REGENESIS

# Oxygen Release Compound (ORC®) Installation Instructions

**(Augered Hole Back-Fill Method)**

**SAFETY:**

Pure ORC is shipped to you as a fine powder rated at -325 mesh (passes through a 44 micron screen). It is considered to be a mild oxidizer and as such should be handled with care while in the field. Field personnel should take precautions while applying the pure ORC. Typically, the operator should work upwind of the product as well as use appropriate safety equipment. These would include eye and respiratory protection, and gloves as deemed appropriate by exposure duration and field conditions.

Personnel operating the field equipment utilized during the installation process should have appropriate training, supervision and experience.

**GENERAL GUIDELINES:**

ORC may be installed in the contaminated saturated zone in the ground utilizing hand augered holes, Geoprobe® type hydraulic punch equipment, or hollow stem augers. This set of instructions is specific for Geoprobe equipment. Alternate instructions may be obtained from the Regenesis Technical Support Department.

For optimum results the ORC slurry installation should span the entire vertical contaminated saturated thickness, including the capillary fringe and “smear zone”.

Two general installation approaches are available. The first is to back-fill only the probe hole with slurry. This is a simple approach, in that it is easy, straightforward, and the location of the ORC slurry is precisely known after installation. However, this method requires significantly more probe holes than the alternative, and may take more time for the completion of the remediation process. These instructions are for this method utilizing Geoprobe equipment.

The second method is to inject the slurry through the probe holes into the contaminated saturated zone. This method requires fewer probe holes, is less disruptive to the site, and aids the spread of oxygen by spreading the ORC source material. However, it may be difficult to know the exact, final disposition of the ORC installed with this method. A separate set of instructions for this method utilizing Geoprobe equipment is available from Regenesis.

Note: It is important that the installation method and specific ORC slurry point location be established prior to field installation. It is also important that the ORC slurry volume and solids content for each drive point be predetermined. The Regenesis Technical Service Department is available to discuss these issues and Helpful Hints at the end of these instructions offers relevant information. Regenesis also has available Technical

Bulletins covering source treatments with ORC.

**SPECIFIC INSTALLATION PROCEDURES:**

1. Identify the location of all underground structures, including utilities, tanks, distribution piping, sewers, drains, and landscape irrigation systems.
2. Identify surface and aerial impediments.
3. Adjust planned installation locations for all impediments and obstacles.
4. Pre-mark the installation grid point locations, noting any that have special depth requirements.
5. Auger a hole into the ground utilizing the method chosen: hand augering; solid stem auger and drill rig; or hollow stem auger and drill rig.
6. The hand augering and solid stem auger will generally require a soil matrix that will stay open during auger removal. If this is the method being used, the ORC slurry should be installed immediately upon tool removal from the hole.
7. Mix the appropriate quantity of ORC slurry for the current drive point. (See separate "Directions for ORC® Slurry Mixing" and Helpful Hints). **Note: Do not mix more slurry than will be used within a 30 minute period.**
8. Where soil conditions are unstable in the saturated zone, denser slurries are recommended. Sixty-five percent solids is normally appropriate in these situations, since it is relatively close to the density of soil.
9. Tremie pump option. The slurry may be pumped through standard geotechnical slurry pumps and a tremie hose. Follow equipment manufacturer's operating instructions. Regenesis recommends a tremie application from the bottom of the hole up to the top of the capillary fringe. This is especially important if there is ground water in the bottom of the installation hole, since it serves to maintain the densest ORC slurry mix.
10. Tremie pipe option. In relatively shallow situations, a tremie pipe may be used. Depending on the open hole diameter, a PVC tremie pipe of 1" to 2" diameter may be used. The hole should be filled from the bottom of the hole to the top of the capillary fringe. It is normally a good idea, and may sometimes be a necessity, to use a "plunger" inside the tremie pipe to push the slurry through as the pipe is withdrawn. A funnel to pour slurry into the tremie pipe is advised.
11. Hollow-stem auger option. If the hole being drilled would collapse during tool removal, augering applications require a hollow stem. By drilling with a plug in place, an open temporary source hole is created. The slurry may be installed with a tremie pipe or a tremie pump, following the pump manufacturer's operating instructions. Depending on the saturated zone soil conditions, it may be necessary to carefully coordinate the rate of auger withdrawal with the rate of slurry addition to preserve the hole void space for acceptance of the slurry.
12. Hollow stem auger option---auger as "tremie pipe". When soil conditions in the saturated zone are unstable and hole collapse is likely, the hollow stem auger may be used as a tremie pipe. Prior to dropping the auger plug at the bottom of the hole, the ORC slurry is poured directly into the hollow stem, in a volume equal to the expected requirement for the hole. A plunger inside the auger is used to push the slurry down in the hole to keep it there as the auger is removed.
13. Install an appropriate seal, such as bentonite, above the ORC slurry through the entire vadose zone. This helps assure that the slurry stays in place and prevents contaminant migration from the surface. Depending on soil conditions

and local regulations, a bentonite seal can be pumped through the slurry pump or added via chips or pellets after probe removal.

14. Remove and decontaminate auger.
15. Finish the augered hole at the surface as appropriate (concrete or asphalt cap, if necessary).
16. Move to the next installation point and repeat steps 5 through 15.

**Helpful Hints**

A. Physical characteristics

A1. Slurry

The ORC slurry is made using the dry ORC powder (rated at -325 mesh). It makes a smooth slurry, with a consistency that depends on the amount of water used.

A thick, but pumpable, slurry that approaches a paste can be made by using 65-67% solids. This material is normally used for back-filling a bore or probe hole. It is especially useful where maximum density is desired such as where ground water is present in the hole or there are heaving sands.

As a rule, it is best to mix the first batch of slurry at the maximum solids content one would expect to use. It can then be thinned by adding additional water in small increments. By monitoring this process, the appropriate quantities of water for subsequent batches can be determined.

The slurry should be mixed at about the time it is expected to be used. It is best to not hold it for more than 30 minutes. Thinner slurries, especially, can experience a separation upon standing. All ORC slurries have a tendency to form cements when left standing. If a slurry begins to thicken too much, it should be mixed again and additional water added if necessary.

Care should be taken with slurry that may be left standing in a grout pump or hose. Problems can generally be avoided by periodically re-circulating the slurry through the pump and hose back into the pump's mixing or holding tank.

B. Operating characteristics

B1. Operations - General

When performing a probe hole back fill installation, it is important to fill the appropriate portion of the hole (see below) with a thick slurry that will solidify in place. Moderate amounts of pressure should be used to avoid fracturing the soil matrix or pumping slurry into the soil.

The operator should use care and monitor pumping pressures and quantities to assure that the hole is being filled without pushing excess material into the soil matrix. Ideally, the rate of slurry pumping will be coordinated with the rate of probe withdrawal. As explained further in the following section, it is usually important to assure installation up to the top of the capillary fringe.

B2. Fill Volumes

Probe hole back-filling

| Per 10' (Ten Foot) Length | | | |
|---|---|---|---|
| **Theoretical** | | **Operating Volume** | |
| **(Gallons/Fluid Ounces/Cubic Inches)** | | **(Gallons/Fluid Ounces)** | |
| **Sand, Silts & Clay** | | **Sand** | **Silts & Clay** |
| 1" Diameter | .41 gal/52 fl. oz./94.2 cu. in. | .61 gal/78 fl. oz. | .51 gal/65 fl. oz. |
| 1 1/2" Diameter | .92 gal/117 fl. oz./212.0 cu. in. | 1.38 gal/176 fl. oz. | 1.15 gal/146 fl. oz. |
| 2" Diameter | 1.63 gal/209 fl. oz./376.8 cu. in. | 2.44 gal/313 fl. oz. | 2.04 gal/261 fl. oz. |
| 2 1/4" Diameter | 2.06 gal/264 fl. oz./476.9 cu. in | 3.09 gal/396 fl. oz. | 2.57 gal/330 fl. oz. |

Note that the operating volumes include a 50% excess above the theoretical volume in sands and 25% in clays and silts. This is important to successful treatment. The additional material allows for a small degree of infiltration of the slurry into the surrounding soil and fractures, as well as hole diameter variability. It is important to assure that the entire contaminated saturated zone is treated (including the capillary fringe), since this is often the area of highest pollution concentration. Failure to treat this area due to improper installation can undermine an otherwise successful remediation effort.

**For direct assistance or answers to any questions you may have regarding these instructions, contact Regenesis Technical Services at 949-366-8000.**