Part 5: Evaluating Landfill Gas as Potential

Presented By:
Linda Nutting
SCS Engineers

June 26, 2001
Training Workshop
Sao Paulo, Brazil
Outline

- Objectives
- Rough Approximation Method
- Model Estimates
- Field Testing
- Summary
Objectives

- Estimate the current and future quantities of gas that will be generated and may be recovered at a landfill
- Information is used for landfill gas project planning and design
- 3 methods available
Landfill Gas Generation

- Amount of LFG production is governed by:
  - amount of waste
  - type of waste
  - age of waste
  - moisture content
  - temperature
  - pH

- These factors cannot be easily modified

- LFG production peaks about one year after waste placement and decreases 2% to 8% per year thereafter
Rough Approximation Method

- **Simplest method**
- Assumes that each metric ton of waste will produce approximately 6 m$^3$ of landfill gas per year
- Waste should be less than 10 years old
- Production rate may be sustained for approximately 5 to 10 years
Rough Approximation Method - Confidence Levels

- This approach is used for initial project planning and screening (not for system design)
- Estimates in the range of approximately +/- 50% accuracy
USEPA LanGem Model

- First Order Decay Equation
- Takes into account site specific information
- Rate constants can be adjusted for regional climatic conditions
- Best used for landfills with greater than 1 million tons of waste in-place
USEPA LanGem Model

- USEPA model is widely used in the LFG industry
- USEPA model consistent with Intergovernmental Panel on Climate Change Protocols (IPCC) for calculating greenhouse gas emissions inventories
- Other LFG models available
Model Estimates

- Projects Landfill Gas Generation Rate
- Projects Landfill Gas Recovery Potential
- Confidence Levels
Model Output

LFG GENERATION AND RECOVERY ESTIMATE
KAMPHANGSAEN LANDFILL

YEAR

LFG m³/hr

Generated
Recovered
Methodology

- USEPA Landfill Gas Emissions Model

\[ Q = Lo \cdot R \cdot (e^{-kc} - e^{-kt}) \]

- Develop Site-Specific Inputs:
  - Methane Generation Potential (Lo)
  - Methane Generation Rate Constant (k)

- Projected Methane Generation and Recovery Rates
Key Inputs

- Year Landfill Opened
- Annual Acceptance Rate
- Quantity of Waste In-Place
- Remaining Disposal Capacity
- Landfill Closure Date
- Precipitation
Methane Generation Potential (Lo)

- **Range of Values:**
  - 0 – 312 (m$^3$CH$_4$/Mg)

- **USEPA Default Values:**
  - CAA – 170 (m$^3$CH$_4$/Mg)
  - AP42 – 100 (m$^3$CH$_4$/Mg)

- **Suggested Local Value:**
  - Approximately 140 – 180 (m$^3$CH$_4$/Mg)
Methane Rate Constant (k)

- Range of Values:
  - 0.003 – 0.4 (1/yr)

- USEPA Default Values:
  - CAA – 0.05 (1/yr)
  - AP42 Wet Climate – 0.04 (1/yr)
  - AP42 Dry Climate – 0.02 (1/yr)

- Suggested Local Value:
  - Approximately 0.05 – 0.15 (1/yr)
Projected LFG Generation Rate

- Model output provides an estimate of annual methane generation rates.
- Generally assumes landfill gas contains 50% methane.
Projected LFG Recovery Rate

- The actual LFG recovery rate will depend on the following:
  - LFG collection system coverage (% = radius of influence/landfill area)
  - LFG recovery system collection efficiency (depends on collector design and landfill characteristics)
Projected LFG Recovery Rate, continued...

- **Expected range:**
  - 60 to 85% of projected landfill gas generation rate
Confidence Levels

- Sources of Uncertainty:
  - Method
  - Data quality
  - Collection efficiency of the landfill gas system
  - Other factors

- Estimates in the range of +/-25% for initial years
- Greater variances in the longer term
Field Testing

• Install test wells
• Perform testing and monitoring
• Field Testing Issues
• Confidence Levels
Install Test Wells

- Install as many vertical extraction wells or horizontal collectors as possible in representative portions of the landfill.
- Flare recovered gas to control discharge.
Perform Testing and Monitoring

- Balance the well field
- Recover LFG on a continuous basis during the testing period
- Monitor gas quality at each well and at the flare station
- Review results
Field Testing Issues

- **Advantages:**
  - Provides site-specific data
  - Provides information on landfill leachate levels

- **Disadvantages:**
  - May overestimate sustainable LFG recovery rate
  - May not provide information on seasonal variations
Confidence Levels

- Sustainable gas yields may be only 50% of results from a field testing program.
- Extend testing program to increase confidence levels and verify landfill gas resources.
Summary

- Information on LFG recovery rates is a critical element in project planning and sizing of utilization equipment.
- 3 methods available.
- LFG modeling combined with field testing provide the best results.
- Field testing should be performed on a continuous basis over an extended period.