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Enhancement of Congo red decolorization by membrane-free structure and bio-cathode in a microbial electrolysis cell

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1 Enhancement of Congo red decolorization by membrane-free structure and bio-cathode in a  
2 microbial electrolysis cell

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8  
9 **Abstract:** A membrane-free microbial electrolysis cells (MFMEC) with bio-cathode was applied  
10 to enhance azo dye Congo red decolorization by the improvement of cathodic action and  
11 membrane abandon. To reveal the advantages of MFMEC, a membrane-free electrolysis cell  
12 (MFEC) without microorganism and a microbial electrolysis cell (MEC) with membrane were set  
13 as comparisons. The electrochemical characteristics of MFMEC and its relation with  
14 decolorization were analyzed by measuring cathode potential, EIS and current change. The results  
15 showed that MFMEC with bio-cathode acquired lower cathode potential than MFEC. The charge  
16 transfer resistance of MFMEC was 5.2  $\Omega$  which was lower than MEC (43.6  $\Omega$ ). The  
17 decolorization efficiency of MFMEC with different voltages (0.3 V, 0.6 V and 0.9 V) were nearly  
18 identical and stable at 87.9%, 85.1%, and 86.7% respectively in 24 h. In batch tests without  
19 solution renewal, the decolorization had a remarkable increasing (25%) in cycle 2 and 3, then it  
20 had declined since cycle 4. The main degradation product was benzidine which produced by azo  
21 bond cleavage. More  $\text{CH}_4$  was produced with 0.9 V as a side reaction that restricted further  
22 increase of decolorization rate. The result demonstrated that both the act of co-substrates and  
23 accepting electrons from cathode were the main decolorization approaches of MFMEC.

24 **Keywords:** microbial electrolysis cell; membrane-free; bio-cathode; Congo red; decolorization

## 25 26 27 28 **1. Introduction**

29 Azo dye is an ordinary industrial dye used in textile and dyeing industry, and certainly  
30 become one of the hazardous contaminants in refractory wastewater [15]. Azo dye wastewater will  
31 cause environmental issues such as aesthetic problem, water transmittance decrease and even

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