Soils and Environmental Pollution

Organic Chemicals

Some wind up in soil, intentionally or not, and have possible adverse effects on water quality and soil organisms.

Fate in the Soil Environment

Volatilization



Sorption



Refers to the distribution of a substance between soil solids and solution. The rate of movement in soil (dissolved in the soil solution) decreases as extent of sorption increases. Extent of sorption is determined by chemical properties of organic solute and soil solids. For example, sorption is very high for cations like the herbicide paraquat but low for the anionic herbicide 2,4-D. In general, sorption is high for hydrophobic solutes if there is a lot of soil organic matter. In some cases, sorption is even irreversible (bound).

Leaching



Affected by soil hydraulic properties. Leaching is greater in highly permeable soils. However, leaching is affected by degradation and sorption.

Runoff



Soil properties that favor infiltration limit runoff.

Degradation

Rate expressed in half-life which is the time required for ½ of the current mass to be degraded. There are nonbiological degradation processes such as photodegradation and chemical degradation. However, biological degradation, especially microbial degradation, is usually more important. Biological degradation depends on the presence of enzymes capable of altering specific chemical structures.



Degradation behavior of selected pesticides (results for atrazine and alachlor are suspect).

Bioremediation of Organic Contamination

The objective is to enhance microbial metabolism and thereby accelerate the degradation of contaminants. This approach is typically less expensive than soil excavation and solvent extraction or incineration. Two approaches are biostimulation and bioaugmentation.

Biostimulation

Involves the addition of organic or inorganic nutrients to raise the numbers and activity of indigenous degraders. Fertilizers have been used to stimulatate hydrocarbon degraders. Approaches to subsurface contam-ination include forced injection of air and nutrients.

Bioaugmentation

Involves inoculation of soil with organisms that have a specific capacity to degrade a contaminant. For this approach to work, the introduced organism must be able to successfully competitive with native organisms. One can fortify with selected native strains.

Inorganic Contaminants

Several of metals and nonmetals

As, Cd, Cr, Cu, Hg, Mn, Mo, Ni, Pb and Zn

There are various sources of these contaminants including waste materials applied to the land surface or buried in land-fills.

Fate of Inorganic Contaminants in Soil

The mobility of inorganic contaminants and plant-uptake of these are reduced by sorption processes. Metals wind up as

Form	Fraction	Mobility
Exchangeable cations	Minor	High
Bound to organic matter	Secondary	Low
Bound by minerals	Major	Very low

Managing Inorganic Contamination

Eliminate or reduce application. Otherwise,

Lime to increase pH and precipitate metals Drainage to increase oxidation of metals to less soluble form.



Effect of pH on metal adsorption.

An alternative is phytoremediation. Use hyperaccumulating plants to mine soil of contaminants. Grow, harvest and recover. Successful phytoremediation requires high uptake and biomass yield.

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