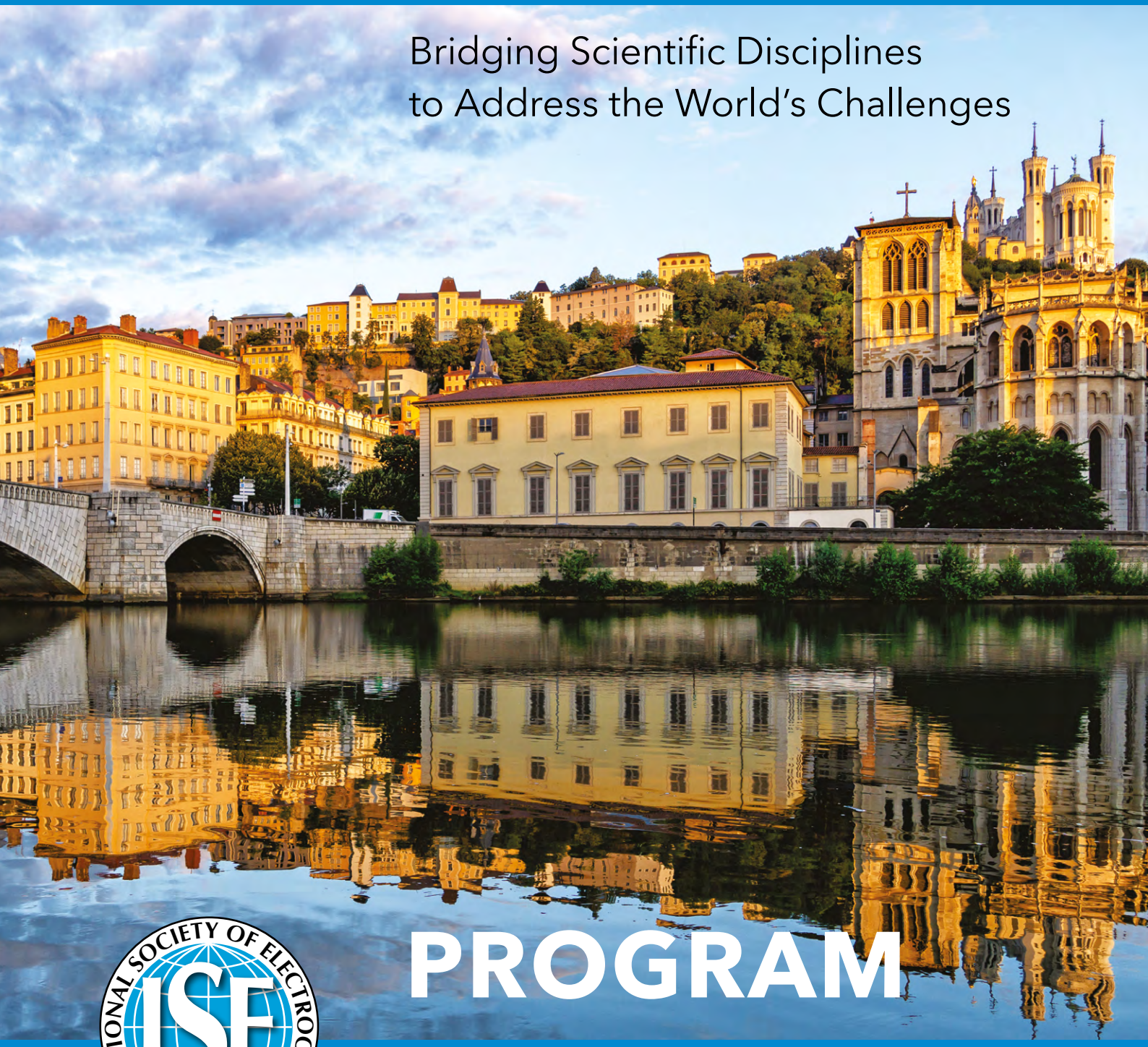
74th Annual Meeting

of the International Society of Electrochemistry

3 - 8 September 2023
Lyon, France

Bridging Scientific Disciplines
to Address the World's Challenges



PROGRAM

https://annual74.ise-online.org
e-mail: events@ise-online.org

Symposium 10 Electrochemical systems and engineering for energy storage and resources recovery and sustainable environmental management

Room: Bellecour 3

Chaired by: Luis Fernando Arenas Martinez, Chi-Chang

09:30 to 10:00 **Keynote**

Karine Groenen Serrano *(Laboratoire de Génie Chimique, Université Toulouse 3 Paul Sabatier, Toulouse, France)*

Years of Advancements in Electrochemical Processes: From Advanced Direct Oxidation to Hybridization for Wastewater Treatment

10:00 to 10:15

Xie Quan *(School of Environmental Science and Technology, Dalian University of Technology, Dalian, China)*, Peike Cao

Heterogeneous Electro-Fenton — An Emerging Environmentally-Friendly Technology for Advanced Water Treatment and Purification

10:30 to 11:00 *Coffee Break*

11:00 to 11:15 **Invited**

Florence Fourcade *(Université de Rennes, Rennes, France)*, Hélios Yasmine, Océane Turquetil, Catherine Couriol, Fares Zouaoui, Pierre-François Biard

Feasability and interest of electrooxidation coupled to ozonation for organic pollutant removal

11:15 to 11:30

Màxim Gibert-Vilas *(Laboratoire Géomatériaux et Environnement, Université Gustave Eiffel, Champs-sur-Marne, France)*, Màxim Gibert-Vilas, Yoan Pechaud, Nihal Oturan, Théo Isigkeit, Laurent Gautron, Mehmet A. Oturan, Clément Trellu

Hydrodynamics, mass transport and reactivity within a continuous electrochemical baffled reactor for removal of organic compounds

11:30 to 11:45

Davide Clematis *(Department of Civil Chemical and Environmental Engineering, University of Genoa, Genoa, Italy)*, Clément Cid, Antonio Barbucci, Marco Panizza

Machine Learning to Optimize Electrochemical Advanced Oxidation Processes for Low Conductive Solution – Performance and Economical Analysis

11:45 to 12:00

Guillaume Hopsort *(Laboratoire de Génie Chimique, Université de Toulouse, CNRS, INPT, UPS, Toulouse, France)*, Laure Latapie, Karine Groenen Serrano, Karine Loubière, Théodore Tzedakis

New insights into the urea electrochemical oxidation on nickel anode

12:00 to 12:15

Jing Ding *(School of Envrionment, Harbin Institute of Technology, Harbin, China)*

Exploring the Synergism of Sunlight and Electrooxidation on Persulfate Activation for Efficient Degradation of Bisphenols

12:15 to 12:30

Mojtaba Mohseni *(Chemical Process Engineering, forckenbeck strasse, 51, Aachen, Germany)*, Daniel Felder, Maximilian Thönes, John Linkhorst, Robert Keller, Matthias Wessling

A Novel Flow-through Module Using Microtubular Gas Diffusion Electrodes for Micropolltants Removal from Water

Machine Learning to Optimize Electrochemical Advanced Oxidation Processes for Low Conductive Solution – Performance and Economical Analysis

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Are Electrochemical Advanced Oxidation Processes (EAOPs) ready to shine in the wastewater treatment galaxy? The key steps to complete their evolution and reach a larger market are decreasing electrode material costs, developing innovative cell design, and optimizing energy management [1,2]. These factors are highly relevant when EAOPs are applied to low-conductive solutions (e.g. pharmaceutical wastewaters with conductivity < 1 mS cm-1). In this peculiar case, energy consumption and the sustainability of the overall EAOP are strictly related to the cell design. Solid Polymer Electrolyte (SPE) based cells have recently been introduced for disinfection and organic pollutants oxidation [3-5]. The presence of such a membrane sandwiched between the two electrodes allows the treatment of water matrices with low conductivity avoiding the necessity of supporting electrolytes, which could introduce further issues. To fulfil the sustainability target of SPE-based processes (environmental and economic), it is essential their couple with renewable energy sources (RES) and energy storage systems (ESS).
In this work, an EAOP system based on SPE technology is designed and modelled considering its integration with photovoltaic panels (PV-panels) as RES and a Lithium-ion battery as ESS. The removal of salicylic acid from a low conductive solution has been taken as a model solution. As regards the electrochemical process, the system design is based on experimental activity to extrapolate information about performance removal. At the same time, RES and ESS management have been modelled and optimized using a machine learning (ML) approach. The ML analysis is based on a hybrid K-means – Grey Relational Analysis (GRA) - Elman Neural Network (ENN) approach [6]. The hybrid algorithm was trained using a database created by PVGIS Online Tool from the Joint Research Centre. This training activity is required to help the algorithm forecast the PV panel production based on the weather conditions, even without a complex physical model, and allow the distribution of solar energy among the electrochemical system, energy storage system and the external power grid (if present). The ML energy balance optimization will be compared with a non-adaptive statistical approach based on historical weather series. The discussion will also analyze the impact of other key parameters (number of PV panels, ESS size, treated volume, electrode cost) to provide a deep economic evaluation of the process.

References

[1] S.O. Ganiyu, C.A. Martínez-Huitle, M.A. Rodrigo, *Applied Catalysis B: Environmental 270 (2020) 118857*
[2] D. Clematis, M. Delucchi, M. Panizza, *Current Opinion in Electrochemistry 37 (2023) 101172*
[3] D. Clematis, M. Panizza, *Electrochimica Acta 378 (2021) 138127*
[4] D. Clematis, M. Panizza, *Current Opinion in Electrochemistry 26 (2021) 100665*
[5] J. Isidro, D. Brackemeyer, C. Sáez, J. Llanos, J. Lobato, P. Canizares, t. Matthee, M.A. Rodrigo, *Separation and Purification Technology 208 (2019) 109*
[6] P. Lin, Z. Peng, Y. Lai, S. Cheng, Z. Chen, L. Wu, *Energy Conversion and Management 177 (2018) 704*