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APPLICATION OF AN ELECTROBIOCHEMICAL SLURRY REACTOR FOR THE TREATMENT OF A SOIL CONTAMINATED WITH LINDANE

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Abstract

Lindane is a chlorinated pesticide known for its toxicity persistence in the environment. Recently, it has been proposed that soil microbial fuel cell technology (SMFC) could be applied to enhance the removal of organic matter, phenol, and petroleum hydrocarbon in contaminated soil and simultaneous electricity output. The purpose of this research was to enhance biodegradation of lindane and simultaneously electricity generation on electrobiochemical slurry reactor (EBCR).

The electrobiochemical slurry reactor consisted of a Plexiglass cylinder approximately 6 cm in diameter and 8 cm in height (308 mL capacity) and was inoculated with a sulfate reducing inoculum acclimated to lindane. The internal resistance (R_{int}) of EBCR was calculated as a function of cell voltage using electrochemical impedance spectroscopy (EIS). The EBCTR was batch-operated for 30 day at room temperature.

Results from EIS showed that the equivalent circuit obtained from the Nyquist plot had anodic resistance R_1=2064Ω, cathodic resistance R_3 = 192 Ω; and electrolyte/membrane resistance R_2 = 7Ω; so the total internal resistance R_{int} was 2263Ω. The EBCR showed a 30% lindane removal efficiency along with a maximm volumetric power volumetric of 165 mWm^{-3}. Organic matter removal was 72% . After 30 d operation lindane metabolites were not detected in the EBCR.

It was reported a removal of 90% of initial 80 mg/L phenol (10 d operation) from a rice pad soil using a fuel cell. The latter developed a voltage of 530mV and a power density of 29.5 mW/m^2 cathode surface. Our results were relatively lower, although it has to be considered that the log of octanol water partition coefficient of phenol is 1.46 whereas that of lindane is 3.6, that is, lindane is less bioavailable, more toxic, and much less soluble than phenol. Also, a great variety of bacteria has been reported to use phenol as carbon and energy source, whereas lindane is less biodegradable. Finally, it can be concluded that our EBCR showed a low-to-moderate lindane removal capability.