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Bio-energy generation in an affordable, single-chamber microbial fuel cell integrated with adsorption hybrid system: effects of temperature and comparison study

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ABSTRACT

A microbial fuel cell (MFC) integrated with adsorption system (MFC-AHS) is tested under various operating temperatures with palm oil mill effluent as the substrate. The optimum operating temperature for such system is found to be at ~35°C with current, power density, internal resistance (R_{in}), Coulombic efficiency (CE) and maximum chemical oxygen demand (COD) removal of 2.51 ± 0.2 mA, 74 ± 6 mW m^{-3}, 25.4 Ω, 10.65 ± 0.5% and 93.57 ± 1.2%, respectively. Maximum current density increases linearly with temperature at a rate of 0.1772 mA m^{-2} $°C^{-1}$, whereas maximum power density was in a polynomial function. The temperature coefficient (Q_{10}) is found to be 1.20 between 15°C and 35°C. Present studies have demonstrated better CE performance when compared to other MFC-AHSs. Generally, MFC-AHS has demonstrated higher COD removals when compared to standalone MFC regardless of operating temperatures.

Abbreviations: ACFF: activated carbon fiber felt; APHA: American Public Health Association; CE: Coulombic efficiency; COD: chemical oxygen demand; ECG: electrocardiogram; GAC: granular activated carbon; GFB: graphite fiber brush; MFC: microbial fuel cell; MFC-AHS: microbial fuel cell integrated with adsorption hybrid system; MFC-GG: microbial fuel cell integrated with graphite granules; POME: palm oil mill effluent; PTFE: polytetrafluoroethylene; SEM: scanning electron microscope

KEYWORDS:

Bio-energy generationtemperature effecthybrid microbial fuel celladsorptionpalm oil mill effluent