

BIO-REMEDIATION - The Natural Way

- Recent research by Carl Potter of the EPA has found that composting significantly reduces polynuclear aromatic hydrocarbons found in creosote. BioCycle September, 1995.
- Compost is valuable as pollution prevention tool from storm water treatment to global warming (methane contributes to global warming 400X more than CO₂). BioCycle 1995 Washington D.C., Rosalie Green, PhD, EPA
- Compost encourages the growth of many types of bacteria that have the ability to help detoxify many types of pesticides, simply by using them as food. High humus levels are the most important property facilitating pesticide degradation.
- "Evaluating the Suitability of MSW Compost as Soil Amendment in Field Grown Tomatoes, Part B: Elemental Analysis", D.E. Stilwell, Compost Science & Utilization, 1(3):66-72 (1993)
- Statistical analysis showed that plants grown in soils amended with compost had fruits with higher concentrations of sodium (Na) and Potassium (P) and concentrations of beryllium (Be) and cadmium (Cd) decreased.
- Another service of compost is in neutralizing toxins in the soil. The organic acids produced from compost have the ability to bind metals such as aluminum (highly toxic to plants and prevents the absorption of phosphorus) into stable compounds. Thus the aluminum is "locked up" in a stable complex, unable to harm plants. Composting, Rodale Press, 1992.
- The toxicity of plant poisons (high salt concentrations, heavy metals, etc.) become less severe in a soil high in humus (compost). Humus: Origin, Chemical Composition, and Importance in Nature, Dr. Selman A. Waksman
- Hazardous chemicals such as carbofuran insecticide (carbamate family) and simazine herbicide (triazine family) were added to compost piles. Tests showed that 100% of the carbofuran was degraded and 98.6% of the simazine was degraded after only 50 days of composting - Department of Health Services, California, October 1988.
- Compost has been used to help cleanup toxic wastes and chemical spills. Bioremediation of soil contaminated with diesel, JP-4, and motor gasoline at a site (Fairbanks, Alaska) were treated with sewage sludge and composted. Within 70 days some toxins were below measurement limits and others significantly reduced. "Treatment of Fuel Product Contaminated Soil in a Cold Climate Using Composting Technology"; T. J. Simpkin, D. Walter, J. Doesburg, June 1992.



- Composting destroys allelopathic chemicals from trees such as cedars, junipers, walnuts, eucalyptus, etc. International Plant Propagators Society, 1992.
- Numerous recent research has shown compost very effective at preventing erosion. This usually occurs at lower cost and without the pollution of traditional or conventional approaches. The International Erosion Control Society at its 1994 conference in the USA had many papers on the use of compost for flood control, watershed management, sediment control, revegetation and Xeriscape^l technology.
- Research has found that biodegradation of PCB and TCB, and BaP (PAH) with compost is a function of time with a 40% reduction of these chemicals in 4 months. Compost Science & Utilization, Winter 1995
- The White Rot Fungus that decomposes dead wood (into compost) also has the ability to clean up (digest) chemicals such as: pentachlorophenol (a wood preservative more toxic than CCA), dioxins, cyanides, DDT, TNT (explosive), creosote, and coal tar. Other toxic chemicals being tested are Lindane and Toxaphene. After treatment it was found that 90% of the toxin was destroyed within 60 days. Organic Gardening, August 94.
- Research at Rutgers University (Ilya Raskin - New Brunswick) has found a species of Indian Mustard plant, is particularly adept at soaking up lead, cadmium, chromium, nickel, zinc, and copper. Rates were measured at 1 ton of lead per acre and a cost of \$60-100K/acre to a depth of 20 inches vs \$400K for disposal or other cleanups. Wall Street Journal
- Research has found degradation of explosive propellants by composting. Propellants (WC860 and H5010) contain nitrocellulose, nitroglycerin, dibutylphthalate, calcium carbonate, dinitrotolulene, diphenylamine, potassium nitrate, sodium sulfate, graphite, tin dioxide. For WC860 a 83% decrease in only 8 weeks was found and H5010 a decrease of 65% in 6-8 weeks were found. BioCycle, September 1995.
- Scientists at Department of Energy's Pacific Northwest Laboratory in conjunction with the USDA have found that used vegetable oil (fry potatoes, etc. at restaurants) is an inexpensive way to stimulate microbes to eat toxic contaminants in water. Laboratory experiments have shown that microbes energized by vegetable oil can filter nitrate from simulated underground aquifers. The microbes use the carbon in the oil as a energy source and metabolize the nitrate and transform it into nitrogen gas which is harmless.
- Researchers have found that bacteria living in the guts of worms breakdown (detoxify) many hazardous chemicals such as hexachlorocyclohexane (HCH), Organic Gardening May/June 1993

- Alpine pennycress, a small perennial herb, has been found to be a hyperaccumulator of cadmium and zinc, holding 30,000 ppm of zinc in its leaves without loss of growth compared to 500 ppm for most plants. The plant can be harvested, dried and then burned for electrical power generation with the resulting ash being recycled (smelted) and marketed commercially. USDA-ARS, Environmental Chemistry Laboratory, Beltsville, Maryland, Dr. Rufus Chaney.
- A bacteria (*klebsiella terrigena*) that naturally occurs in municipal sewage sludge degrades at least 3 major herbicides (atrazine, cyanazine, and simazine). Similar research has shown that alachlor, metolachlor, and 2,4,D are similarly affected by different microbes. Agricultural Research Service, Beltsville, MD, American Nurseryman, December 15, 1995.
- *POPULUS deltoides* - "Cottonwood", fast growers, easily transplanted, native from Alaska to Central America, used to eliminate toxins from groundwater due to its quick water intake and high respiration rate. Toxins like TCE (trichlorethylene- used to degrease parts)
- Sunflowers (*Helianthus sp.*) have the ability to remove radioactive and toxic metals from soil and water. Some strains of sunflowers can remove up to 95% of toxic contaminants in 24 hours and will remove all contaminants in longer time frames. One test in Ohio showed that water containing 350 PPB uranium entered the test plot and emerged at 5 PPB or less, well below the EPA standard of 20 PPB. A test at Chernobyl in Russia found that sunflower growing on styrofoam rafts had roots that registered 8,000 times more cesium and 2000 times more strontium than surrounding water. Wall Street Journal.
- It has been found that biofilters remove toxic emissions as effectively as conventional systems but at 3 the cost. The filters were made with microbes in a 1:1 mix of pine bark and poultry litter. It reduced acetone, styrene, and methyl ethyl ketones to harmless substances. Work is also be done on bio-scrubbing sulfur dioxide and carbon disulfide.
- The US Department of Energy's Argonne National Laboratory has found that TNT-contaminated soil could easily be bioremediated by creating a slurry of water soil and molasses. As the various soil dwelling bacteria fed on the molasses they also consumed the TNT (even though they could not consume the TNT directly as a food source). Journal Of Environmental Quality Jan.-Feb. 1997.
- A team of researchers at the University of Guelph in Ontario has discovered that lemon-scented geraniums are capable of absorbing and accumulating large amounts of heavy metals from soil. Laboratory tests found the plants were able to absorb 3,200 mg cadmium, 18,700 mg of lead, 6,400 mg of nickel, and 650 mg of copper in 1 kilogram of dry plant tissue in only two weeks. The plants could also tolerate nearly 29,000 ppm of hydrocarbon contaminants, which were present in test soils. For more information call (519) 824-4120, plant patients for bio-remediation have been applied for. American Nurseryman, March 15, 1998.

- PTERIS vittata - "Ladder Brake Fern", is a hyper accumulator of arsenic in soils, plant tissue can take soil at 40 ppm of arsenic and plant tissue can reach 7,526 ppm in the fronds in one field test, in laboratory tests the fronds can reach 22,630 ppm. American Nurseryman, March 15, 2001, pp. 16

Bio-remediationOf ChemicalsBy Compost

It has been proven that Compost can bioremediate (in-situ or at facility) the following types of chemicals:

- polynuclear aromatic hydrocarbons found in creosote.
- chemicals such as carbofuran insecticide (carbamate family) and simazine herbicide (triazine family)
- pentachlorophend, dioxins, cyanides, TNT, DDT, creosote, and coal tars.
- biodegradation of PCB and TCB, and BaP (PAH)
- pentachlorophenol (a wood preservative more toxic than CCA), dioxins, cyanides, DDT, TNT (explosive), creosote, and coal tar.
- Explosive propellants (WC860 and H5010) contain nitrocellulose, nitroglycerin, dibutylphthalate, calcium carbonate, dinitrotolulene, diphenylamine, potassium nitrate, sodium sulfate, graphite, tin dioxide.
- hexachlorocyclohexane (HCH)
- alachlor, metolachlor, and 2,4,D
- CE (trichlorethylene- used to degrease parts)
- explosives 2,4,6,-trinitrotoluene, hexayydro-1,3,5,-triniro-1,3,5-trizine, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
- Chlorophenol, PAH's (1-octadecene; 2,6,10,15,19,23-hexamethyl-tetracosane, phenanthrene,flouranthene and pyrene) and Aroclor 1232
- mineral oil and grease, diesel, JP-4, and gasoline



- almost any hydrocarbon based material

Revegetation Projects:

- wetlands reconstruction
- mine tailings and other degraded soils
- strip mine
- erosion control for slopes

Biofilters for:

- storm water treatment
- odor scrubbing of meat processing and slaughter houses
- odor control for sewage treatment plants
- natural filtration media for green roofs