

## RESEARCH ARTICLE

# Power generation and toluene bioremediation through single chamber benthic microbial fuel cell fed with sugarcane waste as a substrate

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## Summary

The water polluted with toluene could be treated using a membrane less single chamber benthic microbial fuel cells (SBMFCs) by using sugar cane waste as a substrate producing energy. Toluene oxidizes into intermediate benzoic acid and completely converts into non-toxic carbon dioxide. The BMFC generated a voltage of 0.530 V between 40 and 80 days when the external resistance was 1 k $\Omega$ . The highest power density and current density generated about 34.7 mW/m<sup>2</sup> and 120 mA/m<sup>2</sup> within 41 days. Furthermore, toluene remediation rate was 98.22% by BMFC. On the 41st day, redox curves were measured around −0.6 V (forward peak) and −0.5 V (reverse peak) while specific capacitance of 0.141 F/g. The Nyquist plot was fitted equivalent circuit from electro-impedance spectroscopy performed to measure overall internal resistance (54.81  $\Omega$ ). The scanning electron micrographs showed that pores over multi-anode surface were improperly spaced, but these pores were for biofilm growth. The 16S rRNA pyro-sequencing results identified the *Staphylococcus* sp. and *Pseudomonas* sp. These results showed that BMFC could be used for the power production and the toluene remediation. In this work, sugarcane waste was used as a substrate in a multi-anode system, as well as toluene treatment and energy production with the help of SBMFC without membrane.

## KEYWORDS

biofilm, multi-anode, power generation, remediation, single chamber microbial fuel cell, toluene

## 1 | INTRODUCTION

The existence of aromatic compounds, which are discharged into the environment from various industries, causes extensive pollution of surface water. They are also employed as solvents and raw ingredients for different chemical industries.<sup>1</sup> Toluene is an universal environmental pollutant due to its high water solubility (0.174%–0.187%), greater volatility, and strong mobility.<sup>2</sup> It is a

typical aromatic volatile molecule that is extensively utilized to manufacture other chemical and organic industrial solvents for paints, inks, adhesive, metal detergent, and gasoline additives to antirust oil glues, polyurethane, antioxidant, and corrosion inhibitor.<sup>3</sup> However, governments worldwide have strictly limited the use and emissions of toluene because it could severely damage the environment due to its bio-toxicity and irritability.<sup>4</sup> On the other side, the growing demand for renewable energy