organic micropollutants (WFD Watch List compounds recalcitrant to biological treatment) using advanced analytical methodologies based on high resolution mass spectrometry (Orbitrap MS) and to identify those transformation products posing the highest risk for the aquatic environment if discharged or for humans in case of reuse of treated water for potable purposes. Effect of process modifications (the addition of catalysts or combination of plasma with ozonation) on the formation of TPs and their persistence will be evaluated.
Mobility	University of Ferrara, Italy – 6 months Institute of Physics, Belgrade, Serbia – two short stays (1 month)
Supervisory team	Mira Petrovic (ICRA) Paola Verlicchi (UNIFE) Nevena Puac (IPB)
Educational requirements	Chemistry, Chemical Engineering, Environmental engineering , Environmental science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of analyses of organic contaminants in water using LC-MS will be considered a plus.

Fellow code: ESR 6	
Title of individual research project	**Application of UV-LEDs AOPs for the efficient removal of OMPs from wastewater**
Host institution	Faculty of Chemical Engineering and Technology (FKIT), Zagreb, Croatia
Double doctorate degree	1. Faculty of Chemical Engineering and Technology (FKIT), Zagreb, Croatia 2. University of Girona, Spain
Brief description of individual research project	Advanced oxidation processes (AOPs) have proven to be among the most effective techniques for removing OMPs from water samples. However, for economic feasibility, the source of light is a critical aspect of AOPs. The objective of the proposed project is to develop and optimize innovative technology based on UV-LED AOP for the economically viable treatment of wastewaters containing OMPs with the goal to maximize the effectiveness regarding OMPs removal, toxicity and biodegradability of treated water. The research work will be focused on studying the applicability of different UV-LED AOPs for the degradation of pharmaceuticals in simulated and real wastewater. The following AOPs will be investigated: photochemical (UV-C with H2O2) and photocatalytic (UV-C, UV-A) with TiO2 with/without addition of H2O2. Degradation of targeted OMPs and formation of their transformation products will be monitored by LC coupled to high resolution mass spectrometry (HRMS) and by toxicity on Vibrio fischeri and Daphnia magna. An evaluation of potential reactor geometries and positioning of LEDs inside the photoreactor will be conducted as well as designing treatment applications that adjust to the unique features of LEDs compared to other light sources.
Mobility	Catalan Institute for Water Research (ICRA), Girona, Spain – 6 months
Supervisory team	Sandra Babic (FKIT) Gianluigi Buttiglieri (ICRA)
Educational requirements	Chemistry, Chemical Engineering, Environmental engineering, Environmental science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment and oxidation processes will be considered a plus.

Fellow code: ESR 7	
Title of individual research project	**Surface modification and functionalisation of adsorbent materials**
Host institution	Faculty of Technology and Metallurgy (TMF), Belgrade, Serbia
Double doctorate degree	1. Faculty of Technology and Metallurgy (TMF), Belgrade, Serbia 2. Faculty of Mechanical Engineering and Naval Architecture (FSB) , Zagreb, Croatia
Brief description of individual research project	Nano-engineered adsorbents offer great potential for water innovations, in particular for decentralized treatment systems, point-of-use (POU) and point-of-entry (POE) devices and for removing non-degradable contaminants. This ESR project will study processes for surface modification and functionalisation of inorganic (natural zeolites) and carbon based (graphene oxide (GO) and reduced graphene oxide (RGO) adsorbents aimed to improve their sorptive characteristic and applicability in wastewater treatment. Sorbent surface will be modified to improve adsorptive efficiency and surface polarity using two approaches: 1) impregnation by different oxides (using thermal and mechano-chemical treatments) and biopolymers (wet impregnation of chitin, alginate) and 2) use of environmental friendly non-equilibrium plasmas operating at atmospheric and low pressures for enhanced performance of the adsorbents. Plasma–surface interactions will tune physical, chemical, and morphological properties of adsorbents.
Mobility	Faculty of Mechanical Engineering and Naval Architecture (FSB) , Zagreb, Croatia – 8 months
Supervisory team	Nevenka Rajic (TMF) Lidija Curkovic (FSB) Nikola Skoro (IPB)
Educational requirements	Chemistry, Chemical Engineering, Environmental engineering, Materials Engineering, Environmental science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment, material sciences or plasma processing will be considered a plus.

Fellow code: ESR 8	
Title of individual research project	**A green microwave - assisted synthesis of Au/TiO2/graphene oxide nanohybrids for visible light-induced photocatalysis**
Host institution	Faculty of Mechanical Engineering and Naval Architecture (FSB) , Zagreb, Croatia
Double doctorate degree	1. Faculty of Mechanical Engineering and Naval Architecture (FSB) , Zagreb, Croatia 2. University of Girona, Spain
Brief description of individual research project	Graphene oxide (GO), a new class of carbon material comprising of single-atom-thick sp2 hybrid carbon atoms, has received much attention owing to its intriguing characteristics (large surface area and high activity). It has been confirmed that graphene oxide composites with metal oxides, especially with TiO2 render better photocatalytic activity than pure ones. Main objective of this project is development, synthesis and characterization of novel ternary composites based on Au/TiO2/graphene oxide photocatalysts with low band gap energies and increased visible-light-driven photocatalytic activities. For the synthesis of gold nanoparticles (AuNPs) an eco-friendly method with plant extract as a natural source of both the reducing and the stabilizing agents will be used. GO will be synthesized using the improved Hummer's method. Synthesis of nanohybrids will be performed by microwave-assisted sol–gel method. The films will be characterized by FTIR, XRD, Raman and micro-Raman spectroscopy, FESEM, AFM, UV-Vis, SEM-EDS, X-Ray photoelectron spectroscopy (XPS), ellipsometry, DTA, TGA, DSC, UV/VIS diffuse reflectance spectroscopy, Brunnauer–Emmett–Teller surface area. The developed catalysts will used in solar driven AOPs for OMPs (i.e. human antibiotics, psychiatric drugs, personal care products, disinfection by-products) degradation in urban wastewater focusing on the study of byproducts formation.
Mobility	Catalan Institute for Water Research (ICRA), Girona, Spain – 10 months
Supervisory team	Lidija Curkovic (FSB) Jelena Radjenovic (ICRA)
Educational requirements	Chemistry, Chemical Engineering, Environmental engineering , Environmental science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of material synthesis, characterization or oxidation processes will be considered a plus.

Fellow code: ESR 9	
Title of individual research project	**Removal of OMPs by nanophotocatalysts and nanobiocatalysts immobilized into magnetic supports**
Host institution	University of Santiago de Compostela (USC), Spain
Double doctorate degree	1. University of Santiago de Compostela (USC), Spain 2. RWTH Aachen University (RWTH), Aachen, Germany
Brief description of individual research project	The possibility of combining the co-precipitation of the ZnO and TiO2 nanoparticles with magnetic materials offers a great advantage and simplification for their use as photocatalysts, as they could be separated with a magnetic field. Furthermore, superparamagnetic nanoparticles based on magnetite have been recently employed as supporting materials for oxidative enzymes and used as nanobiocatalysts. However, both alternatives have not been evaluated so far for water treatment. This project opens a multifocal approach for the removal of emerging contaminants focused on: (i) the potential of the tailor-made magnetic nanocatalyst in a formulated combination of photocatalyst (TiO2 and ZnO) with magnetite, (ii)the capacity of the magnetic nanobiocatalyst in a formulated combination of laccase and silica magnetic nanoparticle to be used in the different configurations of the magnetic reactor with internal and external separation of the nanoparticle, (iii) the removal of the target OMPs will be attempted using the different approaches of photocatalysis and biochemical catalysis.
Mobility	Rheinisch-Westfaelische Technische Hochschule Aachen, Germany – 6 months University of Applied Sciences and Arts, Northwestern Switzerland – 4 months
Supervisory team	M. Teresa Moreira (USC) Andreas Schaeffer (RWTH) Philippe Corvini (FHNW)
Educational requirements	Biotechnology, Chemical Engineering, Environmental engineering, Environmental science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment and oxidation processes will be considered a plus.

Fellow code: ESR 10	
Title of individual research project	**Novel TiO2-based composite co-catalysts for solar driven water purification**
Host institution	Faculty of Chemical Engineering and Technology (FKIT), Zagreb, Croatia
Double doctorate degree	1. Faculty of Chemical Engineering and Technology (FKIT), Zagreb, Croatia 1. University of Girona, Spain
Brief description of individual research project	Harvesting a broader spectrum of solar irradiation for TiO2 utilization in environmental purposes considers the lowering of band gap of applied material, whilst inhibiting the recombination of photogenerated charges. Several strategies, including: surface modification, nonmetals incorporation, doping with metals, dye sensitizing and composites with other semiconductors, may be applied. The latter offers viable solution for set tasks, particularly when using photocatalytically active semiconductors possessing significantly lower band gap than TiO2. Among them, SnS2, BiVO4 and α-Fe2O3 are rather innocuous, their conduction bands are more negative than that of TiO2, ensuring fast and efficient injection of electrons. The effectiveness of such composite materials in solar driven water treatment may be enhanced with additional co-catalyst material, graphene oxide (and its reduced form – GO/RGO), ensuring an increase in the surface area as well as reduction of photogenerated electrone/hole (e-/h+) pairs, and providing durable properties through consecutive runs. The prepared composites will be inspected for their structure, morphology, composition and optical properties by: FTIR, TGA, SEM/EDXS, XRD, AFM, XPS and DRS. Solar driven water treatment using as-prepared composite photocatalysts will be focused on the removal/degradation of emerging OMPs included in the Watch list of EU WFD.
Mobility	Catalan Institute for Water Research (ICRA), Girona, Spain – 6 months
Supervisory team	Hrvoje Kusic (FKIT) Mira Petrovic (ICRA)
Educational requirements	Chemical Engineering, Environmental Engineering, Environmental Science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment and oxidation processes will be considered a plus.

Fellow code: ESR 11	
Title of individual research project	**Studying the enhancement of the removal of OMPs from wastewater by adding powder activated carbon in an MBR**
Host institution	University of Ferrara (UNIFE), Italy
Double doctorate degree	1. University of Ferrara (UNIFE), Italy 2. Faculty of Chemical Engineering and Technology (FKIT), Zagreb, Croatia
Brief description of individual research project	Membrane bioreactors (MBRs) are considered an effective biological and physical barrier in the wastewater treatment process. Their performance is strictly correlated to operational conditions (SRT, HRT, reactor configuration, redox, T), but even by optimizing them, a complete removal of OMPs is not achievable due to the wide spectrum of chemical and physical characteristics of the OMPs. The core of this project will be the development of a hybrid system that is of an enhanced bioreactor, obtained by adding powder activated carbon (PAC) in an MBR to also favour sorption process for the removal of OMPs from wastewater (mainly pharmaceuticals).The project will investigate the effect of different dosages of PAC on the removal of the selection of OMPs, the global removal efficiency for the selected compounds by using a pilot-scale hybrid MBR fed with real wastewater and a full-scale MBR fed with hospital wastewater (= the full scale MBR treating the effluent of the large hospital of the town). The degradation pathways of the selected OMPs will be studied and a mass balance will point out the main removal mechanisms occurring for the selected compounds. An evaluation of the technical feasibility of the proposed treatment system and an economic analysis will complete the investigation.
Mobility	Faculty of Chemical Engineering and Technology (FKIT), Zagreb, Croatia - 12 months
Supervisory team	Paola Verlicchi (UNIFE) Dragana Mutavdzic-Pavlovic (FKIT)
Educational requirements	Biotechnology, Chemical Engineering, Environmental engineering, Environmental science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment will be considered a plus.

Fellow code: ESR 12	
Title of individual research project	**Design of hybrid nano-engineered bioprocesses for wastewater treatment**
Host institution	Catalan Institute for Water Research (ICRA), Girona, Spain
Double doctorate degree	1. University of Girona, Spain 2. Technical University of Munich, Germany
Brief description of individual research project	The capability of microbes to reduce functionalized graphene compounds can be used for advanced biological treatment of wastewater. Addition of low cost graphene oxide to an anaerobic community may enhance the redox conversion of persistent pollutants to their less toxic equivalents. The role of bioreduced graphene oxide (bRGO) in the anaerobic conversion of contaminants seems to be dual, as it may act as electron shuttle between the microorganisms and the pollutants, and it may promote the direct interspecies electron transfer between the microorganisms. This project will focus on developing a hybrid nano-engineered biotreatment based on bRGO. We will evaluate the redox conversion and metabolic pathways of a range of pollutants persistent to aerobic treatment (e.g., halogenated, nitro and azo-compounds). The addition of graphene oxide will be evaluated under methanogenic and sulfate-reducing conditions. Given that the presence of bRGO may also enhance methane production, the process will also be evaluated in terms of the production and quality of the biogas.
Mobility	Technical University of Munich, Germany – 12 months
Supervisory team	Jelena Radjenovic (ICRA) Jörg E. Drewes (TUM), Konrad Koch (TUM)
Educational requirements	Chemical Engineering, Environmental Engineering, Biotechnology, Environmental Sciences, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment, biological treatment processes, and analyses of organic and inorganic contaminants in water including GC- and LC-MS will be considered a plus.

Fellow code: ESR 13	
Title of individual research project	**Development of hybrid system by integrating nanocatalyst and adsorptive composites in situ in sequential biofiltration systems**
Host institution	Technical University of Munich, Germany
Double doctorate degree	1. Technical University of Munich, Germany 2. University of Santiago de Compostela (USC), Spain
Brief description of individual research project	Sequential biofiltration systems offer tremendous opportunities to enhance the degradation of OMPs. However, contaminants that are not amendable to biological or chemical oxidation will not be effectively attenuated. Thus, combining these biological processes with innovative physico-chemical processes employing novel (nano) engineered materials and adsorptive composites as well as next-generation membranes can result in the establishment of a wide range of different OMPs as well as microbial contaminants (i.e., viruses, antibiotic resistant bacteria or antibiotic resistance genes). Building upon the findings of WP1 and 4, suitable nano-engineered materials and composites (chitosan nanocomposites) will be incorporated as reactive barrier in the sequential biofiltration concept to target OMPs that are not suitable to biological degradation. In addition, next-generation membranes will be employed as a final polishing step after biofiltration exhibiting low fouling propensities. These process combination might enhance not only the removal of OMPs but also the reduction of antibiotic resistance genes while exhibiting a low carbon footprint. Targeted studies will be conducted to elucidate the fate and transport of these contaminants in these hybrid systems including a life cycle analysis and life cycle costing in comparison to traditional advanced water treatment processes.
Mobility	University of Santiago de Compostela (USC), Spain – 12 months
Supervisory team	Jörg E. Drewes, Uwe Hübner (TUM) Gumersindo Feijoo (USC)
Educational requirements	Biotechnology, Chemical Engineering, Environmental Engineering, Hydrogeological Engineering; Environmental Science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment will be considered a plus.

Fellow code: ESR 14	
Title of individual research project	**Hybrid ozone-ceramic membrane process: increasing hydroxyl radical yield and OMP reduction while reducing membrane fouling**
Host institution	Catalan Institute for Water Research (ICRA), Girona, Spain
Double doctorate degree	1. University of Girona, Spain 2. Faculty of Mechanical Engineering and Naval Architecture (FSB) , Zagreb, Croatia
Brief description of individual research project	Ozonation is a standard process applied for reducing OMP concentrations in secondary effluent. As many key OMPs react slowly with ozone, an increased degree of conversion of ozone to hydroxyl radicals is desirable, which would allow reducing the necessary transferred ozone dose to achieve the process aim. Two essential types of catalysts exist in heterogeneous catalytic ozonation, metal oxides and activated carbon. Ceramic membranes offer durability and high integrity, both features that are desirable in mitigating water quality risks in water reuse including microbiological ones. Recently, several studies reported on the positive impact of pre-ozonation on membrane fouling, but essentially, their metal oxide surface can act also as catalyst to decompose residual ozone, generating thereby hydroxyl radicals inside the membrane that could reduce OMPs. Optionally, suspended powered activated carbon or membrane surface modification can be used as further means to increase the hydroxyl yield. The synergistic integration of ozonation and ceramic membrane filtration thereby provides an interesting package providing abatement of chemical and microbiological contaminants alike. There are a number of unknown fundamental aspects related to this process ranging from materials science to chemical engineering that will be studied. Also, other water quality aspects will be studied, such as the influence of water matrix compounds and the reduced formation of undesired ozonation byproducts such as NDMA or bromate
Mobility	Faculty of Mechanical Engineering and Naval Architecture (FSB) , Zagreb, Croatia – 12 months
Supervisory team	Wolfgang Gernjak (ICRA) Lidija Curkovic (FSB)
Educational requirements	Chemical Engineering, Environmental Engineering, Environmental Science, or similar.
Other specific requirements	Previous experience in experimental research-like activities (e.g. demonstrated in the form of master thesis work) in the field of (waste)water treatment will be considered a plus.