

Application Instructions

S-MicroZVI[®] is a remediation amendment engineered for the *in situ* chemical reduction of chlorinated contaminants. The product features zero valent iron particles that are less than 5 microns in size and are suspended in a glycerol carrier. These materials are strong reductants and should never be combined with acids or oxidizers (see Health and Safety section).

S-MicroZVI Composition

40% sulfidated colloidal ZVI
45% food grade glycerol
15% water-based carrier

Physical Characteristics

Appearance: Dark gray viscous liquid
Viscosity: About 5000 cP (temperature dependent)
Density: 15 lb/gal

Helpful Chemical Property Measurements

The following solution characteristics measurements were obtained on a suspension mixture comprise of 4000 mg/L activated carbon from PlumeStop and 4000 mg/L zero valent iron from S-MicroZVI.

pH = 8.7
ORP = -492 mV
Conductivity = 2.36 mS/cm

Best Practices

Material Handling: S-MicroZVI is packaged in 50 lb buckets, 500 lb drums and 3000 lb totes. Use care/assistance if moving a tote with a pallet jack. A double diaphragm pump should be used to transfer S-MicroZVI from drums and totes into the mixing tank. Centrifugal drum pumps and dosing or metering pumps are not recommended due to the high viscosity of the material. Because of the low mass of S-MicroZVI typically required in the mixing tank, a bucket or similar container should be used to batch the ZVI material by weight or volume.

Mixing: S-MicroZVI should be homogenized in its packaging container before adding it into the mixing tank. Pails of S-MicroZVI are best mixed using a hand drill equipped with a paint mixer attachment. Totes and drums

of S-MicroZVI should be mixed to a homogeneous consistency at the start of each application day using a 4 ft paint mixer attachment. As with all remedial reagents, it is a best practice to make sure the entire drum/tote is well mixed – including corners & bottom - before transferring into the mixing tank.

Mixing Order: Whenever S-MicroZVI is co-applied with other remedial reagents (PlumeStop[®], 3D Microemulsion[®], pH modifiers, etc.), the order of addition should be as follows:

- 1) Water
- 2) Other amendments (PlumeStop[®], 3DME, etc.)
- 3) S-MicroZVI

Mix Tank: A conical tank less than 500 gal is recommended for batching. It should be equipped with a mixer than has enough power to gently agitate the mixture. The goal is to keep solids suspended without overly aerating the material.

Cleaning: Always thoroughly rinse all S-MicroZVI containers before disposal. Rinse water from this step should be placed into the mixing tank for application. Inspect tanks for any residue of reagents that were recently used in the tank. If there is any evidence rinse tank thoroughly. A thorough cleaning step should be performed at the end of each work day. This should be accomplished by flushing the entire injection system with municipal water.

Health & Safety

Risk Potential, Hydrogen Sulfide: S-MicroZVI will give off hydrogen sulfide (H₂S) gas when exposed to acid. For this reason, it is imperative that low pH (acid) solutions NOT come into contact with solutions containing S-MicroZVI.

In the interest of safety, a hydrogen sulfide detector should be part of every S-MicroZVI application program.

Hydrogen sulfide is toxic, corrosive, and flammable. The threshold of odor detection for hydrogen sulfide is approximately 0.0005 ppm; however, at higher concentrations hydrogen sulfide will suppress the olfactory senses. For this reason, one's sense of smell is not a reliable method of detection, and failure to rely on a hydrogen sulfide detector can lead to overexposure and potentially death. The OSHA Permissible Exposure Limit for an 8-hour timeweighted average is 10 ppm, and hydrogen sulfide is classified as Immediately Dangerous to Life and Health at 100 ppm. With proper handling, no detectable hydrogen sulfide will be produced by S-MicroZVI.

Do not mix S-MicroZVI with acid, this includes HRC or HRC Primer.

- Adding acid to S-MicroZVI can cause hydrogen sulfide to be produced for many hours. If hydrogen sulfide is being produced, work must stop.

Do not combine S-MicroZVI with any oxidizing agent (PersulfOx[®], RegenOx[®], etc.)

- S-MicroZVI is a strong reductant. Combining
- S-MicroZVI with oxidizers will cause a vigorous exothermic reaction and has the potential to produce hydrogen sulfide.

Preferred Storage Conditions: S-MicroZVI should be stored in cool, dry places if possible. Indoor storage is preferred – if this is not available, seek a covered or shaded spot outdoors.

Shelf Life^{}:** S-MicroZVI should be used within 4 weeks of arrival onsite.

^{**} Shelf life may decrease with extreme temperatures. For situations where prolonged temperature may exceed 90F we advise to use the product as soon as possible. Small amounts of hydrogen gas may evolve from the material during storage. For this reason, buckets, drums, and totes are vented.

Handling Practices: Standard PPE should be used when handling S-MicroZVI. This includes eye protection, gloves and face shield when mixing.

There are some specific characteristics to keep in mind for these materials:

Density: A half-full pail may be heavier than it appears, use care when lifting.

Cleanliness: This product will stain clothes.

Slip concerns: S-MicroZVI can be very slick if spilled. In the event of a spill, use caution as the floor may be very slippery.

Do's & Don'ts

Do	Don't
<ul style="list-style-type: none"> ✓ Use a diaphragm pump to transfer S-MicroZVI from totes or drums. ✓ Use a bucket or graduated vessel to measure S-MicroZVI for the mixing tank from totes or drums. ✓ Rinse each mix tank at the end of the day to prevent excess buildup of ZVI solids. ✓ Use tap water for rinsing and cleaning. ✓ Inject the equivalent of a 7-borehole volume of clear water into injection wells and any affected monitoring well upon completion of the injection program. ✓ BDI Plus[™] and S-MicroZVI are compatible. Apply BDI Plus as typical. ✓ Use pails of S-MicroZVI within 2-3 days of opening. ✓ Use standard PPE when using S-MicroZVI. This includes safety glasses, face shield, and gloves. 	<ul style="list-style-type: none"> ✗ Use dose pumps, drum pumps, etc. to transfer S-MicroZVI. ✗ Store product below 30 degrees to avoid thickening. ✗ Use buckets that contained RegenOx[®], PersulfOx[®], HRC[®], or HRC Primer. ✗ Leave suspensions containing S-MicroZVI in the mixing tank overnight or for an excess period (4-5 hours). Ever add acid or oxidizers to S-MicroZVI. ✗ Use sodium bisulfite or other oxygen scavengers. These are unnecessary with S-MicroZVI. ✗ Use partial pails of S-MicroZVI that were opened for a previous site. ✗ When batching, add more than 50lb. of total suspension to pails