Biodegradation of linear C5-C7 alkanes by microbial communities: kinetics and microbiological aspects

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ABSTRACT. C5-C7 linear alkanes are constituents of gasoline and are widely used in the industry as solvents or intermediates for chemical reactions. Their emission to the atmosphere causes serious environmental problems. Besides the physico-chemical technologies, biological processes have been studied in the past few decades for air cleaning.
The main goal of this work is to characterize the degradation of C5-C7 linear alkanes by a microbial consortium collected from a gasoline contaminated soil. As fungi display a great potential for degradation of hydrophobic volatile compounds (such as C5-C7 alkanes), the mineral medium used was adjusted to pH 4 and gentamycine (40 mg/l) was added, in order to favour their growth, against bacteria. The experiments were conducted at 30°C and 125 rpm, in closed bottles of 125 ml containing 3ml of inoculum previously adapted to pentane during 2 months, and 17 ml of mineral medium. Alkanes were introduced one by one in the bottle (pentane, hexane, heptane and pentane again in this order) to reach concentrations varying between 50 and 80 mg/l approximately in the headspace. Various degradation cycles were performed for each molecule. Alkanes and CO2 concentrations in the headspace were measured by GC and kinetic degradation results were fitted to a Gompertz model, which allowed to determine for each alkane and for each cycle, a maximum degradation rate (Vmax). It was found that heptane was more easily degraded (Vmax=7.30 mg/l.h) than hexane (Vmax=4.39 mg/l.h) and pentane (Vmax=2.14 mg/l.h). In the second run for pentane, Vmax was 4.51 mg/l.h, indicating than the consortium was still improving its adaptation to the solvent. The corresponding specific degradation rates were 44.6; 86.1 and 160.2 $mg_{alkane}/mg_{prot}/h$ for pentane, hexane and heptane, respectively. The alkane conversion rate to CO2 was decreasing from 80.9 % to 68.4%, for C5 to C7 alkanes, indicating that heptane was probably more easily assimilated for biomass build up than pentane.
In this consortium, 12 bacteria strains belonging to *Actinomycetes*, *Bacillus*, *Pseudomonas*, *Aeromonas*, and *Acinetobacter* genera and 3 fungal species belonging to *Cladosporium*, *Penicillium* and *Aspergillus* genera were isolated.