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Geomembrane liner testing using the GLLS®: A high-voltage electrical leak location system

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ABSTRACT: The high-voltage electrical leak location method, is used to accurately locate leaks in the geomembrane liners of surface impoundments, tanks, or landfills covered with a protective soil. The method was first introduced as a commercial service in the United States in 1985 after five years of extensive research and development. Subsequently the method was registered as the Geomembrane Leak Location System (GLLS®). More than 300 sites have been successfully surveyed in the United States, Italy, the United Kingdom, Germany, Japan, Saudi Arabia, Peru, and Canada. The liners that have been surveyed ranged in size from less than one hundred square metres to ninety thousand square metres. These surveys were performed as the final quality control (QC) test of the liner before acceptance of waste material or to locate leaks in facilities with a known leakage problem. The surveys have shown that GLLS® inspections can improve geomembrane lined facilities by detecting and locating significant leaks for repair. In addition, the data indicates that an average of 22 leaks per hectare are located when GLLS® inspections are conducted.

1 INTRODUCTION

The GLLS® detects electrical paths through the geomembrane liner caused by water or moisture in holes through the geomembrane liner. A voltage is connected to one electrode placed in the water or soil covering the liner and to a second electrode placed in the leak detection zone for double-lined systems or in earth ground for single-lined systems.

Electrical current flowing through the leaks in the liner produces localized anomalous areas of high current density at the leaks. These areas are located by scanning the survey area for these electrical signals.

With the proper implementation of equipment and survey procedures the GLLS® can detect and locate very small leaks. The leak signal amplitude is proportional to the amount of electrical current flowing through the leak. To maximize this current, GLLS® uses a high voltage power supply with safety circuits to provide optimum voltage, depending on the current requirement.

The high voltage power supply produces a proportionally higher leak signal to provide optimum leak detection.

2 Surface impoundment and tank surveys

GLLS® surveys are conducted with water or soil covering the geomembrane. For manual surveys with water covering the liner, the water depth must be between 150 and 750 mm in depth when surveying the bottom floor area. The manual survey system consists of a portable electrical probe and associated instrumentation. The operator wades in the water and systematically scans the submersed liner to locate any leaks. When detected, leaks are accurately located to within 20 mm or less and immediately marked.

If the water in the geomembrane lined impoundment cannot be lowered or the water in the pond is too hazardous for personnel to wade, then a remote survey method is used to survey the liner.

The remote survey method uses a probe that is towed back and forth across the impoundment. The probe cable is connected to the leak location instrumentation. The probe is designed to scan the bottom of the pond as survey personnel systematically pull the electrode across the pond.

Survey scans are typically made on 600 mm spacings, therefore, the probe will pass within 330 mm of any potential leak.

3 Landfill surveys

A GLLS® survey of a landfill liner or landfill geomembrane cap is a very effective method for finding leaks under the protective soil cover. The leaks may occur while placing a protective soil cover over the geomembrane liner. In addition, leaks are detected that may have been missed during the liner installation.

Because a geomembrane liner of a landfill has protective soil covering the liner, point-by-point electrical measurements are made instead of the continuous electrical scans used for surveys in water. The measurements are made on the soil surface. The data is recorded on a portable data acquisition logger and then

down-loaded to a portable computer for processing and data analysis.

The data processing is done on-site so leaks can be immediately marked for repair. The survey is conducted by making measurements along survey lines spaced at regular intervals across the bottom floor area of the landfill.

The electrical measurements are typically made on a 0.5 metre by 1.0 metre grid pattern. When a suspect area is indicated in the processed data, further measurements are taken to precisely localize the leak.

4 Landfill Monitoring and Remote Leak Detection

A newly developed Electrical Leak Imaging and Monitoring system (ELIM) can be used to monitor for leaks in the geomembrane liner covered by waste material.

This method uses a series of electrodes placed on top of or underneath the geomembrane liner during liner installation. The electrodes are connected to an instrument panel located near the landfill and used to make the electrical measurements. Data is stored in a portable data acquisition system or transmitted to a base station for advanced computer processing and analysis.

ELIM system can be used as a permanent monitoring system placed in the landfill cell during liner installation or used as a portable leak location system operated from the top of the waste material.

The system has been used to accurately locate leaks under 3 m of waste material in a landfill having a known leakage problem. The data clearly indicates a distinct feature located at 60 metres East and 10 metres North. The feature was excavated exposing two cuts approximately 5 to 10 cm in length which have been repaired solving the leakage problem.

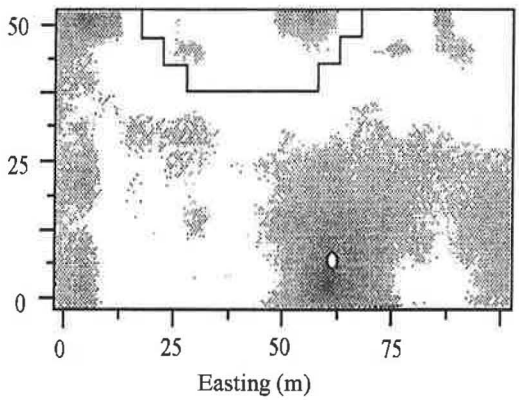

Figure 1: Shade-of-Grey Plot for ELIM Data Collected at a Landfill Site (3 metres of waste covers the geomembrane)

5 SUMMARY

The GLLS®, a high-voltage electrical leak location survey method is a commercial field proven technique that has been used to locate leaks at over 300 geomembrane lined facilities world-wide.

GLLS® located many leaks that were not previously detected using other test methods and inspections, or that were caused during the placement of the protective soil cover.

The method and equipment can locate leaks after the protective soil cover is placed over the liner and is a very cost effective way to check liner installation quality or quickly solve a leakage problem.

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