**Ex situ** remediation of polluted soils by absorptive polymers, and a comparison of slurry and two-phase partitioning bioreactors for ultimate contaminant degradation

M. Concetta Tomei, Domenica Mosca Angelucci, M. Cristina Annesini, Andrew J. Daugulis

**Highlights**

- We investigate absorptive polymers for ex situ soil bioremediation.
- We compare the performance of the novel technology with a slurry bioreactor.
- The polymer is very effective in decontaminating the soil (77% removal in 4 h).
- The polymer is readily regenerated in a two phase partitioning bioreactor.

**Abstract**

The present study has provided a comparison between a conventional ex situ method for the treatment of contaminated soil, a soil slurry bioreactor, with a novel technology in which a contaminant is rapidly and effectively removed from the soil by means of absorptive polymer beads, which are then added to a two-phase partitioning bioreactor (TPPB) for biodegradation of the target molecule. 4-nitrophenol (4NP) was selected as a model contaminant, being representative of a large class of xenobiotics, and the DuPont thermoplastic Hytrel™ 8206 was utilized for its extraction from soil over ranges of soil contamination level, soil moisture content, and polymer:soil ratios. Since the polymers were able to rapidly (up to 77% and 85% in 4 and 24 h respectively) and selectively remove the contaminant, the soil retained its nutrient and microflora content, which is in contrast to soil washing which can remove these valuable soil resources. After 4 h of reaction time, the TPPB system demonstrated removal efficiency four times higher (77% vs 20%) than the slurry system, with expected concomitant savings in time and energy. A volumetric removal rate of 75 mg4NP·L⁻¹·h⁻¹ was obtained in the TPPB, significantly greater than the value of 1.7 obtained in the slurry bioreactor. The polymers were readily regenerated for subsequent reuse, demonstrating the versatility of the polymer-based soil treatment technology.

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1. **Introduction**

The treatment of contaminated soil is a global concern that has arisen from expanded industrialization, non-uniform and inconsistently enforced environmental regulations, as well as tragic pollution legacies from earlier periods when the harmful effects of contaminant dumping were either unknown or were...