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Impact of applied current on sulfate-rich wastewater treatment and microbial biodiversity in the cathode chamber of microbial electrolysis cell (MEC) reactor

Kai Wang[a, b], Yuxing Sheng[b,*], Hongbin Cao[b], Keping Yan[a], Yi Zhang[a, b,*]

[a] Industrial Ecology and Environment Research Institute, College of Chemical and Biological Engineering, Zhejiang University, Hangzhou 310058, PR China

[b] National key Laboratory of Biochemical Engineering and Key Laboratory of Green Process and Engineering, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, PR China

ABSTRACT

Microbial electrolysis cell (MEC) coupled with sulfate-reducing bacteria (SRB) was used to degrade sulfate-rich wastewater which was deficient in electron donors. Results confirmed that SRB could trigger vigorous synergy with an applied current. An applied electrical field of 1.5 mA (R1) resulted in the highest sulfate removal, which was 14.9% higher than that of the control reactor (R0). In addition, organic-substance consumption decreased with the increase of applied current. The concentration of lactic dehydrogenase (LDH), an indicator of cell rupture, increased by 3.59 times at 2.5 mA; that of ATP, an indicator of cell metabolism, sharply decreased under 2.5 and 3.5 mA. This finding indicated that high current led to plasmatorrhexis, low growth rate, and metabolic activity, subsequently reduced sulfate-reduction efficiency. Conversely, a proper current resulted in the enhancement of extracellular secretion, which was conducive to biofilm formation as further confirmed by detection through SEM. Electrochemical impedance spectroscopy (EIS) illustrated the SRB in the biofilm could accelerate the rate of direct electron transfer to cathode. Genus-level results further revealed that the dominant bacterium *Desulfovibrio*, an SRB, was richer in the cathode biofilm and R1, compared with R0.