Electrical Leak Location of Landfill Liner Geomembranes

Federation of New York – Solid Waste Association

[→] 23 May 2018
FLEXIBLE MEMBRANE LINERS
Flexible Membrane Liners

Manufactured from plastics in ~4,000 lb rolls
- Polyethylene (HDPE or LLDPE)
- Polyvinyl Chloride (PVC)

Spark tested when rolled for shipping
- No defects from the manufacturing plant
Flexible Membrane Liners

Extremely low hydraulic conductivity
- $1 \times 10^{-15} \text{ m/s (through diffusivity)}$

Leakage through geomembranes
- Negligible amount through diffusivity
- Majority of leakage is through defects or damage as-installed
- Allowable leakage rate is commonly exceeded
CAUSES OF LEAKAGE
Sources of Leakage through Installed FMLs

References say nearly 80% of defects are from damage during cover soil placement

• 1/4 of leaks through geomembrane damage/defects
  – Typically pinholes through extrusion welds, slices, missing patches
    • 10 defects/acre for some installations with minimum CQC
    • 3 defects/acre in geomembrane itself for good CQA in the 1990s
    • 1 defect/acre common with current CQA practices

• 3/4 of leaks from cover soil placement
  – Typically large tears and gouges
    • 10+ defects/acre common after some cover soil operations
    • 3 defects/acre common with very careful soil placement
ELECTRIC LINER INTEGRITY SURVEYS
Geomembrane Damage Detection Methods

Bare Geomembrane Damage Detection

- **Visual Inspection**
  - Range from “keeping an eye on it” to formal/methodical visual inspection
  - Visual inspection aided by contrasting white membrane surface
  - Electric liner integrity surveys confirm a few small leaks per acre

- **Electric liner integrity surveys (“ELIS’s”)**
  - Sensitivity ~1mm diameter on bare geomembrane with good contact
  - Wet methods
    - ASTM D7002 (“Water Puddle” Method)
    - ASTM D7703 (“Water Lance” Method)
  - Dry methods
    - ASTM D7953 (“Arc Test” Method)
    - ASTM D7240 (“Spark Test” Method) with conductive-backed geomembrane
Geomembrane Damage Detection Methods

Inspections through cover soil

• Nothing can be detected visually through cover soil
• Geo-electric “dipole” surveys (sensitivity <10mm diameter)
  – Manual dipole survey
  – GPS “double-dipole” survey
• Site-specific-method geophysical tests
  – Through 10-15+ ft of material (if free of sizeable metal fragments)
  – Through brine solutions – no problem with any level of conductivity, provided chemicals do not attack test equipment
Geomembrane Damage Detection Methods

Most Reliable Approach

- **During Geomembrane Installation**: Full Standard CQA
- **Installed Geomembrane**: Conductive Geomembrane Spark Test (per ASTM D7240) to find the smallest of defects;
- **During Cover Soil Placement**: Continuous Observation
- **After Cover Soil Placement**: Dipole Survey through Cover Soil (per ASTM D7007)

- *Find small defects with a bare membrane survey, then*
- *Find cover soil placement damage with a dipole survey.*
EL PASO ELECTRIC COMPANY
El Paso Electric - Montana Power Plant Ponds

Installed Membrane (before cover soil placement)

- Careful CQA
- No ELIS

Covered Geomembrane Stage

- ASTM D7007 Dipole Survey
## El Paso Electric - Montana Power Plant Ponds

### Table 1, Hole List

<table>
<thead>
<tr>
<th>Hole Number</th>
<th>Approximate Size of Largest Dimension (in)</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>6.0</td>
<td>Equipment Damage</td>
</tr>
<tr>
<td>2</td>
<td>4.0</td>
<td>Equipment Damage</td>
</tr>
<tr>
<td>3</td>
<td>24.0</td>
<td>Equipment Damage</td>
</tr>
<tr>
<td>4</td>
<td>18.0</td>
<td>Equipment Damage</td>
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<td>8</td>
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<td>9</td>
<td>9.0</td>
<td>Equipment Damage</td>
</tr>
<tr>
<td>10</td>
<td>4.0</td>
<td>Equipment Damage, several holes</td>
</tr>
<tr>
<td>11</td>
<td>0.8</td>
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<tr>
<td>12</td>
<td>1.5</td>
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<tr>
<td>13</td>
<td>1.0</td>
<td>Equipment Damage</td>
</tr>
<tr>
<td>14</td>
<td>0.25-1.0</td>
<td>Equipment Damage, several holes</td>
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<tr>
<td>15</td>
<td>8.0</td>
<td>Equipment Damage, several holes</td>
</tr>
<tr>
<td>16</td>
<td>2.0</td>
<td>Equipment Damage</td>
</tr>
<tr>
<td>17</td>
<td>1.5</td>
<td>Equipment Damage</td>
</tr>
</tbody>
</table>

### Figure 3: Hole locations
Dipole Survey Findings:
- 17 leaks located over 3 acre installed area
- Leak sizes up to 80 inches long
- All leaks found attributed to cover soil operations
If you are only going to use one electric liner integrity survey test, make sure you use a dipole test after cover soil placement!
THANK YOU