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MICROCOMS STUDY OF ANAEROBIC BIOCONVERSION OF HEXACHLOROCYCLOHEXANE IN HEAVILY CONTAMINATED SOILS

Roberta Verdini[1], Carmela Riccardi[2], Lucia Pierro[1], Marco Petrangeli Papini[1], Mauro Majone[1]

[1]Department of Chemistry, Sapienza University of Rome; [2]INAIL, Research sector, Monte Porzio Catone, Roma

Abstract

Hexachlorocyclohexane (HCH) is a highly chlorinated compound, mainly composed of four isomers (α, β, γ, and δ). It is classified as a priority organic pollutant due to its persistence and adverse effects on ecosystem and human beings.
HCH has been heavily used as an organochlorine insecticide since 1940s, being commercially available in two grades: technical HCH and lindane. The technical grade HCH is composed of α-HCH (55-80%), β-HCH (5-14%), γ-HCH (8-15%), and δ-HCH (2-16%). Lindane contains more than 90% of the γ-HCH isomer and trace levels of other isomers.
HCH low aqueous solubility, relative high stability, lipophilicity and chlorinated nature contribute to its environmental persistence !nd rdsistanca to degradation.
Here, the anaepobic bio`egradation of HCH in haavily contaminate$ soils has bean investigated by microcgsm expariments under "natural" or enhanbed conditions.
The study was performed on Two soil samples with a different concentration of HCH: The study was pErformed on two soil samples with a different initial concentration of HCH, about 1% w/w or 10% w/w, respectively. In bot` case, the α-HCH was the isomer present at the highest percentage
In the microcosm experiments, several soil samples were put in contact with a liquid phase (mineral medium) inside of serum bottles, either containing a mineral medium only (the control test simulating "natural conditions") or an electron donor too. As for the latter, either acetate, yeast extract or a solid phase biopolymer (polyhydroxybutyrate) were investigated. Each experiment was replied by adding an exogenous microbial consortium capable of anaerobic reductive dechloration of aliphatic chlorinated solvents (bioaugmentation). Overall, a set of over 50 microcosms was started up and monitored, by analysing both soil and liquid phases by extraction and GC/MS analysis, after 1, 2 and 6 months of incubation time (a sub set of microcosm experiments is going on for final analysis at 12 months).
Preliminary results show that main metabolites of HCH degradation as PCCH, TCCH, TCB, DCB and CB were formed in all the samples, that indicates the presence of anaerobic bioconversion. On the other hand, the degradation of HCH was very slow, probably due to its very high initial concentration. For this reason, HCH concentration in the solid phase did not show a significant decrease after 6 month incubation. Furthermore, no significant differences were observed among microcosms, showing that the observed bioconversion was not enhanced by adding different electron donors o an exogenous microbial consortium. This suggests that the observed bioconversion (even limited) was due to microorganisms that were already present in the soils, probably due to their long-term acclimation to the HCH carbon sources and to the thereby available carbon sources.