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Bioremediation of Contaminated Groundwater

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ABSTRACT

Contaminated groundwater from industrial areas in former East Germany was biologically treated using lab-scale solid-state reactors. The ability of bacterial strains of the autochroneous microflora to utilize representative pollutants was tested.

Index Entries: Bioremediation; groundwater; hydrocarbons; BTEX; solid-state reactors.

Abbreviations: BTEX, benzene-toluene-ethylbenzene-xylenes; BOD_5, biochemical oxigen demand; COD, chemical oxigen demand; IR, infrared; PAH, polycyclic aromatic hydrocarbons; PCB, polychlorinated biphenyls.

INTRODUCTION

Contamination of groundwater with several carbohydrates originating from petrol industries causes serious problems in some industrial areas in former East Germany. The present work deals with a concept for a biological remediation of such polluted groundwater.

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Table 1
Representative Concentrations of Several Parameters and Compounds in a Contaminated Ground Water

Parameter/compound	Concentration	
	Minimum	Maximum
COD, mg/L	390	650
BOD_5, mg/L	75	335
TOC, mg/L	30.5	120
BTEX, mg/L	0.5	115
Phenolic compounds, mg/L	1.5	13
PAH, μg/L	3	142
PCB, μg/L		<1
Total hydrocarbons (IR), mg/L	20	900

The main pollutants were aromatic compounds of the BTEX-type, phenol and its alkylated derivatives, and, in lower concentrations, also polycyclic aromatic hydrocarbons (Table 1). Special problems originate from the volatility of some compounds, i.e., in some cases relatively low concentration of distinct hydrocarbons, and abrupt changes in waste compound composition and concentration.

RESULTS

Distinct strains as well as mixed communities and enrichment cultures of the authochtoneous microflora were characterized with respect to their ability to metabolize several aromatic carbohydrates under metabolic and cometabolic conditions. This includes investigations on the ability of distinct strains to utilize representative pollutants at varying concentrations (Fig. 1).

Original groundwaters were biologically treated under several reaction conditions, e.g., with nonimmobilized cells or in lab-scale solid-state reactors, under semicontinuous and continuous conditions (Fig. 2A–D). In the latter case, carrier materials with different hydrophobicities for cell immobilization (Carrier 1: more hydrophilic; Carrier 2: more hydrophobic; Fig. 2D) were used.

ACKNOWLEDGMENT

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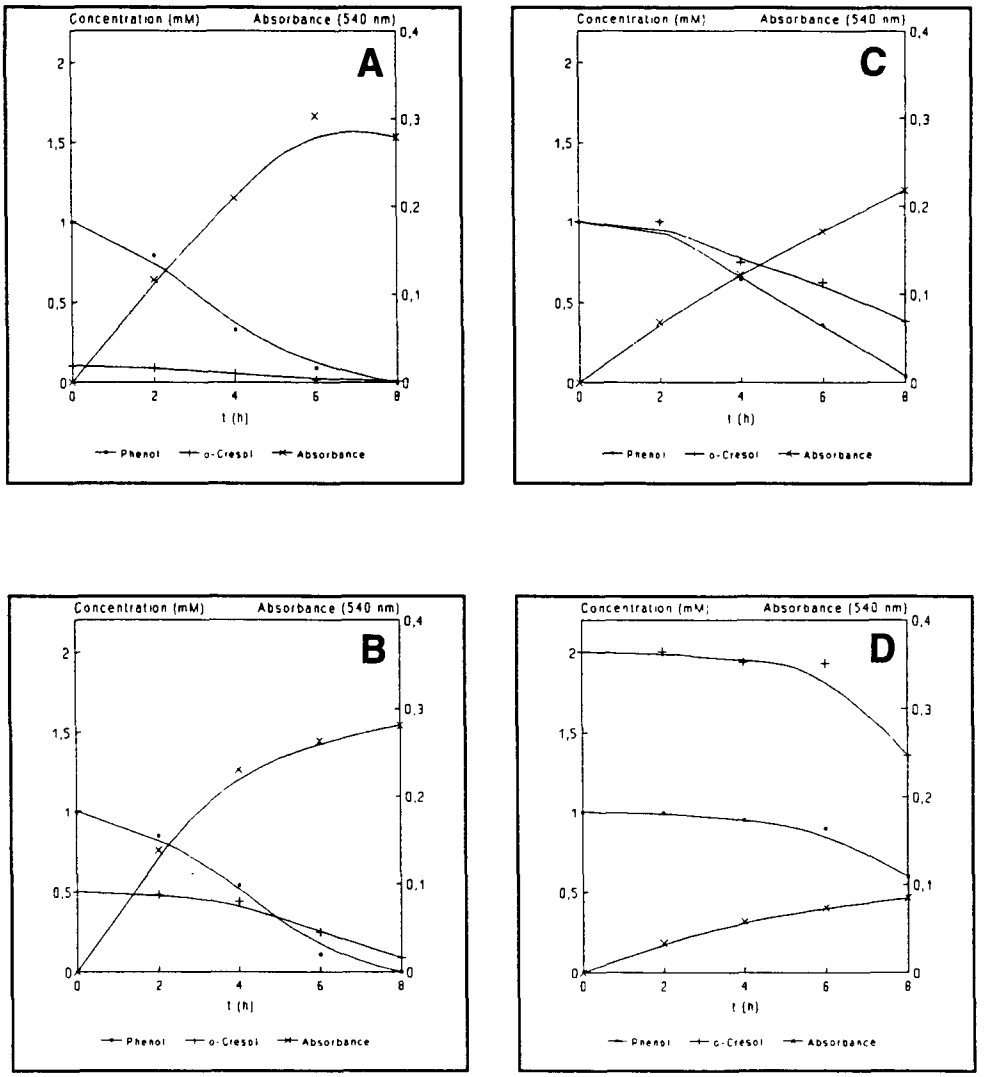

Fig. 1. Metabolization of o-Cresol by a strain isolated from groundwater using phenol as cosubstrate; concentration of phenol: 1 mM/L, respectively; concentration of o-Cresol: **A** \$0.1 m*M* /L, **B**: 0.5 m*M*/L, **C**: 1 m*M*/L, **D**: 2 m*M*/L.

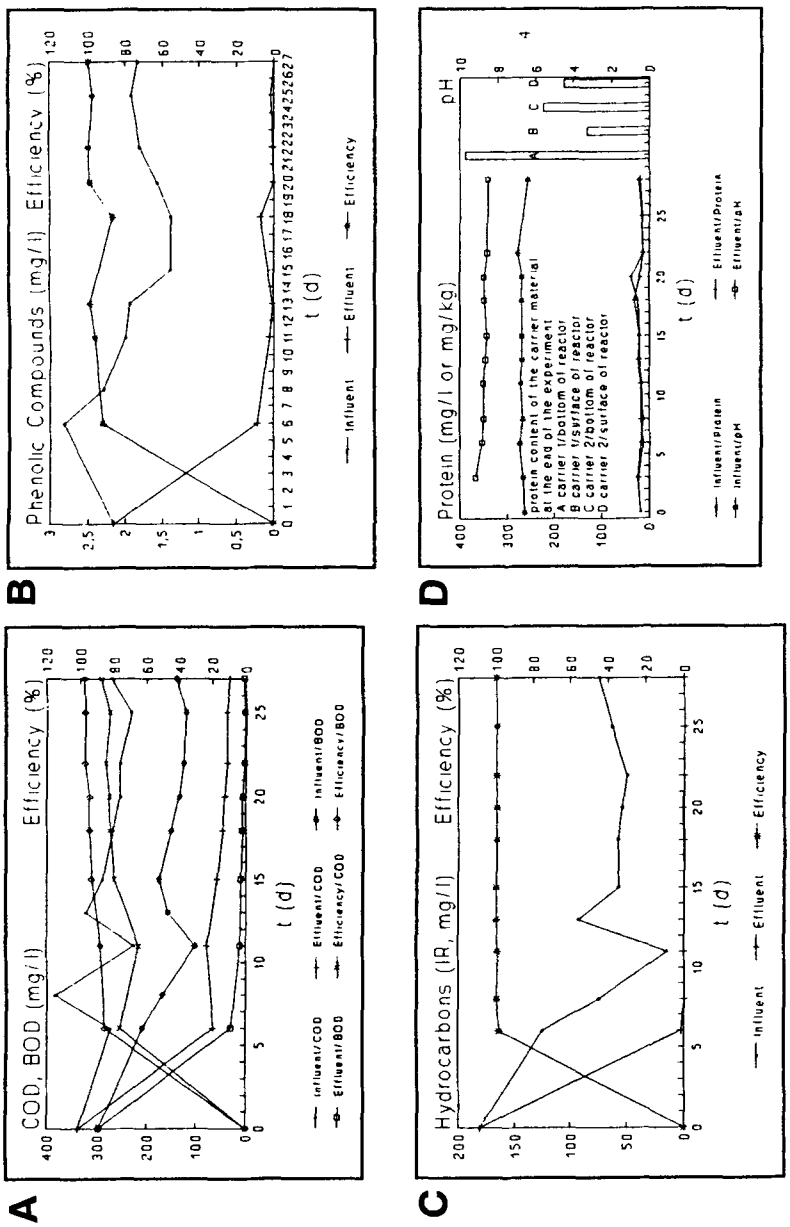

Fig. 2. Continuous treatment of an original groundwater in a lab-scale solid-state reactor under up-flow conditions: **A**: COD, BOD_5; **B**: phenolic compounds; **C**: total hydrocarbons (IR); **D**: pH and protein content of the carrier materials.