Master project: bio-electrochemical remediation of micropollutants in industrial wastewater

Location: Group of Energy Materials, EPFL-Valais, Rue de l'Industrie 17, 1950 Sion

Target: Master project, R&D (semester project or master thesis project)

Context: The Group of Energy Materials is looking for a Master student to pursue investigations on the bio-electrochemical remediation of organic micropollutants in industrial wastewater. Electrochemical cells consisting of at least two electrodes, a cathode and an anode, will be activated with biomaterials to form biocatalytic films on the electrodes. The research will then focus on the valorization of wastewater organic load into biomethane. A particular interest will be given to five micropollutants of concern and we aim to assess the feasibility of the process to decompose them. Reductive and oxidative degradation will be studied under various bio-electrochemical conditions in lab-scale bio-electric cells where the catholyte and anolyte are separated by an ion-conductive membrane.

Thesis objectives: The candidate will set up and carry out bio-electrochemical experiments. The objectives will be to activate the electrodes with biomaterials before assessing the degradation of five targeted micropollutants present in the wastewater of an industrial partner. Cathodic and anodic transformation mechanisms will be investigated and the role of biofilms will be confirmed against reference tests. The electrochemical and bio-electrochemical behavior of targeted molecules will be studied by analytical electrochemistry and consolidated by ex-situ analyses. If a proof-of-concept is achieved, a first implementation of the process in a single chamber flow bio-electrical reactor will be pursued.

Your tasks:

- Plan and schedule experiments.
- Inoculate electrochemical cells with biological material in order to activate the electrodes.
- Investigate the electrochemical behavior of organic molecules with and without biocatalysts.
- Analyze the exhaust gas composition and production (gas chromatography, flow meter) and calculate process efficiency, selectivity, and productivity.
- Monitor the pH, total organic carbon, and chemical oxygen demand of the electrolyte over time. More detailed analyses of the effluents will be done by the industrial partner (HPLC).

Your background:

- The candidate is familiar with environmental science and biology
- Knowledge of electrochemistry principles and methods is a plus
- Knowledge of analytical chemistry techniques

For further information, please contact Jan Van herle and Cédric Frantz

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