Semi-pilot scale MEC for pig-slurry treatment and resources recovery. Limiting the impact of high nitrogen concentration.

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Biological treatment of pig slurry becomes problematic due to its inherent high ammonium content. When directly fed to the anode of a bioelectrochemical systems (BESs) it usually results in a significant deterioration of its performance or even a total process failure (Mahmoud et al., 2017). Our research aims at limiting the impact that ammonium has on the performance of a microbial electrolysis cell (MEC) during pig slurry treatment by using a two-fold strategy. On the one hand, nitrogen concentration in the fed was gradually increased from 500 to 3000 mg-TN L^{-1}, as the proportion of slurry in the feed increases (from 40 to 80% (Figure 1A)) to favor the acclimation of microbial communities. On the other hand, nitrogen was allowed to migrate to the cathodic chamber through a cation exchange membrane where it was recovered for its subsequent use in struvite production. This study was performed in two semi-pilot double-chamber MECs (each having a total volume of 16 L (Figure 1B) and designated as MEC-1 and MEC2), and using phosphate buffer as catholyte.

The results show that current density increases gradually as the proportion of pig-slurry in the feed increases (Figure 1A) and that nitrogen can be removed from the anode and recovered at the cathode at a maximum rate of 325 mg-NT $L^{-1}_{reactor}$ d^{-1} (57 % efficiency), which indicates the suitability of this approach for successfully feeding pig slurry to a MEC. Moreover, a significant amount of hydrogen was recovered in the cathode (it was produced at a rate of 0.2 L_{H2} $L^{-1}_{reactor}$ d^{-1}), all of which would help to improve the technoeconomical feasibility of this technology.

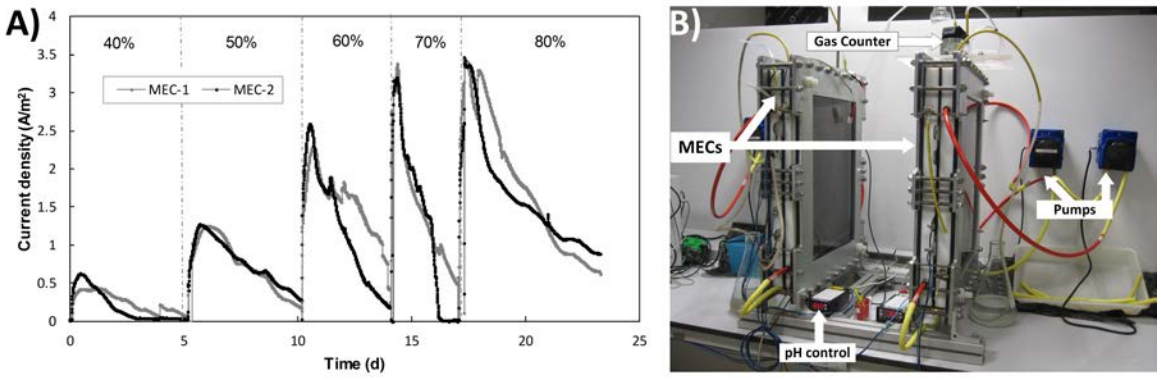

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Figure 1. A) Current density (A/m_2) at the different stages of the process (designated according to the percentage of slurry in the feed (40, 50, 60, 70 or 80%)) in MEC-1 and MEC-2. B) Reactor set-up.

Mahmoud, M., Parameswaran, P., Torres, C.I., Rittmann, B.E., 2017. Electrochemical techniques reveal that total ammonium stress increases electron flow to anode respiration in mixed-species bacterial anode biofilms. Biotechnol. Bioeng.