

## THE USE OF GCLS IN EXPOSED COMPOSITE LINER SYSTEMS

Geosynthetic Clay Liners (GCLs) and geomembranes are frequently used together in composite liner systems for landfill and pond applications. In addition to serving as a low-permeability, self-healing material underneath the geomembrane, GCLs also provide a good working surface to install the geomembrane. CETCO's standard installation guidelines (TR-402) recommend that deployed GCL (whether used alone or with an overlying geomembrane as part of a composite liner system) be covered with a minimum of 12 inches of soil. The cover soil is recommended for various reasons, including physical protection, seam performance, and uniform hydration.

Since many waste disposal applications involve the use of granular soil drainage layers or soil protection layers over composite liner systems, this installation recommendation is normally met. The purpose of this document is to discuss "exposed" pond liner applications, where a GCL is placed under a geomembrane with no cover soil.

Exposed liner systems are not typically recommended by CETCO in consideration of:

- **Panel Separation.** As discussed in TR-338, there is an increased potential for in-situ separation of overlapped GCL panels in exposed lining systems. Leaving the geomembrane exposed will allow it to undergo wide temperature fluctuations, causing thermal expansion and contraction of the geomembrane. Repeated expansion and contraction of a textured geomembrane, especially on steep slopes, can place the underlying GCL in tension, causing GCL necking. GCLs with a woven geotextile are less susceptible to tension necking than those made with two nonwoven geotextiles. Geomembrane temperature fluctuations can also drive repeated wetting and drying of GCL, which may cause panels to shrink. To mitigate the potential for GCL panel separation, the longitudinal seam overlaps on the GCL should be increased or heat-tack welded (quick application of a flame torch followed immediately by light pressure).
- **Hydraulic Performance.** As discussed in TR-341, repeated cycles of GCL wetting and drying, coupled with ion exchange between the sodium bentonite and calcium or magnesium present in the subgrade soil, can increase a GCL's permeability over time. The effects of ion exchange are less severe if desiccation does not occur. As discussed above, an exposed geomembrane can reach high temperatures, which may facilitate desiccation of the GCL. Upon cooling, condensation beneath the geomembrane can then re-hydrate portions of the GCL. The extent of wetting and drying can be limited by maintaining a constant water level in the pond. To evaluate the potential for ion exchange, the subgrade soil can be tested for concentrations of calcium, magnesium, sodium, and potassium.

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- **Traffic on the Liner System.** If, as part of operation and maintenance, the pond will be periodically drained to allow for removal of sediment or sludge from the pond bottom, a protective layer over the liner system is strongly recommended for any areas that will be exposed to traffic (In some instances, where heavy traffic loads are expected, a thicker cover soil layer, or a cover soil stabilized with a geogrid or geoweb, may be necessary). Heavy construction equipment used to remove accumulated sediments can damage both the geomembrane and GCL.
- **Puncture Performance.** A pond liner system that has been covered with a protective layer of soil will be less susceptible to physical damage than an exposed liner.

In some exposed pond liner applications, GCLs are selected to act as a cushioning layer between the geomembrane and large protrusions in the subgrade below, to reduce or eliminate puncturing of the geomembrane. It is important to note that when a GCL is used as a cushion beneath an exposed geomembrane, it may not satisfy hydraulic conductivity requirements due to damage from subgrade protrusions, as well as the other factors described above. However, even if the GCL is damaged, if it prevents puncturing of the geomembrane, then its presence will improve the overall liner system's hydraulic performance.

In summary, CETCO does not normally recommend leaving a geomembrane/GCL composite liner uncovered for extended periods of time, unless the technical issues discussed above are taken into consideration, on a site-specific basis. The decision to use an exposed composite liner system should be made by the owner and design engineer.