UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola de Doctorat

Resum de Tesi Doctoral

DNI/NIE/Passaport:

Nom i cognoms: **Ana Sotres Fernández**

Títol de la tesi: **Microbial fuel cell running on high strength animal wastewater – Nitrogen removal strategies and microbial community characterization**

Unitat estructural: **Departament d'Enginyeria Agroalimentària i Biotecnologia**

Programa: **Enginyeria Ambiental**

Codis UNESCO: **330800** **330807** **330810**

(Mínim 1 i màxim 4, podeu veure els codis a http://doctorat.upc.edu/gestio-academica/impresos/tesi-matricula-i-diposit/codis-unesco)

Resum de la tesi de 4000 caràcters màxim (si supera els 4000 es tallarà automàticament)

A microbial fuel cell (MFC) is a bioelectrochemical system (BES) capable of converting the chemical energy contained in the chemical bonds of a substrate into electrical energy by means of electrochemical reactions catalyzed by microorganisms. The amount of energy to be gained by bacteria capable of transferring electrons to an anode is significantly higher compared to other alternative electron acceptors. Exoelectrogenic microbial populations tend to be selectively enriched on the anode electrode, being essential for the performance improvement of the MFC in terms of electricity production from organic matter oxidation. MFC technology arises as an attractive alternative for the treatment of high strength animal wastewater, such as pig slurries, to potentially improve energetic valorisation of organic wastes, concomitantly to carbon and nitrogen content reduction or recovery.

The first part of the thesis (Chapters 4, 5 and 6) focuses on the study of microbial populations harboured on the anode electrode of MFCs. The effect of different ion exchange membrane materials and different inoculum sources over the microbial population was studied in discontinuously fed MFCs. A detailed study of the microbial community dynamics and composition onto the anode biofilms, under different feeding conditions (synthetic wastewater and the liquid fraction of pig slurry), was then studied in continuously fed MFC. A highly diverse microbial community is shown to be present under these different scenarios and, its final composition is being dependent on the factors studied.

The second part of the thesis is focused on understanding the nitrogen dynamics in a two-chambered MFC, and the possible strategies available to remove or recover it. First of all, the diffusion/migration of ammonia nitrogen through the cation exchange membrane was studied in batch essays under different operational conditions (Chapter 7). The results obtained showed that the diffusion/migration of ammonia nitrogen is dependent on the voltage applied and, when using pig slurry, ammonia migration reaches values close to 50%.

These results suggested that the use of MFC technology could be a good strategy to deal with the nitrogen excess in this kind of substrates. Two different processes for MFC nitrogen recovery and removal were developed. First, a physicochemical-based process for nitrogen recovery was developed coupling a stripping-absorption unit to the cathode chamber (Chapter 7). Results showed the stripping/absorption-BES system is a feasible technology to recover ammonia from pig slurries.

Second, a nitrogen removal strategy by means of biological processes was studied using synthetic high strength wastewater as feed (Chapter 8). In this case, the ammonia nitrogen migrating from the anode to the cathode, was removed applying intermittent aeration cycles in the cathode chamber of the MFC where a concomitant nitrifying-denitrifying microbial community being established.

The feasibility to recover/remove nitrogen from high strength animal wastewater, such as pig slurries, using different MFC strategies has been demonstrated at lab scale. Hence, it can be considered as a potential technology for scaling up the treatment of high strength (organic and nitrogen) wastewaters, so as to accomplish the requirements needed for agricultural uses. Likewise, the knowledge acquired about the biofilm developed on the anode reveals itself as a key point for the resilience of BES at different environmental conditions and for further developments.

Lloc: Barcelona Data: 15 de Mayo de 2015