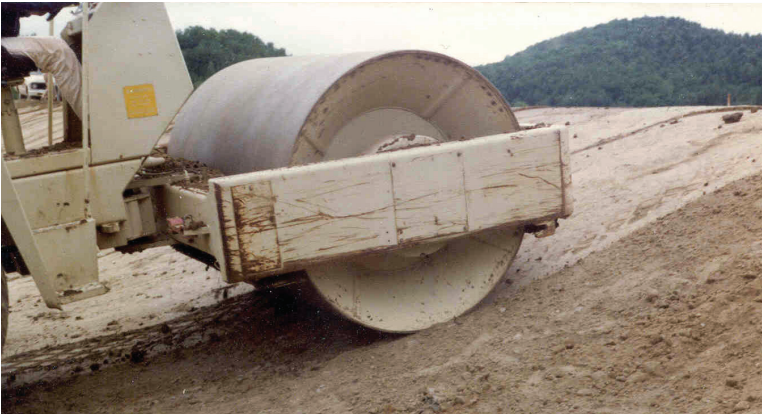


# VOLCLAY<sup>®</sup>

## SOIL SEALANTS



## VOLCLAY® SOIL SEALANTS

VOLCLAY sodium bentonite has been used for over 60 years to create low permeability liners in a variety of applications. There are two primary methods of using VOLCLAY to create a liner. The most common of these is mixing VOLCLAY into soil, then compacting the mixture into place. In less critical applications, VOLCLAY is sprinkled into an existing lagoon where it settles to the bottom and creates a seal to reduce leakage. This guide provides general instruction on VOLCLAY liner installation.

### VOLCLAY/Soil Liners

The first and most important step in properly installing a VOLCLAY/soil liner is determining the correct VOLCLAY application rate, soil moisture content and degree of compaction. CETCO's laboratory uses a proprietary testing method in determining the application rate for any given soil. For an additional charge, CETCO can verify that application rate through flexible or rigid wall permeability testing. Permeability testing per ASTM D7100 is recommended when there are concerns about chemical compatibility between VOLCLAY and the liquid to be

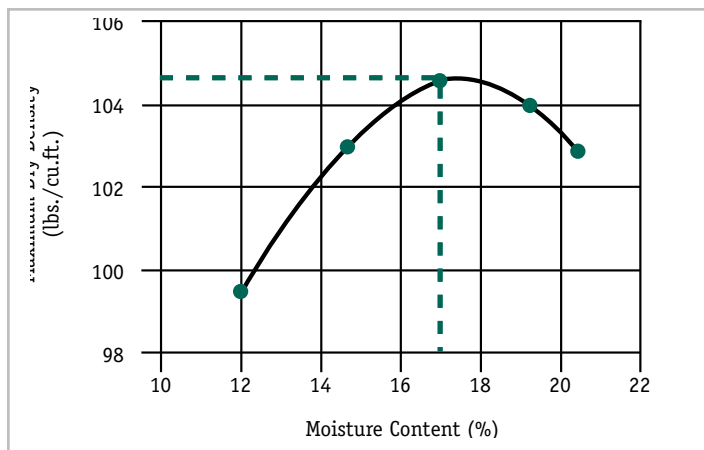


Figure 1.

contained. Moisture content and degree of compaction should be determined by an independent laboratory using the Standard Proctor Test, which will produce a moisture/density relationship for the soil bentonite mixture (see fig. 1). (We do not recommend the Modified Proctor Test because resulting values have a lower optimum moisture content, which tends to increase permeability.) CETCO recommends compacting the soil to 90% of the maximum density at 2–3% wet of the optimum moisture content.

### MIXING

We recommend the pug mill method and the mix-in-place method for incorporating VOLCLAY into soil. The mix-in-place method is probably the most widely used and most cost-effective for most projects.

### PUG MILL MIXING

The pug mill is a batch mixing plant (usually located on or near the construction site), that blends the appropriate amount of soil, VOLCLAY and water soil. In most pug mill applications there are two or more hoppers: one containing soil, the other containing bentonite. A conveyor belt runs below, and the soil and bentonite are metered onto the belt. The conveyor belt then dumps the soil and VOLCLAY combination into a mixing chamber where water is added to adjust moisture content to 2–3% wet of optimum. Material is then mixed (see cover page photo).

Once mixed, the soil/VOLCLAY mixture is dispensed into a dump truck and hauled to the job site. The mixture is usually applied using an asphalt spreader. These spreaders can quickly apply a controlled layer of soil/VOLCLAY, which is immediately ready for compaction. Alternatively, the soil/VOLCLAY mixture can be spread using a variety of earth-moving equipment such as bull dozers and scrapers.



Photo 1. – A Bomag “recycler,” normally used to recycle asphalt pavement, does an excellent job of mixing soil and Volclay.

### MIX-IN-PLACE

Equipment such as a high-speed rototiller or an asphalt road reclaimer can be used to mix VOLCLAY into the soil. A disk is not recommended because it cannot mix VOLCLAY and soil to a homogenous consistency. The asphalt road reclaimer's high-speed mixing and accurate depth placement make it an excellent choice (see photo 1).

During a mix-in-place process the mixer first breaks up the soil. Moisture content is then adjusted before VOLCLAY is added. This results in the most consistent, workable mix. Next, VOLCLAY is spread over the soils surface. This can be done in several ways. One way is to mark a grid on the soil so that one bag of bentonite can be evenly distributed throughout that grid. For example, if the application rate is 5 pounds per square foot, and the VOLCLAY is supplied in 2,000-pound bags, one bag will cover 400 square feet. An area 10 feet wide by 40 feet long could then be marked, and a bag of VOLCLAY spread evenly throughout that area.



A second way to spread VOLCLAY is using an agricultural spreader. These spreaders typically need modification since most are designed to dispense pounds per acre, not pounds per square foot, as required in a VOLCLAY application. To calibrate the spreader, a tarp or shallow box approximately 2 feet by 2 feet (four square feet) is first weighed and then laid on the ground. The truck then passes over the tarp, dispensing VOLCLAY at a set rate. After the pass, the tarp is carefully picked up and weighed. After subtracting the weight of the tarp, you should have an indication of the VOLCLAY dispensing rate in lbs. per square foot. The dispensing rate can then be adjusted up or down to meet the target application rate. Again, if the application rate were 5 pounds per square foot, and the tarp were 4 square feet, the target weight would be 20 pounds plus the weight of the tarp. Once calibrated, the spreader should be checked occasionally to ensure that the proper application rate is maintained.

A "strike box" can be used in similar fashion. The box is constructed with sides that are exactly the same depth as the depth of VOLCLAY required for the job. Again, assuming a rate of 5 pounds per square foot, the depth of the VOLCLAY can be calculated given the standard bulk density of 64 pounds per cubic foot.

The calculation is as follows:  
 $64 \text{ lbs./12 inches} = 5.33 \text{ lbs./in.}$   
 $5.33 \text{ lbs./in.} \times 5 \text{ lbs.} = 1.06 \text{ in.}$

The strike box would then be constructed with the inside walls 1.06 inches deep. After the spreader dispensed bentonite over the box, a straight edge is used to level the bentonite and to ensure that the box is full.



Photo 2. – Supersacks of Volclay delivered to a job site are ready to be placed in a grid pattern to ensure proper application rates.

In all of these methods, it is better to have a little too much VOLCLAY than too little.

## COMPACTION

After the soil/VOLCLAY mix has been mixed and placed, it needs to be compacted. Compaction usually is accomplished with a pad foot,

wobble wheel or steel wheel vibratory roller (see photo 3). Sheep's foot rollers should only be used on liners 12 inches or more thick, and comprised of multiple lifts. The liner should be compacted to a minimum of 90% Standard Proctor. The recommended maximum compacted lift thickness is 6 inches.

## PROTRUSIONS THROUGH THE SOIL/VOLCLAY LINER

To seal against any protrusions in the liner such as pipes, footings or concrete slabs, first place and compact the soil/VOLCLAY mixture as close to the protrusion as is practical. Then, dig a small trench (roughly 3 inches wide and 3 inches deep) around the protuberance. Place and hand compact a blend of soil and VOLCLAY in the proportions of four parts soil to one part VOLCLAY into the trench (see fig. 2). Alternatively, a bead of pure bentonite can be placed in the trench.

## CONSTRUCTION QUALITY ASSURANCE (CQA)

The same CQA measures used in compacted clay liner construction are used in soil/VOLCLAY liner construction. Proper density and moisture are important to the sealing quality of the resulting soil/VOLCLAY liner. These qualities should be frequently monitored with a nuclear density gauge to ensure the equipment, materials and methods of construction are adequate to achieve the required performance criteria. Constructing a small test pad adjacent to the project is an excellent CQA technique. In-situ and other destructive permeability testing can be performed on the test pad without disrupting the integrity of the actual liner. If a test pad is not available, CETCO recommends that samples of the soil/VOLCLAY mixture be taken before compaction. Then it should be recompacted to field conditions in the laboratory.

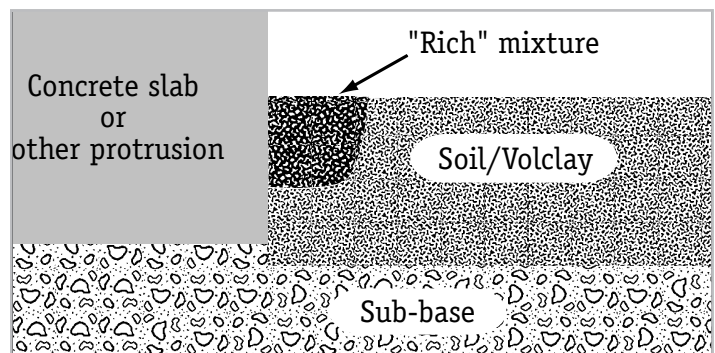


Figure 2. – A rich mixture of soil and Volclay is placed in a small trench around the protrusion.

## PROTECTIVE COVER

A 6-inch to 18-inch cover of native soil, sand or stone should be placed over the soil/VOLCLAY liner to protect it from surface erosion and desiccation. This cover should be placed as the liner is installed. If drainage pipes or leachate collection pipes are required, they can be buried in this cover. In liquid impoundments, a layer of rip-rap should be laid at the water line to protect from erosion due to wave action.

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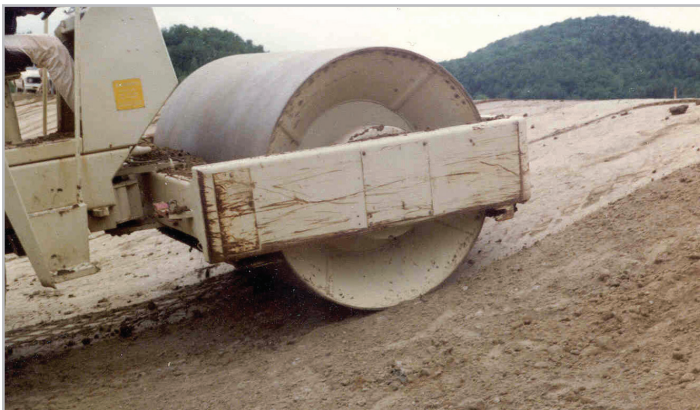


Photo 3. – A steel wheel vibratory roller compacting the liner in 6-inch lifts.

### HYDRATION

Under most conditions, prehydration of the VOLCLAY liner is not necessary. However, in situations where contaminated liquid or leachate will be in contact with the liner, the compacted liner should be flooded with fresh water for 72 hours before it comes in contact with any contaminants.



Photo 4. – Placement of mixed soil and bentonite.

### The Sprinkle Method

In some cases, VOLCLAY may be used to seal existing ponds that are leaking excessively. If the pond can be drained, CETCO recommends constructing a soil/VOLCLAY liner as explained above. However, if draining the pond is impractical, the sprinkle method may provide a simple solution. (Note: This method may harm fish!) VOLCLAY is simply sprinkled through the surface of the water at a rate of approximately

2 pounds per square foot of water surface area and allowed to settle to the bottom. This rate can go as high as 5 or 6 pounds per square foot in some situations. The VOLCLAY can be poured into the water over the edge of a boat, or blown over the surface of the water from the shore using a pneumatically powered device. Although it is simple, the sprinkle method is not typically as effective as the soil/VOLCLAY liner.

The sprinkle method works as VOLCLAY settles through the water to the bottom of the pond, where it begins to swell. If water is leaving the pond through cracks or a gravel layer, water should be flowing toward those openings. The VOLCLAY will be carried into those openings where it will swell to seal them. CETCO recommends using a coarse granular product such as VOLCLAY Crumbles. Because their particle size is larger than the other granular products, there is less surface area, which gives the product a longer hydration time. This gives the product an opportunity to settle to the bottom and into any openings before it becomes fully swelled.

If leakage is occurring through a particular spot in the lagoon, and that spot can be identified from the surface, the success of the sprinkle method can be increased. The VOLCLAY application can then be concentrated in one area rather than over the whole lagoon. Locating leaks can sometimes be accomplished using special blocks of fluorescent dye. These dye tracers are submerged in the water either at the bottom of the pond (if visible) or suspended from a float about a foot below the surface of the water. As the dye dissolves, it is carried with the water flow toward any leaks. Usually, several blocks are placed throughout the lagoon and dye paths are recorded. By following the paths, it is sometimes possible to identify specific leaks. The VOLCLAY application can then be concentrated in that area.



The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

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