Electrogenic Biotransformation of Organic Substrates: A Bioanodic Approach to Decentralized Energy

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Finding reliable long-term energy solutions remains a critical issue in addressing climate change. This experiment evaluated the potential for microbial fuel cells (MFCs) to generate electricity from household compost, providing a renewable energy source for an average U.S. family. MFCs utilize bacteria-driven organic matter decomposition to produce an electrical current. This project aims to optimize the current MFC system and integrate it into a lamp powered by the average family's organic waste. To begin, a comparative analysis was conducted on compost age, container size, and electrode material, size, and spacing. The most efficient conditions included compost aged 12-18 months, a 1L container, and carbon cloth electrodes spaced at 1 cm, generating an average of 1.08 W. Additionally, a functional MFC-powered lighting system, the LYKA Lamp, was developed using a custom-built step-up DC converter and battery storage system. The lamp requires 11.95 hours to produce and store energy and then provides 2.43 hours of continuous light. An average U.S. family could maintain 3.11 LYKA lamps, leading to $128.76 in annual energy savings and 7.5 hours of light. In addition, about 45,000 lbs of CO_2-equivalent emissions would be prevented per family yearly, demonstrating the economic and environmental benefits of decentralized MFC adoption. These findings encourage the potential of MFCs as a sustainable energy alternative, mitigating organic waste while offering a cost-effective renewable power source.

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