Degradation of azo dyes (Acid orange 7) in a microbial fuel cell: comparison between anodic microbial-mediated reduction and cathodic laccase-mediated oxidation

Kyazze, G., Mani, P., Bowman, K., Farahmand, N., Breheny, M. and Keshavarz, T.

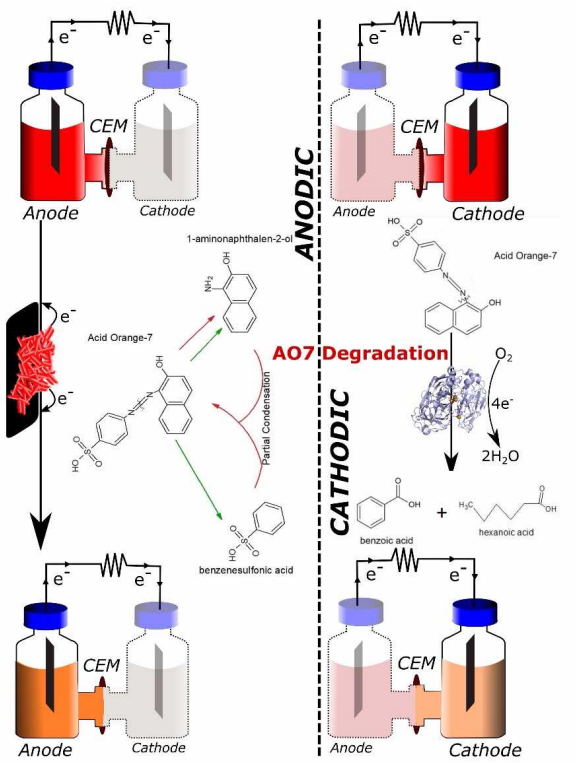
A paper presented at the 4th European Meeting of the International Society for Microbial Electrochemistry and Technology, Newcastle University, Newcastle upon Tyne, 12 - 14 Sep 2018.

Degradation of azo dyes (Acid orange 7) in a microbial fuel cell: comparison between anodic microbial-mediated reduction and cathodic laccase-mediated oxidation

Godfrey Kyazze[1], Priyadharshini Mani[1], Heba Hamed[2], Reham Fathy[2], Marwa Gamal[2], Nabila Selim[2], Hussein Abd El Kareem[2], Kyle Bowman[1], Nasim Faramand[1], Mark Breheny[1], Taj Keshavarz[1], Ola Gomaa[2]

[1]*Department of Life Sciences, University of Westminster, London, United Kingdom,*
[2]*Egyptian Atomic Energy Authority (EAEA), Cairo, Egypt,*
Email: G.Kyazze@westminster.ac.uk

Microbial fuel cells (MFCs) are a promising technology for the simultaneous treatment of wastewater and electricity production. With regard to azo-dye containing wastewater (e.g. from textile manufacturing), the dyes may be fed via the anode chamber containing electrochemically active bacteria or via the cathode chamber containing laccase enzyme as catalyst for oxygen reduction. This study investigated which of the two approaches is the best with regard to rate of decolourisation of the dye (Acid orange 7), COD reduction and electricity production. The power density was higher for the $MFC_{dye\ at\ cathode}$ (25 mW/m^2, COD reduction 80%) compared with 18 mW/m^2 (COD reduction 69%) for $MFC_{dye\ at\ anode}$ (*Shewanella oneidensis* as catalyst). The decolourisation rate of the dye was not statistically significant between the two approaches with ca. 75% decolourisation achieved in 24 h. The anodic dye degradation products were unstable when exposed to air resulting in what seems to be induced diazotization and regaining of colour. In case of degradation by laccase in the cathode chamber, the decolourisation products were stable and simpler in chemical structure (e.g. presence of aliphatic compounds) as determined by GC-MS. This work suggests that feeding azo dyes in cathode chambers of MFCs containing laccase is a better way of treating the dyes than the commonly used approach of feeding the dye in the anode chamber.



Key words: Azo dyes, laccase, microbial fuel cells, decolourisation, degradation.