United States Environmental Protection Agency
Solid Waste And Emergency Response (OS-220)
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EPA

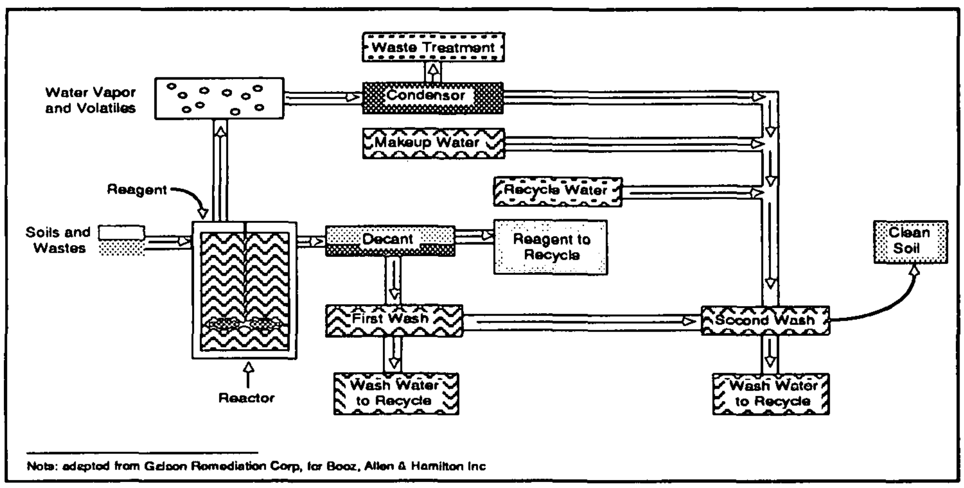
Innovative Technology

Glycolate Dehalogenation

TECHNOLOGY DESCRIPTION

The glycolate dehalogenation process is potentially effective in detoxifying specific types of aromatic organic contaminants, particularly dioxins and polychlorinated biphenyls (PCBs). The process involves heating and physically mixing contaminated soils, sludges, or liquids with an alkali metal hydroxide-based polyethylene glycol reagent in a mobile batch reactor. A typical glycolate dehalogenation treatment facility is shown above in Figure 1.

Figure 1: Schematic Diagram of a Typical Glycol Dehalogenation Treatment Facility



Before treatment, soils are sieved to remove any large rocks and/or debris. The contaminated media are commingled with a reagent to form a homogeneous slurry. The reagent primarily consists of potassium or sodium hydroxide (KOH or NaOH) and polyethylene glycol (PEG); other reagents such as dimethyl sulfoxide (DMSO) or sulfolane (SFLN) may be added to improve the efficiency of the process. The slurry is simultaneously heated (25°C to 150°C) and mixed, consequently decomposing halogenated contaminants into less toxic, water-soluble compounds (glycol-ethers and chloride salts).

Treatment time in the reactor ranges from 0.5 to 5 hours, depending on the contaminant type, initial concentration of the contaminant, water content, humic and clay content (for soils), and the level of treatment desired. Water is vaporized in the reactor and collected in a condensate receiver. A carbon adsorption filter traps any volatile compounds that are not condensed.

Additional treatment of soils is required to desorb reaction by-products and reagent from the dechlorinated soil. This treatment includes physically mixing the dehalogenated soil with water in successive washing cycles. The treated soil is then dewatered and redeposited on-site, while the reagent and wash waters are recycled and ultimately treated and/or delisted.

Advantages of glycolate dehalogenation include toxicity reduction of target contaminants, mobility of treatment unit, short treatment time, non-toxic by-products, and cost-effectiveness relative to conventional technologies for similar wastes (e.g., incineration).

Disadvantages are that the technology is limited to halogenated compounds, and spent reagent, wastewater, and by-products may require further treatment and/or disposal actions. Applications and limitations of glycolate dehalogenation are further discussed in the following sections.

SITE CHARACTERISTICS AFFECTING TREATMENT FEASIBILITY

Glycolate dehalogenation may be used to treat multimedia waste containing aromatic halides such as dioxins, PCBs, and chlorobenzenes. The effectiveness of this treatment on general contaminant groups is provided in Table 1; however, treatability tests are required to determine the effectiveness of glycolate dehalogenation for specific site conditions.

Factors limiting the effectiveness of glycolate dehalogenation include highly concentrated contaminants, high water content, low pH, high humic content (soil), and the presence of other alkaline-reactive materials (e.g., aluminum, other metals). Site-specific characteristics and their potential impact are provided in Table 2.

Table 1
Effectiveness of Glycol Dehalogenation Treatment on General Contaminant Groups for Soil and Debris

	Treatability Groups	Effectiveness
Organics	Halogenated volatiles	⊖
	Halogenated semi-volatiles	⊖
	Non-halogenated volatiles	○
	Non-halogenated semi-volatiles	○
	PCBs	○
	Pesticides	⊖
	Dioxins/Furans	○
	Organic cyanides	○
	Organic corrosives	○
Inorganics	Volatile metals	○
	Non-volatile metals	○
	Asbestos	○
	Radioactive materials	○
	Inorganic corrosives	○
	Inorganic cyanides	○
Reactive	Oxidizers	○
	Reducers	○

Demonstrated Effectiveness ○ No Expected Effectiveness ○
Potential Effectiveness ⊖ Potentially Detrimental X

Table 2: Site-Specific Characteristics and Impacts on Glycolate Dehalogenation Treatment

Characteristics Impacting Process Feasibility	Reasons for Potential Impact	Actions to Minimize Impacts
Elevated concentrations of chlorinated organics (greater than 5 percent)	Requires excessive volumes of reagent; process less cost-effective	Reagent addition
Presence of aliphatic organics, inorganics, and metals	Glycolate dechlorination uneffective against these waste groups	Employ supplemental treatment technology (e.g., solvent extraction, soil washing)
High water content in waste (greater than 15 percent)	Requires excessive volumes of reagent and increased energy input; process less cost-effective	Reagent addition; evaporation of water during treatment process
Low pH (less than 2)	Requires excessive volumes of reagent; process less cost-effective	Reagent addition, pH adjustment
Presence of other alkaline-reactive materials (e.g., aluminum, other metals)	Reactive materials compete with contaminants for reagent	Reagent addition
High humic content in soil	Increases reaction time, process less cost-effective	Increase reactor time

TECHNOLOGY CONSIDERATIONS

The major technology consideration is determining how a large volume of residual wastewater generated from the soil washing/de-watering process will be managed. The residual effluent may require treatment prior to disposal; however, if the volume of waste water is extremely high (i.e., volumes generated from greater than 30,000 cubic yards of washed soil), it may be more cost-effective to petition EPA to delist the residual effluent, whereby it may be disposed without further treatment. Post-treatment options commonly employed when treating residual wastewaters may include chemical oxidation, biodegradation, carbon adsorption, precipitation, or incineration.

Glycolate dehalogenation operations require no special handling [although special handling of contaminated media (e.g., dioxin contaminated waste) may be required] and energy requirements are not extreme; therefore, operation and maintenance costs are relatively low. A full-scale dehalogenation unit with a capacity of 80 cubic yards per batch requires an average of 670 kilowatts, with 930 kilowatts peak. A sufficient power source is required and may present additional costs if a source is not readily accessible. Preconstruction engineering controls, to guard against accidental spills, include leveling and lining (synthetic) the areas under and adjacent to the treatment facility and diking the area surrounding the facility.

TECHNOLOGY STATUS

Numerous vendors presently possess the technology to conduct full-scale glycolate dehalogenation. Galson Remediation Corporation (GRC) has reported to have successfully applied full-scale glycolate dehalogenation at two sites containing PCB-contaminated waste oil. The GRC full-scale reactor has a single batch capacity of 80 cubic yards and is designed to treat 160 to 200 cubic yards of waste per day. GRC quotes the average cost of a treatability test is between $2,000 and $3,000, depending upon the chemistry of the target contaminant(s). Treatment costs range from $100 to $300 per cubic yard; actual costs are contingent upon site-specific characteristics. A summary of vendors capable of conducting pilot- and/or full-scale treatment are listed in Table 3.

Mobile glycolate dehalogenation units have been field-tested on various waste types and media at numerous CERCLA sites at the bench- and pilot-scale. These sites include:

- Montana Pole Wood Preserving Site, Butte, Montana - An oily phase liquid containing 3.0 percent (30,000 ppm) pentachlorophenol (PCP) and oil containing up to 84 ppm chlorinated dioxins and furans were treated to below their respective detection limits. In total, 9,000 gallons of contaminated oil were treated within 1.5 hours.
- Western Processing Site, Kent, Washington - Heterogeneous mixtures of oil, solids, and water containing pesticide phosphate esters and TCDD (up to 120 ppb) were treated to below their respective detection limits. In total, 7,550 gallons of waste were treated within 13 hours.
- P.W.C., Guam - Soils contaminated with Aroclor 1260, ranging in concentrations from 300 ppm to 2,200 ppm, were treated to below 2 ppm within 5 hours. The high temperature alkaline-glycol treatment process, developed by EPA, operates efficiently without adding DMSO or SFLN.

EPA has selected glycolate dehalogenation as a component of the selected remedy for three CERCLA sites. Site names, ROD sign dates, target contaminants, waste volumes, and media are provided in Table 4.

Table 3
Vendor Information

Company	Contact	Address
Galson Remediation Corporation (dechlorination)	Robert Peterson Edwina Milicic	6627 Joy Road E. Syracuse, NY 13057 (315) 436-5160
S.D. Meyers, Inc. (dechlorination)	Joe Kelly	180 South Ave. Talmage, OH 44278 (216) 633-2666
Chemical Waste Management (dechlorination)	Dick Rosenberg	150 W. 137th St. Riverdale, IL 60627 (312) 841-8360
U.S. EPA, Risk Reduction Engineering Laboratory (dehalogenation)	Alfred Kornel Charles Rogers	26 W. Martin Luther King Drive Cincinnati, Ohio 45268 (513) 569-7421 or 569-7757

OFFICE OF RESEARCH AND DEVELOPMENT CONTACTS

Supplemental information concerning glycolate dehalogenation may be obtained from Charles Rogers, U.S. EPA, Risk Reduction Engineering Laboratory, Cincinnati, Ohio 45268, (513) 569-7757 or FTS 684-7757.

Table 4
Glycolate Dehalogenation at CERCLA Sites

SELECTED:		
Region 1 - Re-Solve, MA 9/87	PCBs in Sediment, Soil	3,000 cubic yards sediment 22,500 cubic yards soil
Region 2 - Wide Beach, NY 9/85	PCBs (Arochlor 1254) in Soil	28,600 cubic yards
Region 6 - Sol Lynn, TX 3/88	PCBs in Soil	Not provided