

Biodegradation and detoxification of phenolic compounds by pure and mixed indigenous cultures in aerobic reactors

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Abstract

Degradation and detoxification of a mixture of persistent compounds (2-chlorophenol, phenol and *m*-cresol) were studied by using pure and mixed indigenous cultures in aerobic reactors. Biodegradation assays were performed in batch and continuous flow reactors. Biodegradation was evaluated by determining total phenols, ultraviolet spectrophotometry and chemical oxygen demand (COD). Microbial growth was measured by the plate count method. Scanning electronic microscopy was employed to observe the microbial community in the reactor. Detoxification was evaluated by using *Daphnia magna* toxicity tests. Individual compounds were degraded by pure bacteria cultures within 27 h. The mixture of 2-chlorophenol (100 mg l⁻¹), phenol (50 mg l⁻¹) and *m*-cresol (50 mg l⁻¹) was degraded by mixed bacteria cultures under batch conditions within 36 h: 99.8% of total phenols and 92.5% of COD were removed; under continuous flow conditions 99.8% of total phenols and 94.9% of COD were removed. Mineralization of phenolic compounds was assessed by gas chromatography performed at the end of the batch assays and in the effluent of the continuous-flow reactor. Toxicity was not detected in the effluent of the continuous-flow reactor.

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1. Introduction

Wastewater from industries rarely contains a single pollutant as chemicals manufacture involves multiple unit operations and processes. The multi-substrate nature of an industrial effluent is characterized by the presence of a variety of compounds in varying concentrations (Godbole and Chakrabarti, 1991). 2-Chlorophenol, phenol and *m*-cresol compounds, for instance, are released into the environment by the industrial effluents of petrochemical, textile, pharmaceutical, chemical plants, and the like. These compounds are toxic and persistent: they accumulate in the environment and usually affect the performance of industrial as well as urban treatment plants. Phenolic compounds are serious river water pollutants in Argentina, where industrial effluents are frequently discharged into streams after being

slightly treated or untreated (AGOSBA-OSN-SIHN, 1994; IEIMA, 1990). The development of improved technologies capable of degrading persistent and recalcitrant compounds then becomes necessary.

Microbial degradation is a useful strategy to eliminate these compounds and detoxify wastewaters and polluted environments (Puhakka et al., 1995; Morgan and Watkinson, 1989). Several bacterial strains belonging to a variety of genera degrade phenolic compounds (Hägglom and Valo, 1995; Chitra et al., 1995; Shimp and Pfaender, 1987; Gurujeyalakshmi and Oriel, 1989). Despite the availability of biochemical information on the catabolism of phenolic compounds, there is a lack of information regarding the design and operation of treatment facilities. The purpose of this investigation has been to study biodegradation and detoxification of a mixture of persistent compounds: 2-chlorophenol, phenol, *m*-cresol, by pure and mixed indigenous cultures in both batch and continuous flow fluidized-bed aerobic reactors.

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