USA Waste Generation and Recovery

Millions of Tons

Generation
Recovery

Southwest Landfill Location

232 acres in North Central Florida
15 miles southwest of Gainesville
What’s it mean?

- Garbage could generate 50 GW (in theory)
- Current installed USA electric capacity: 600 GW
Southwest Landfill History

- Opened November 1973
- UF recirculated Leachate from 1990 to 1995
- Closed December 1998
- FDEP approved resumption of recirculation in 2002
- FDEP approved adding groundwater in 2004
28-Acre Lined Cell

- Composite bottom liner protects the aquifer
- HDPE top liner captures explosive methane gas
Swamp Gas Alert!

EPA and FDEP consider “Bio-reactors” to be experimental...Caution

- Increased gas emissions and odors
- Fire potential
- Slope instability
- Liner instability
- Surface seeps
What is a “Bio-reactor?”

A landfill that has water added to stimulate biodegradation.
Can use a variety of liquids, including:
- Leachate
- Sludges
- Waste or pure water

The Goal:
Maintain moisture near Field Capacity
Overall Mass Balance

\[ \Delta S = G - (B + H + L + C) \]
What is Leachate?

<table>
<thead>
<tr>
<th></th>
<th>Leachate:</th>
<th>Seawater:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloride</td>
<td>2,000</td>
<td>19,400 ppm</td>
</tr>
<tr>
<td>Sodium</td>
<td>1,100</td>
<td>10,700</td>
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<tr>
<td>Sulfate</td>
<td>0</td>
<td>904</td>
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<tr>
<td>Magnesium</td>
<td>0</td>
<td>1,290</td>
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<tr>
<td>Calcium</td>
<td>0</td>
<td>411</td>
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<tr>
<td>Bicarbonate</td>
<td>900</td>
<td>150</td>
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<tr>
<td>Iron</td>
<td>2,400</td>
<td>0.01</td>
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<tr>
<td>Ammonia</td>
<td>900</td>
<td>&lt;1</td>
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<tr>
<td>Color</td>
<td>Coffee</td>
<td>Colorless</td>
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</table>
Leachate Recirculation

- 15 million gallons have been recirculated from July 17, 2003 through Dec. 22, 2005 (40kgpd)
- 3.7 million gallons of external groundwater were added from June 1, 2004 to February 31, 2005
Leachate Recirculation System

1. Leachate is drained by gravity
2. Accumulated in a sump
3. Pumped back into the landfill
   - 5 Horizontal Gas Wells – Top
   - 22 Horizontal Injection Lines - Interior
Recirculation Operational Issues

- Distribution of leachate
- Seepage
- Instrument failure
- Interference with gas collection
Leachate Recirculation Advantages

- Eliminates need for hauling
- Stabilizes waste quickly
- Stimulates landfill gas production
What is Landfill Gas?

- LFG is dangerous
- Explosive as a 5 to 15% mixture in air
- LFG is valuable
- Has about 55% the fuel value of natural gas

Landfill Gas – Produced from decomposition of organic material; aka Swamp Gas

Constituents of Landfill Gas

- Methane 55%
- Carbon Dioxide 38%
- Nitrogen 3%
- Oxygen 1%
- Trace Gases 3%
Landfill Gas to Energy

- Began in December 2003
- Partnership with Gainesville Regional Utilities (GRU)
- A single unit produces up to 920 kW
Landfill Gas to Energy System

1. Landfill gas is collected by applying a vacuum through 5 horizontal and 27 vertical gas wells and 20 cleanouts
2. Pressurized to 3 psi
3. Delivered to GRU’s generators
4. Converted to electricity
Landfill Gas Lower Heating Values

- 7/15/2003: Leachate Recirculation Begins
- 6/1/2004: Groundwater Augmentation Begins
- 9/1/2004: Groundwater Augmentation Ends
- 9/28/2004: Hurricane Jeanne
Landfill Gas to Energy Advantages

- Utilizes a renewable energy source (biomass)
- Reduces greenhouse emissions
- Generates revenue -- county projects
- 5-year payback (2008)
- Supplements traditional energy production
Delivered & Collected Landfill Gas
December 2003-December 2005

Date

Delivered & Collected Landfill Gas
December 2003-December 2005

Date
gas delivered gas collected

mmBTU/hour
0.0 5.0 10.0 15.0 20.0 25.0

Chart shows the delivered and collected landfill gas from December 2003 to December 2005. The data is represented over time, with specific dates listed on the x-axis and the amount of gas delivered and collected on the y-axis.
Energy Production at the SWLF Since Closure

Energy (mm Btu/hour)

7/15/03 Recirculation
Operational Issues

- Instrument failure
- Storm activity
- Liner Design (air intrusion)
- Communication between gas collection system and Generators
- Daily temperature variation affects AF ratio
- Gas utilization ratio –
  1\textsuperscript{st} Year 50\%, 2\textsuperscript{nd} Year >70\%
Any questions?

- What is the impact of recirculation on leachate quality and quantity?
- How has recirculation affected the expected – i.e. the Dry Tomb – gas production curve?
- Are bio-reactors economically viable?
- Eventual disposition of recirculated liquids?
<table>
<thead>
<tr>
<th>Year</th>
<th>Generation</th>
<th>Recovery</th>
<th>%Recovery</th>
<th>Recovery of Generation</th>
<th>Recovery of Population</th>
<th>Power Equivalent</th>
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<td>1991</td>
<td>288</td>
<td>31</td>
<td>11%</td>
<td>6.3</td>
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