The Capabilities and Limitations of Electrical Leak Location

Abigail Gilson, M.S., P.E.,[1]

[1]TRI Environmental, Austin, Texas; e-mail: abeck@tri-env.com

INTRODUCTION

Electrical Leak Location (ELL) methods for locating leaks in installed geomembranes can work fantastically well, or not at all, with most ELL surveys falling somewhere in between these two extremes. Site conditions are the largest factor in method success, especially for methods applied after cover material placement. Site conditions include the effect of weather patterns, cover material properties, number, type and location of leaks present in lining system, and issues with cover material isolation. An ideal site will feature cover materials that are completely isolated from the surrounding ground, saturated down to the surface of the geomembrane, and no more than a few small leaks. Site conditions during testing are rarely ideal, and this case study of a soil-covered dipole method ELL survey shows how site conditions can affect testing results, both positively and negatively. In addition, constraints, timing and logistics of construction can impact testing results as detailed.

CASE STUDY

Project Description. The case study presented here features a double-lined landfill with an ALR of 20 GPAD. The primary liner was tested by introducing a current injector to the cover material in the survey area and grounding the power supply to the underlying primary geosynthetic clay liner (GCL). The ELL survey was performed in early winter in the Northeast U.S. Repairs made to the detected leaks were performed after the survey. The following Spring, excessive leakage called for an investigation of suspect locations including the repairs made and the tie-in area. Leaks found during the investigation called for a second complete survey.

Initial Survey. Survey area isolation was compromised by a berm, which had been placed on one end of the cell, bridging to the surrounding ground. In addition, a steady rainfall began toward the beginning of the commencement of the survey. Due to an impending snowstorm and the onset of winter, the survey could not be delayed until clement weather. Not surprisingly, the artificial leak was not easily detectable, but nothing could practically be done to improve site isolation. The steady rain provided as wet a survey area as possible. Electrical mapping was performed per ASTM D8265. A total of eight leaks were located, including a knife slice so small that it was not visually detected and had to be located with a hand-held multimeter. In spite of the poor isolation, the active rainfall causing even the smallest of leaks to actively leak during the survey disturbed the voltage field enough that the small leaks were discernible on the map due to the voltage pattern. Unfortunately, the steady rain prevented the isolation of the holes in order to check the surrounding vicinity for additional leaks. Also, the low end of the survey area at the tie in was filled with rainwater run-off from the survey area. Any leaks in the tie in area would be masked by this run off, which essentially appears as a large leak along the entire top edge of the survey area.

Post-Survey Investigation. Monitoring of the leak detection layer showed leakage coming from the leak detection layer in excess of the state mandated 20 gpad over the winter months. The confidence gained from the ASTM D8265 approach with comprehensive electrical mapping made it unlikely that there was a leak missed during the original survey, unless it was in the tie-in area or near the holes that were located, including any unsuccessful repair patches. The local coordinate system used for electrical mapping was saved as part of the ELL project files so that each repair location could be quickly rechecked. The project site conditions were generally dry during the post-survey investigation. The investigation included applying the dipole method to recheck all repair locations and the tie-in areas. The tie-in areas still included a width of exposed geomembrane as isolation trenches. By wetting only the exposed geomembrane in the tie-in areas, current is encouraged to flow through any leaks present there in spite of the poor isolation caused by the installed berms on the adjacent edges. The post-survey investigation located a leak directly adjacent to one of the repair patches, identical to the original leaks found in that area, as well as several leaks in the tie-in area.

Second Complete Survey. In order to make sure that nothing was missed, a complete second survey was performed. The second survey located one pinhole on an extrusion weld in an area where no leaks had been detected during the first survey and one significant puncture immediately adjacent to the original repair patch where an additional leak was detected during the post-survey investigation. This area had been excavated and was open during the second survey. The dipole operator followed the leak signal to one edge of the excavation and pulled up on the geotextile cushion layer. A ~1" diameter rock could be seen lodged in the geomembrane, located under the geotextile cushion. When the rock was removed, the puncture encompassed the full diameter of the rock. It is possible that this rock fell under the geotextile when the original repairs were being made and then it was covered back up and subjected to the full weight of the cover material over the winter.

CONCLUSION

Sufficient moisture and electrical isolation are essential in the application of ELL methods in order to achieve maximum sensitivity. In addition, multiple leaks, especially when in close proximity, have the potential to mask each other. The area(s) immediately adjacent to uncovered leaks should be rechecked once the leaks are isolated and/or repairs are made. Additionally, repair locations should be recorded via GPS and kept as part of project records in case damage is caused during reinstallation of the cover material over the repair patches. Whenever possible, repair patches can be installed immediately and rechecked electrically after replacement of the cover material. Very small holes are not always detected, and electricity will follow the path of least resistance, which will be the larger hole locations or any isolation breaches. It is likely that the pinhole on the extrusion weld was not actively leaking during the first test but a leak path had formed over the winter so that it was picked up in the Spring. Leaks may not be detectable unless a leak path is formed, so irrigation of the cover material is essential in dry climates. Perfect conditions and procedures are not always possible or practical, which is why it is important to understand what can happen in these cases.