

**Name:**

Jesús Quintana Terriza

Research Group (if relevant):

TARINDUSTRIAL Escuela Técnica Superior de ingenieros industriales de la Universidad Politécnica de Madrid (ETSII-UPM)

Research Centre (if relevant):

PhD supported by CEDRIÓN C.T.I. S.L and the Consejería de Investigación y Educación (Programa de Doctorados Industriales, Comunidad Autónoma de Madrid) through an industrial doctoral scholarship (IND2022/AMB-23691) to (Jesús Quintana) hosted at (Universidad Politécnica de Madrid)

Department/School(s) (if relevant):

Department of industrial chemical engineering and environmental

College:

Universidad Politécnica de Madrid

Supervisor(s):

- Academically
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Dc. Patricia García Munoz
- Company
Clara Fernández García
Sonia Ruiz Trujillo
CTO: Hector Puago Martínez

Funding body:

Industrial doctorates of the community of Madrid

Area (field) of study:

Water treatment with atmospheric plasma. Use of advance oxidation process to degrade contaminants in water.

Thesis Title:

Design, fabrication and evaluation of the prototype of a reactor for atmospheric plasma activated water

PhD Candidate Profile

Abstract:

Electro-Hydro-Dynamics (EHD) is the branch of science that studies the movement of a fluid under an electric field and develops technology based on these studies. Through corona discharge, which is the generation of a plasma due to a strong electric field, ions are produced and accelerated under this electric field. Generating a fluid current known as ionic wind when the ionisation medium is air.

The plasma is therefore a cloud of high-energy ions and electrons, which, when in contact with a fluid, gives rise to many chemical reactions, leading to short and long-lived reactive oxygen species (ROS) and reactive nitrogen species (RNS).

Plasma activated water, known as PAW (Plasma Activated Water), is therefore characterised by its high load of active species, that, over time, react to end up becoming mainly peroxides, nitrates and nitrites. Those species make changes in different parameters such as the conductivity and the oxidation reduction potential of the water while its pH decreases. The presence of these active species is very useful for their application in water treatment, especially for their disinfection and decontamination potential. It is this potential that allows the activation of water with plasma to be considered as an emerging treatment in the regeneration of wastewater, allowing the elimination of pathogens and contaminants of emerging concern, without the need for additional chemical products. In addition, PAW due to its composition presents some germicidal behaviour and is used as a surface disinfectant agent, being a more sustainable substitute to many current commercial products. Finally, due to its low toxicity and high speed of germination and crop growth, it could help to mitigate the food production crisis.

The main objective of this project is to study known plasma generation techniques for water activation, as well as the development of new ones, to be used for the simultaneous disinfection and elimination of contaminants of emerging concern in different aqueous matrices (freshwater and wastewater), as well as for surface cleaning or food washing. To this end, the different active species generated in the water will be studied, studying the effects on different water quality parameters, to finally carry out a progressive scaling up that will allow the construction of a prototype water activation reactor under the premises of the sustainability of the process, analysing its economic and environmental impact.

The PAW is an emerging alternative for highly sustainable water treatment that is fully aligned with Sustainable Development Goals 6, 9, 11 and 12. The demonstration of the feasibility of this project would represent an important and revolutionary step in the sustainability of water treatment by reducing the need for chemical products that generate a great impact on the environment.

CEDRIÓN C.T.I. S.L. is a “startup” of the business creation program from the Universidad Politécnica de Madrid (ActúaUPM), it was established in February 2017. Its activity is focus on researching, developing, manufacturing and optimizing non-thermal atmospheric plasma devices. Focusing its application on two research branches. On the one hand, using the ionic wind generated by plasma devices as cooling devices. Since they are two to seven times lighter than current systems. On the other hand, the use of plasma devices for purification, either air or liquids. Specifically, this industrial doctorate is in this line of research, studying the interaction between plasma and water.

Collaborations:

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PhD Candidate Profile

Publications:

N/A

Presentations:

VI Investigation seminary UPMWater *The importance of water* Spain January 2023