Design, Construction and Operation: Landfill Gas Horizontal Collectors

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Introduction

• Design
• Construction
• Operational Data
• Current Thinking
• Summary
Horizontal Collector Pump Test

\[ \psi_1 - \psi_2 = \frac{Q}{CR_I^2 LK} \left( R_I^2 \ln \frac{r_2}{r_1} - \frac{r_2^2}{2} + \frac{r_1}{2} \right), \quad r_2 > r_1 \]
Test Data vs. Model

EXHIBIT 4. Best Fit Curve for P1-P3, Deep Probes (7/18)
Design Variables

- Flow rate (i.e., gas generation)
- Applied vacuum
- Permeability
- Radius of influence
- Length
Practical Considerations

- Comprehensive gas collection system
  - Flow decreases to single collector; ROI increases
- Air intrusion/short-circuiting
  - Forces limit on applied vacuum; then ROI
- Waste decomposition
  - Decreases permeability; requires more vacuum
  - Decrease in flow; require less vacuum
- Water impacts
  - Blocks vacuum; flow is then limited
Design Criteria

• Use network of collectors
  – Horizontal spacing: 100 feet on-center
  – Vertical spacing: 30 feet o.c.
• Solid pipe length: 75 feet
• One wellhead every 600 feet of collector
• 6-inch pipe minimum
• Slope perforated and solid pipe; use low point drains, if needed
Trench Profile

- Slope back into landfill (HP at wellhead)
  - Drain pit at end of trench
- Slope back into landfill, multiple HP/LP
  - Drain pit at intermediate LPs
- Slope out of landfill (trap and wellhead)
  - Drain liquids out of horizontal
Trench Excavation
Survey Bottom of Trench
Stone Bedding and Pipe
Option: Tire Chips above Pipe
Geotextile Separator
Construction Quality Assurance

- Full-time vs Part-time vs None

- Issues with slope
  - As-built survey

- Issues with bedding/backfill
  - Quality of material, size

- Issues at wellhead
  - Settlement
Operational Data

• Water impacts
• Landfill operations
• Useful life
Construction Cost Analysis

- **One (1) Horizontal Collector**

<table>
<thead>
<tr>
<th>Unit Price</th>
<th>Unit</th>
<th>Quantity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horiz. Collector</td>
<td>$45</td>
<td>LF</td>
<td>850</td>
</tr>
<tr>
<td>Trap</td>
<td>$4,300</td>
<td>EA</td>
<td>1</td>
</tr>
<tr>
<td>Wellhead/tie-in</td>
<td>$2,550</td>
<td>EA</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
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</table>

- **Four (4) Interim Wells (40’ deep)**

<table>
<thead>
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<th>Unit Price</th>
<th>Unit</th>
<th>Quantity</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Vertical Well</td>
<td>$90</td>
<td>LF</td>
<td>160</td>
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<tr>
<td>Wellhead/tie-in</td>
<td>$2,550</td>
<td>EA</td>
<td>4</td>
</tr>
<tr>
<td>6-inch lateral</td>
<td>$33</td>
<td>LF</td>
<td>800</td>
</tr>
<tr>
<td>TOTAL</td>
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</table>
Horizontal Collectors vs Interim Wells

- **Timing**
  - Area to be overfilled soon or left as is

- **Waste filling rate**
  - Fast vs slow

- **Landfill staff available to install horizontals**

- **Operator cooperation**
  - Fill around wells
  - Extend wells as filling occurs
Current Thinking

• Limited lifetime—due to liquids, other issues
• Coordinate working face with horizontal collectors to slope to outside
• Purposefully collect and convey liquid and LFG to outside slope; dual-fluid collector
• Separate LFG and liquid at side slope
  – Option: Trap at wellhead; gravity drain to leachate structure
  – Option: Sump with dewatering pump; dedicated forcemain to leachate structure
NOTES:

1. FOR SECOND AND HIGHER LEVELS, SLOPE 12" SDR17 SOLID HOPE PIPE OUT OF LANDFILL AT 5% MINIMUM TO FOLLOW OPERATIONAL GRADE.

2. SLOPE LATERAL PIPE AT 5% MINIMUM.

3. AN END CAP SHALL BE BUTT FUSED AT THE END OF PERFORATED PIPE.

4. HORIZONTAL COLLECTOR AND CONDENSATE TRAP.

See detail for horizontal collector condensate trap.
Conclusions

• Valuable interim collection method
• Need to understand design parameters
• Need CQA to ensure proper installation
• Recognize limited lifetime (similar to interim wells)
• Coordinate with landfill operations; slope to outside as a dual-fluid collector
Questions

Please contact us with any questions
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