

Technology Safety Data Sheet

Accelerated Subsurface Bioremediation of TCE

Section 1: Technology Identity

Technology Name(s):		Emergency Contact:	
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Section 2: Technology Pictures



Figure 1: Pouring of HRC[®] into Buckets Previously Contaminated by the Soil.



Figure 2: Cleaning of the Used Drill Steels with High-pressure Water.



Figure 3: Operator Ramming Drill Steels into the Ground with the GeoProbe. The Grout Pump is Located at the Left of the GeoProbe.



Figure 4: Flags Marking the Plugs Used Upon Completion of a Location.

Section 3: Technology Description

Many sites throughout the United States have soil and groundwater contaminated by chlorinated solvents like trichloroethylene (TCE). These chemicals are generally difficult to remove. Many treatments involve strong chemicals that pose serious risks to workers. Bioremediation is an attractive alternative. The process uses natural materials from the food industry to stimulate bacteria to breakdown TCE. The technology involves injecting a thick, molasses-like material called Hydrogen Release Compound (HRC[®]) into the subsurface using direct-push hydraulic rods from a commercially available drilling vehicle called a GeoProbe. A sacrificial tip attached to the end of the hollow rod is driven into the ground. Additional sections are attached to reach the desired injection depth. The 35-pound containers of HRC[®] are heated in a hot water bath to 95 degrees Fahrenheit to reduce the thickness of the material prior to injection. Operators manually pour the HRC[®] into the hopper of a grout pump that delivers the HRC[®] through a hose to the drilling rods. After use, the drilling rods are cleaned with high-pressure water to remove the leftover HRC[®].

Section 4: Safety Hazards

Hazard Category:

(Adapted from Appendix A to MIL-STD-882D, February 10, 2000, Department of Defense Standard Practice for System Safety.)

- 4 - Could result in death or permanent total disability
- 3 - Could result in permanent partial disability or injuries or occupational illness that may result in hospitalization of at least three persons
- 2 - Could result in injury or occupational illness resulting in one or more lost work days
- 1 - Could result in injury or illness not resulting in a lost work day
- N/A - Is not applicable to this technology and poses no appreciable risk

A. Buried Utilities, Drums, and Tanks	Hazard Rating: 3
The risk of electrocution is present during any drilling operation where buried electrical lines may be present. Standard drilling precautions must be followed to prevent contacting live lines.	
B. Chemical (Reactive, Corrosive, Pyrophoric, etc)	Hazard Rating: 2
HRC [®] is an irritant that requires protection of the skin and eyes. Gloves, protective clothing, and eye protection are recommended. A face shield would be valuable when pouring the chemical into the hopper of the pump.	
C. Confined Space	Hazard Rating: N/A
This technology is not used in a confined space.	
D. Electrical	Hazard Rating: 1
The Landa pressure washer used for cleaning the drilling rods has an electrical cord that has a significant potential for getting wet. This is a problem if the cord lays in the path of water leaking from the process. Hoses should run in different directions from the electrical cords.	
E. Explosives	Hazard Rating: N/A
There are no explosives used with this technology.	
F. Fire Protection	Hazard Rating: 1
HRC [®] is not flammable. There should be an ABC extinguisher on hand for the kerosene used in the Landa pressure washer to heat water.	
G. Gas Cylinders	Hazard Rating: N/A
No gas cylinders are used with this technology.	
H. Ladders/Platforms	Hazard Rating: N/A
Ladders and platforms are not needed for this technology.	
I. Lockout/Tagout	Hazard Rating: 1
Approved lockout and tagout procedures should be followed for any maintenance activities on the drilling rig or the HRC [®] pump.	
J. Mechanical Hazards	Hazard Rating: 2
The Geoprobe drilling rig poses a risk of injuries to the hands of the operator during the addition of new sections of drilling rods and the hammering of rods into the ground. Keep hands back from the point of operation.	

K. Moving Vehicles	Hazard Rating: 2
<ul style="list-style-type: none"> Forklifts must be used to deliver the containers of HRC[®], which poses risks for site workers of being struck by the vehicles. The Geoprobe poses risks to the operator if he or she does not sit on the seat while moving it. Reaching for the controls while walking beside the unit greatly increases the risk that an operator will slip and have his or her feet slide under the track of the equipment. 	
L. Overhead Hazards	Hazard Rating: 3
The Geoprobe drilling rig can extend high enough to contact overhead electrical lines. Check for acceptable clearance from any electrical lines before raising the drill rig.	
M. Pressure Hazards	Hazard Rating: 2
The Landa pressure washer used to decontaminate the drill rods has a maximum pressure of 2500 psi, which can harm other workers. Injuries may include skin burns and injection. Keeping workers away from the direct spray will eliminate this hazard.	
N. Slips/Trips/Falls	Hazard Rating: 2
<ul style="list-style-type: none"> The slippery HRC[®] solution, if spilled, increases the risks of falling. Care is needed in handling and storing of this material. If water splashes out of the hot water bath onto the plastic sheeting, it becomes a slip hazard. Use of a non-slip surface will eliminate this hazard. If a worker improperly lifts a 32-pound bucket of HRC[®], he or she may slip or trip. Avoiding manual labor will eliminate this hazard. A conveyor or a carboy tilter may provide a solution. Wooden plugs hammered into the ground upon the conclusion of the process stick up approximately two inches. These plugs are a trip hazard. Pounding the plugs all the way into the ground will alleviate this problem. 	
O. Suspended Loads	Hazard Rating: N/A
There are no suspended loads.	
P. Trenching/Excavation	Hazard Rating: N/A
No trenching or excavation necessary for this technology.	
Section 5: Health Hazards	
A. Inhalation	Hazard Rating: 2
If an anticipated release of trichloroethylene (TCE) exists, conduct air sampling to determine necessary respiratory protection.	

B. Skin Absorption	Hazard Rating: 2
HRC [®] is an irritant that requires protection of the skin and eyes. Types of protection that may be necessary include gloves, protective clothing, and eye and face protection (face shield).	
C. Noise	Hazard Rating: 3
The drilling machine made a great deal of noise while it ran. Noise measurements indicated an average of 89.7 decibels (dBA). The Occupational Safety and Health Administration requires all employees who work in an area with a time-weighted average over the Action Level of 85 dBA be placed in a hearing conservation program. Operators who work around the drilling machine should wear hearing protection such as earmuffs or earplugs.	
D. Heat Stress/Cold Stress	Hazard Rating: 2
The work takes place outdoors with the workers in protective garments. The combination of these elements increases the potential for heat stress problems. Training and preventive actions such as providing water and sufficient breaks can reduce risks. Use of a wet bulb globe temperature (WBGT) monitor will alert the supervisor and workers that conditions are favorable for heat stress-related problems.	
E. Ergonomics	Hazard Rating: 2
Moving 35-pound containers of HRC [®] requires proper lifting techniques. Mechanical equipment such as carboys or conveyors may reduce the strain of manually lifting containers.	
F. Ionizing Radiation	Hazard Rating: 2
Soils contaminated with chemicals may also contain radioactive particles. A Radiological Work Permit may be needed to ensure the risks have been considered and protective procedures are in place. Additional personal protective equipment may be needed to prevent spreading contamination. Disposable foot coverings are an example.	
G. Non-ionizing Radiation	Hazard Rating: N/A
Non-ionizing radiation is not associated with this technology.	
H. Biological Hazards	Hazard Rating: 2
Bees and wasps are attracted to the sweet, syrupy HRC [®] solution, which may pose added risks for workers who are allergic to stings.	
I. Other	Hazard Rating: N/A
None	

Section 6: Phase Analysis

A. Construction/Start-up

Unloading equipment from truck/trailer:

- Because the drill is track-driven, proper equipment ramps are needed to prevent equipment from slipping/skidding on the ramps. Blocking the rear tires of the truck may be required.
- Take care when moving the grout pump cart down the truck/trailer ramp to prevent personal injury (sprains, running over one's foot/leg/body). Adding an extra set of wheels to the cart would balance it and eliminate the need to lift it.
- Take care while moving grout pump into position over rough or soft terrain. The movement could create strains, sprains, or back injuries, or cause falls. This is another reason to install an extra set of wheels.

Repositioning the Geoprobe drill:

- The operator must sit in the seat, not walk beside the moving equipment. The travel controls would have been placed in a different position if the intention was to operate the equipment from the ground during traveling/positioning.

Set-up:

- During equipment check/start-up, look at the basic equipment safety concerning hazardous materials such as diesel fuel, gasoline, anti-freeze, hydraulic oil, motor oil, and starting fluid.
- Follow basic equipment safety while climbing on equipment, including three points of contact and clean steps.
- For basic construction safety during set-up and walking around the site, remove tripping hazards, and level rough terrain to avoid ankle sprains. Take special care when carrying drill steels and hoses.

B. Operation

- Tripping hazards are abundant after wooden plugs are driven into the hole to keep the HRC[®] from seeping out of the ground. Approximately two inches of each plug was above the ground.
- Rear outriggers should be lowered during drilling to increase the stability of the equipment. This would eliminate the raising of the drill base plate on the front of the machine when encountering hard ground during drilling operations.
- The operator should sit in the seat while repositioning the machine, not while standing.
- Due to the weight and length of drill steels, workers should be careful to properly lift and carry them. Be aware of other people in the vicinity to avoid hitting them with the drill steels during movement.
- The configuration and design of the pump base makes the operator lift one side of the pump to move it. If any HRC[®] is left in the hopper, the operator must lift the extra weight to move the machine. Adding an extra set of wheels would eliminate this problem.
- The Landa pressure washer should be handled carefully to avoid spraying other workers during this operation.

C. Maintenance (Emergency and Routine)

- Allow hot engine parts (exhaust, engine coolant, etc.) to cool before any maintenance is performed.
- Use extra care to avoid hand slippage from wrench. Also use care during handling of equipment parts while wearing personal protective equipment, especially if it is covered with HRC[®].
- Follow the same precautions during emergency maintenance as during routine maintenance.

D. Shutdown (Emergency and Routine)

Lower drill attachment to the ground or secure mast in travel position before shutdown of machine. Secure any hoses used with the grout pump, which may become tripping hazards if left on the ground.

E. Decontamination/Decommissioning

- Decontaminate areas of the Geoprobe 6610 that come into contact with contaminated soil (tracks, lower car body frame, operator area, and drill attachment).
- Decontaminate the drill attachment.
- Clean drill steels after each use to prevent HRC[®] from solidifying in tubes.
- Decontaminate areas of grout pump unit that were exposed to contaminated soil.

Section 7: Worker Protection Measures

A. Exposure Monitoring

- Air monitoring should be performed if a potential for airborne TCE exists.
- Noise monitoring should be conducted to determine the necessary level of hearing protection.

B. Worker Training

Operators should be trained on the following items. Other safety and health training may be required by the site's safety and health plan.

- Operating procedures
- Hazardous Waste Operations and Emergency Response (HAZWOPER)
- Hazard Communications (HAZCOM)
- Hearing Conservation Program
- Proper fitting and wearing of personal protective equipment
- Possible health hazards associated with the job and the ways to eliminate or mitigate them

C. Medical Surveillance

If noise monitoring indicates noise levels above 85 decibels (dBA), the workers in that area must be placed in a hearing conservation program per the Occupational Safety and Health Administration's noise standard *29 CFR 1910.95*, which will include annual audiograms.

D. Engineering Controls

- Adding one set of wheels to the grout pump cart will eliminate the need to lift the cart during movement.
- Using a conveyor or carboy tilter may eliminate the need to lift 32-pound buckets of HRC[®].

E. Administrative Controls

- Always direct high-pressure water away from all workers when cleaning the inside of the drill rods.
- Mark the location and depth of all underground utilities before digging.

F. Personal Protective Equipment

The following personal protective equipment is required, according to the safe work plan.

- Hard hat
- Safety glasses
- Smocks/coveralls
- Steel-toed work shoes
- Cloth gloves
- Face shield (for drilling and HRC® addition)
- Leather gloves for the driller and mucker
- Ear plugs when working around the drilling area

Section 8: Emergency Preparedness

Accelerated bioremediation treatment does not need any additional emergency preparedness requirements. Workers should be aware of any emergency procedures for the site.

Section 9: Comments, Lessons Learned, & Special Considerations

Overall, this technology is less hazardous than the baseline technology. Its minor safety and health issues can be solved through engineering or administrative controls.

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Copies of this Technology Safety Data Sheet and others developed by the Operating Engineers National Hazmat Program can be found on the internet at: www.iuoeiettc.org.