# GEOSYNTHETIC CLAY LINERS

## PROVEN TECHNOLOGY FOR LIQUID AND WASTE CONTAINMENT

### WE ARE CURRENTLY USING A COMPACTED CLAY LINER. CAN WE SAVE MONEY SWITCHING TO A GCL?

Yes, unless clay is located close to the site, GCLs are usually less expensive. Use the GCL vs. CCL Cost Comparison calculator found on cetco.com to compare.

### WHAT SHOULD I SPECIFY FOR CERTIFIABLE PROEPRTIES OF A GCL?

CETCO certifies to the bentonite and GCL properties found in ASTM D5889 for manufacturing quality control of GCLs. Separate certifiable properties are provided for all CETCO GCL products.

### WHAT IS THE STEEPEST SLOPE ON WHICH BENTOMAT® GCL MAY BE USED?

Reinforced BENTOMAT GCLs have been successfully used on slopes 3H:1V and steeper. These designs were based on internal and interface direct shear testing. Refer to the historical direct shear data found in TR-114bm.

### WHEN IS A GCL "TOO WET" AND SHOULD BE REPLACED?

A GCL only serves its function of low permeability after it is hydrated. The key is that cover material should be placed over the GCL prior to significant hydration. Based upon experience and field testing, a reinforced GCL can usually be hydrated without requiring replacement. Refer to TR-312 for specific guidelines.

### I WANT TO LINE A POND; WHAT GCL SHOULD I USE?

For high head applications, such as recreation ponds and wastewater treatment lagoons, CETCO recommends BENTOMAT® CL .

### THE CONTRACTOR HAS REQUESTED PERMISSION TO USE COVER MATERIAL THAT CONTAINS LIMESTONE OR DOLOMITE. SHOULD I BE CONCERNED?

Calcium and magnesium can leach from cover material and exchange with the sodium ions in the sodium bentonite used in GCLs thus reducing its efficiency. As a general guideline, CETCO does not recommend calcium-rich cover materials.

### WHAT IS THE DIFFERENCE BETWEEN FLUX AND PERMEABILITY?

Flux is the actual rate of flow through the GCL and is expressed in units of volume per unit area per unit time (m3/m2/sec). Permeability or hydraulic conductivity is a mathematical constant derived from Darcy's Law and describes a soil's ability to convey flow under known hydraulic forces. The benefit of using flux is that this value can be used for a direct comparison to any maximum leakage specifications or requirements for a given project. TR-317 provides a complete description of these concepts.

In addition to superior chemical resistance performance, LIQUID BOOT® spray-application effectively seals penetrations, footings, grade beams and other irregular surfaces that are considered critical vapor intrusion pathways.

### IS A GCL COMPATIBLE WITH ORGANIC CHEMICALS?

In general, yes. Small concentrations of common organic groundwater contaminants, for example, have no effect on the hydration and function of a GCL. Even concentrated solutions have little or no effect provided that the GCL is prehydrated with water prior to exposure.

### WHAT IS THE LIFETIME OF A GCL?

To the best of our knowledge, the natural and synthetic components of a GCL will uphold far into the future, likely over 100 years under normal conditions of soil burial. While conclusive data is impossible to provide, the bentonite in GCLs is already extremely old (millions of years), and the synthetic geotextiles are made of chemically stable polymers which resist long-term degradation.

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### WILL CETCO MAKE ROLLS LONGER THAN 150 FT?

Longer rolls are extremely difficult to lift and handle, and CETCO actively discourages the use of rolls exceeding 150 feet. However, in certain applications where large areas must be covered by experienced installers, CETCO has provided rolls up to 250 feet in length.

### WHAT EQUIPMENT DO I NEED TO UNLOAD THE DELIVERY VEHICLES?

CETCO certifies to the bentonite and GCL properties found in ASTM D5889 for manufacturing quality control of GCLs. Separate certifiable properties are provided for all CETCO GCL products.

### WHAT IS THE DIFFERENCE BETWEEN BENTOMAT AND CLAYMAX?

Nearly all BENTOMAT GCLs are reinforced, in which the fibers of a non-woven geotextile are needle-punched through the bentonite layer into either a woven or non-woven geotextile (depending on the product configuration). The needle-punched fibers give these BENTOMAT products excellent internal shear strength for use in sloped applications. BENTOMAT 200R and the CLAYMAX products are non-reinforced, needle-punched GCLs for use in areas with slopes not greater than 10H:1V.

### ARE GCLS EFFECTED BY FREEZE/THAW?

Geosynthetic clay liners are not adversely affected by freeze/thaw cycles. Laboratory testing has shown that the hydraulic conductivity of GCLs remains unaffected after many freeze/thaw cycles. TR-104 provides actual laboratory testing data.

### ARE GCLS COMPATIBLE WITH LANDFILL LEACHATE?

Many laboratory hydraulic conductivity tests have been performed on specimens of CETCO GCLs with leachate as the permeant. This testing has shown that hydraulic conductivity generally remains unchanged. TR-101A is a test report showing laboratory testing data of BENTOMAT permeated with landfill leachate. TR-254 summarizes laboratory testing results of BENTOMAT permeated with multivalent salt solutions representative of landfill leachate.

### HOW LONG DO GCLS TAKE TO HYDRATE?

When a geosynthetic clay liner is placed on a soil, it will hydrate through absorption of moisture contained within the adjacent soil. Testing results provided in TR-222 shows that the GCL will even hydrate when placed on a soil with a moisture content well below optimum.

### WHAT IS THE TYPICAL MOISTURE CONTENT OF THE BENTONITE IN BENTOMAT GCLS?

The moisture content of raw bentonite, before it is incorporated into the GCL, is less than 12%. During manufacturing of the GCL, water is added to the bentonite to assist GCL needle-punching. The resulting bentonite moisture content in BENTOMAT leaving our manufacturing facilities is between 25% and 40%, with typical values of about 30%. These values are well below that of fully hydrated bentonite, and will have no negative effect on performance. In fact, bentonite with 25% to 40% moisture has the appearance, consistency, and strength of a granular soil.

### SHOULD I BE CONCERNED ABOUT GCL PANEL SEPARATION IN THE FIELD?

Separation of overlapped GCL panels may be a concern in "exposed" lining systems - situations where a GCL is left covered only by a geomembrane with no confining cover soil for extended periods of time (months or years). Under these conditions, there have been some documented instances where wide temperature fluctuations in the exposed geomembrane compromised the underlying GCL seams, resulting in gaps between the panels. However, reasonable measures can be implemented to prevent panel separation. This topic is discussed in detail in TR-338.

### WILL BENTOMAT SHRINK IN THE FIELD UPON DEPLOYMENT?

As shown in TR-339, both laboratory and field data have demonstrated that BENTOMAT deployed at its as-manufactured moisture content (25% to 40%) will not shrink upon drying. Thiel (2005) found that GCLs can experience shrinkage when subjected to repeated cycles of wetting and drying (full hydration followed by complete desiccation). However, as discussed in TR-338, reasonable measures can be implemented to prevent this from occurring.

# LIQUID BOOT®

## SPRAY-APPLIED GAS VAPOR BARRIER

## TESTING DATA

| CHEMICAL & PHYSICAL PROPERTIES | | |
|---|---|---|
| PHYSICAL PROPERTY | TEST METHOD | RESULT |
| Accelerated Weathering and Ultraviolet Exposure | ASTM D822 | No adverse effect after 500 hours |
| Air Infiltration | ASTM E283-91 | 0 cfm/sq. ft. |
| Bonded Seam Strength Tests | ASTM D6392 | Passed* |
| Coefficient of Friction (with geotextile both sides) | ASTM D5321 | 0.72 |
| Cold Bend Test | ASTM D146 | Passed. Ø cracking at –25°F |
| Dead Load Seam Strength | City of Los Angeles | Passed* |
| Electric Volume Resistivity | ASTM D257 | 1.91 x 1010 ohms-cm |
| Elongation | ASTM D412 | 1,332% Ø reinforcement, 90% recovery |
| Elongation w/8 oz. non-woven geotextile both sides | ASTM D751 | 100% (same as geotextile tested separately) |
| Environmental Stress-Cracking | ASTM D1693-78 | Passed* |
| Flame Spread | ASTM E108 | Class A with top coat (comparable to UL790) |
| Freeze-Thaw Resistance (100 Cycles) | ASTM A742 | Meets criteria. Ø spalling or disbondment |
| Heat Aging | ASTM D4068-88 | Passed* |
| Hydrostatic Head Resistance | ASTM D751 | Tested to 138 feet or 60 psi |
| Potable Water Containment | ANSI/NSF 61 | NSF Certified for tanks >300,000 gal |
| Puncture Resistance w/8 oz. non-woven geotextile both sides | ASTM D4833 | 286 lbs. (travel of probe = 0.756 in) |
| Sodium Sulfate (2% water solution) | ASTM D543, D412, D1434 | Less than 1% weight change |
| Soil Burial | ASTM E154-88 | Passed |
| Tensile Bond Strength to Concrete | ASTM D413 | 2,556 lbs/ft² uplift force |
| Tensile Strength | ASTM D412 | 58 psi without reinforcement |
| Tensile Strength w/8 oz. non-woven geotextile both sides | ASTM D751 | 196 psi (same as geotextile tested separately) |
| Toxicity Test | 22 CCR 66696 | Passed |
| Water Penetration Rate | ASTM D2434 | $<7.75 \times 10^{-9}$ cm/sec |
| Water Vapor Permeance | ASTM E96 | 0.069 perms |

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