A Field Demonstration of GSE Leak Location Liner: Distance Testing

Conductive geomembranes have been available for many years and are relatively common to the geosynthetic market. GSE developed the first conductive geomembrane over 20 years ago as a way to improve the efficiency and accuracy of liner integrity surveys by establishing a uniform electrical field beneath the liner that was superior to the soil, subgrade, or other geosynthetic product. In the past, electrical connections between the geomembrane panels were assumed to be efficient, but no field demonstration had been conducted to prove this assumption.

Liner integrity testing traditionally was done in small sections using a brush, probes or multiple probes or other localized apparatus because this was the most efficient way to pinpoint the location of the leak and make repairs. In addition, carrying an electric charge over large distances was difficult. Recent advances in welding technology, however, have dramatically reduced the occurrence of false positives and highlighted the benefits of “distance” testing of conductive geomembranes and the measurement and the testing of the entirety of the barrier system at one time. This is most beneficial in the situation where the barrier system is being monitored for leakage or changes in electrical conductivity. In this situation the distance that an electrical signal or current may be conducted is a critical design parameter and thus a practical field demonstration is valuable.

Protocol and Set Up

When geomembrane is installed, panels are connected using various methods in order to form a physical bond, an electrical bond, or both. A dual track wedge weld is described in ASTM 5820 and connects the panels both physically and electrically by creating a hollow channel within the center of the weld that can be pressure tested. If the channel holds air pressure for longer than a few seconds, it is reasonably assumed that the welds on both sides of the channel are complete. The electrical connection in the conductive layer inside the weld (between the unbonded edge of the geomembrane and the bottom conductive layer) must be broken in order to prevent a false positive electrical signal. If the electrical conductivity in this layer is not disrupted, a false positive will be transmitted during surveying and the results will indicate a leak where no hole exists. The welding technology used under the trademark GSE IsoWedge creates a break in the conductive layer of the weld and is protected by patent in most countries. Figures 1 and 2 on the following page illustrate these two circumstances.
Another proven method of connection is the contact weld which is installed to create an electrical connection between two panels (rolls) of conductive geomembrane. It is common practice to connect the two adjacent panels electrically by placing a small section of geomembrane underneath the continuous geomembrane such that the conductive surfaces are in contact, as illustrated below. Again the current assumption is that this provides sufficient electrical conductivity and in practice that appears to be the case; however, this is commonly used only to monitor single panel to single panel connections. Multiple connections across a long distance have yet to be reported.
**Test Description**

Five sections each measuring 40 meters in length by 30-40 centimeters in width of GSE Leak Location Liner, 2.0 mm, HDPE Geomembrane were laid end to end and connected both physically and electrically using underlaid strips of conductive geomembrane, again approximately 30-40 centimeters in width, cut from the cross direction of the strips. These smaller “cut sections” were inverted and the two conductive sides were hot air tack welded together. After the tack weld was cool, an extrusion weld was placed on the top of the two connected strips. This followed the typical extrusion welding sequence of light grinding to clean and roughen the surface followed immediately by extrusion welding with welding rod made from a similar material. Four such connections were made using the same construction and layout. The connections are pictured below. The completed installation was measured with a 50 meter tape and was approximately 200 meters long.

Following construction of the strip, a Texplor combimodule was attached to the west end of the strip and white nonwoven polyester geotextile was placed atop the geomembrane. This geotextile strip was saturated with water. Additionally, the weather during the entire testing was a very light drizzle and very wet conditions. The welding and connections were conducted under tents. A 500 millivolt signal was propagated through the system successfully. Furthermore, after the system stabilized, a 2 centimeter diameter hole was placed in the strip at the end opposite the monitoring module. This change in the signal response was very rapidly noticeable and consistent in variation from the non-hole condition.
Field Demonstration of GSE Leak Location Liner

The analysis of the measured MSS® data and the comparison with the base measurement showed clearly that the EFT®-tracer sent from the source propagated the length of 200 m on the bottom of the conductive liner, passed the hole at the end of teststrip and travelled back 200 m on the surface to the sensor in the MSS® CombiModul (Fig. 4).

Compared with the natural electrical flow in the tight situation only 5% of EFT-tracer energy sent from the source in the MSS® CombiModul passed the test liner strip.

After the SP tests, a 2 centimeter diameter hole was placed in the strip at the end opposite the monitoring module, approximately 200 meters away. With the hole in the strip, the signal response change was very rapidly noticeable and consistent in variation from the non-hole condition. Compared with the SP base measurement data, over 80% more electrical energy reached the sensor in the MSS® CombiModul in 200 meters distance (Fig. 4). In general, alarm criteria in the monitoring system are fulfilled when > 50% of the tracer energy reaches the sensor.

Figure 4. MSS® result: Electrical response – test

Conclusions
The surveying and monitoring of geosynthetic systems via electrical liner integrity surveys is a complicated process, but it has been established to be repeatable, technically viable, and a powerful method for improving the quality and performance of geosynthetic barrier systems. One of the most effective proven methods is an electrical leak location survey that is conducted after initial cover soil placement above (on) the geomembrane (Beck, 2012). The placement of cover soil on the geomembrane has been reported to be the most dangerous time and the most likely to result in a loss of barrier capability (Nosko). Further, electrically conductive geomembranes have a very strong history at supporting and improving the performance of liner integrity surveys (Beck, 2015). However, prior to this paper, the distance of electrical coverage had not been demonstrated with a field trial over a length of 2-3 panel widths. This test has demonstrated electrical conductivity of a conductive geomembrane over a 200 meter length and across 4 field seams. This range of coverage can be useful to design engineers in formulating monitoring plans, monitoring unit spacing and creating CQA (Construction Quality Assurance) programs, requirements and methodology.
REFERENCES


Brouwer, R. and Veldhuizen, F. (2011): Texplor Lekdetectie bei bouwputten. 61, GEOTECHNIEK.


REFERENCES

Stoel, A.E.C. van der, (2013): Waterremmende bodeminjectie (with Texplor Leak detection technologies), 19, GEOTECHNIEK.

Tissing, A. (2010): AMSTERDAM - lekdetectiemeetingen Texplor. Cobouw 7-12-2010, Netherlands
