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Effectiveness of Direct Sulfonated Polysulfone in Dual Chamber Microbial Fuel Cells Based Dewatered Sludge for Power Generation

Abstract

In the realm of bioprocess technology, microbial fuel cells (MFCs) are regarded as a noteworthy innovation that can simultaneously bioremediate wastewater and utilise as renewable energy applications. The investigation began with synthesizing composite proton exchange membrane (PEM) with sulfonated polysulfone (SPSF) and sulfonated chitosan (SCS) as a separator for MFCs. A composite membrane has been developed by crosslinking a microporous SPSF substrate with a thin layer of chitosan (CS). The membrane was then evaluated for its suitability in MFCs which employ dewatered sludge. The appearance and physico-mechanical properties of this composite were thoroughly examined using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), proton conductivity measurements, back-end titration tests, and water uptake studies. Attempts were made to enhance the connection between the duo polymers such as PSF and CS by providing surface changes with the incorporation of sulfonation properties. As a result, two novel types of composite materials were developed: (SPSF/CS) and (SPSF/SCS), which were made by altering a PSF membrane's surface before adding a chitosan layer using the non-solvent phase inversion technique. The proton conductivity of SPSF/CS and SPSF/SCS composites was measured and contrasted with that of unmodified PSF. The composite, SPSF/SCS-1, 0.5 wt%, showed greater proton conductivity and ion exchange capacity (IEC) (1.7 meq/g, 0.061 S/cm) than the unaltered PSF (0.99 meq/g, 0.009 S/cm). According to the MFCs performance, the SPSF/SCS-1, 0.5 wt% membrane demonstrated a substantial electricity production compared to pristine PSF 38.57 mW/m^2 and 0.449 mW/m^2. These results vividly depicted that the composite SPSF/SCS PEM increases the productivity of dual-chamber MFCs.

Keywords

Bioremediation; Dewatered sludge; Microbial fuel cells; Proton exchange membrane; Sulfonated polysulfone