standing of the complex chemistry involved will be used to project improved systems that bind the metals better and resist leaching.

Biodegradation of biphenol by suspended and immobilized cultures of the white rot fungus *Phanerochaete chrysosporium*

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Abstract

White rot fungi are able to attack and degrade a wide variety of recalcitrant organic pollutants including polyaromatic hydrocarbons and chlorinated compounds. However, the unique degradative potential of these organisms has not yet been exploited for commercial waste treatment processes. *Phanerochaete chrysosporium*, the best studied white rot fungus, synthesizes a variety of oxidizing enzymes, such as ligninases and Mn-dependent peroxidases, that catalyze the initial rate limiting step in the degradation of recalcitrant compounds. While the production of these enzymes is essential for biodegradation, it occurs only when the mycelia are grown under very specific conditions that cannot be easily reproduced in bioreactors. We established that high levels of ligninases can be produced by both suspended and immobilized batch cultures of *P. chrysosporium* grown at a temperature of 33 °C in optimized complex media. Subsequently, the degradation of biphenol by cells immobilized in Ca-alginate, κ-carageenan and nylon pads was studied in detail. Using radioactively labelled biphenol it was shown that about 20% of the initial xenobiotic is mineralized to CO2 and another 60% is recovered as water soluable byproducts after 28 days of incubation. The extent of degradation was approximately the same for suspended cultures and cells immobilized in either the Ca-alginate or κ-carageenan. However, inconclusive results were obtained with nylon-immobilized cells due to the binding of the biphenol to nylon. It was observed that rate of mineralization is paralleled by the production of ligninases in the growth media, indicating that the induction of oxidative enzymes is very important for biodegradation. As expected, extensive degradation occurred only after the cells have entered the stationary phase. The effect of xenobiotic and co-substrate

concentration on the rate of mineralization were investigated and will be discussed. These studies have demonstrated that immobilized *P. chrysosporium* cells hold great promise for waste treatment applications.

Biodegradation of multiple substrates stripped from contaminated soils

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Abstract

Biological treatment has become a widely used technique in treating a wide range of organic hazardous compounds of industrial origin. Naturally occurring microorganisms can be acclimated to single or multiple substrates which they break down into non-toxic end products or carbon dioxide and water. Combinations of substrates which enhance the degradation rates of more recalcitrant compounds among other optimization techniques make biodegradation a cheap, efficient, and complete method of removing hazardous compounds from the environment. In our studies we investigated microbial kinetics of multiple substrate feeds with acclimated microorganisms in pulse-fed batch reactors and chemostats. The feasibility of air stripping organic hazardous substances from solid and introducing them to bioreactors via the air stream was also investigated.

We studied the synergistic and antagonistic interactions of multiple substrate degradation to determine if they could be combined to optimize the degradation of the selected compounds. The tested substrates included glucose, phenol, pentachlorophenol (PCP), and dichlorophenol (DCP). Long term studies on the batch fed reactors revealed preferential substrate degradation in the order of glucose, phenol, and pentachlorophenol. The presence of glucose improved the rate of phenol degradation. Phenol was found to enhance PCP degradation, but glucose and PCP were degraded independently. Using the technique of initial rate experiments with the batch-fed cultures, we were able to calculate growth rates and other kinetic parameters through a parameter estimation algorithms developed in-house.

The chemostat reactors were designed with significant recycle to ensure a