Part 5: Evaluating Landfill Gas Potential

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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 LandGem 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

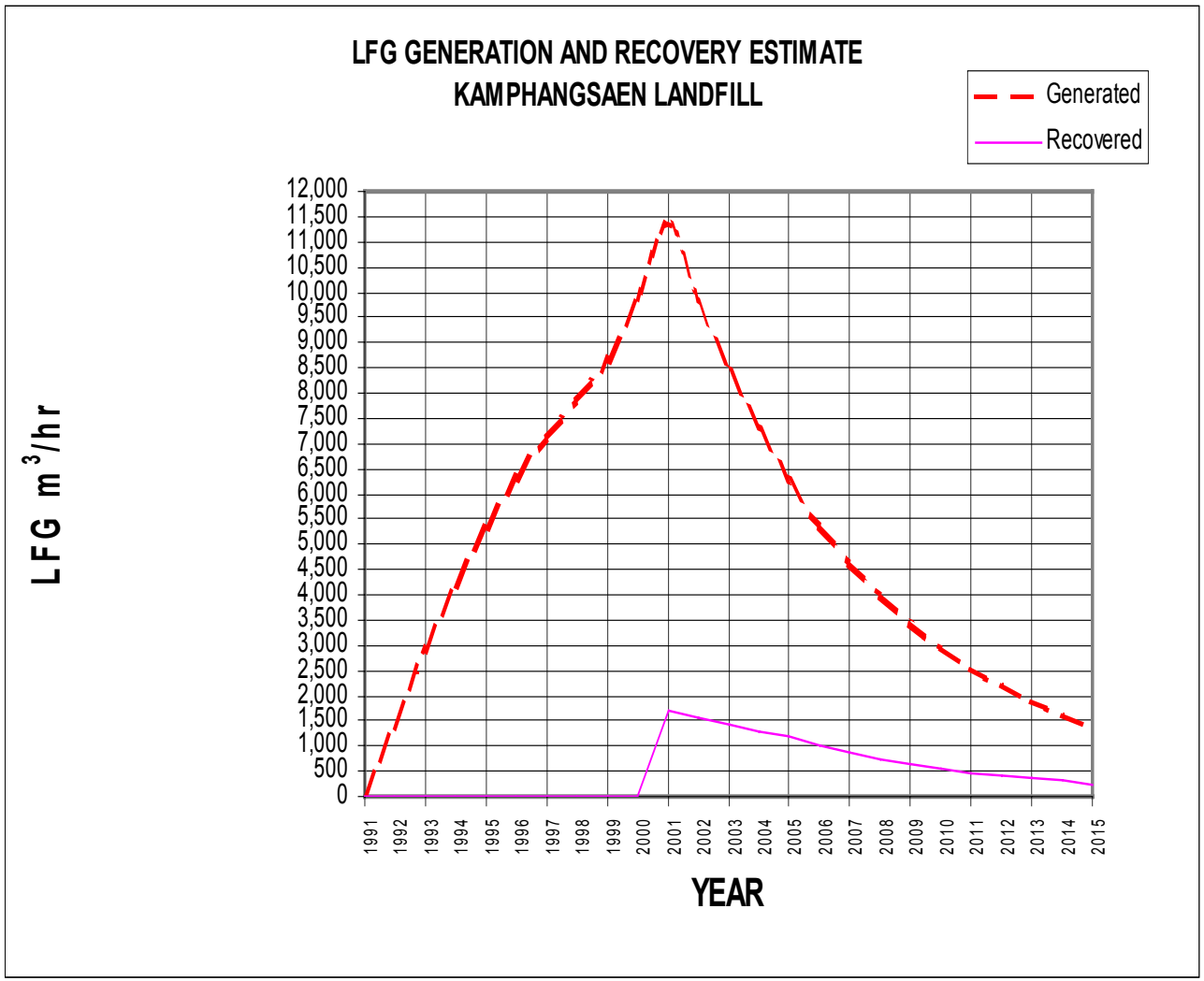
USEPA LandGem Model

- 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



Methodology

- USEPA Landfill Gas Emissions Model

$$Q = L_o R \left(e^{-kc} - e^{-kt}\right)$$

- 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 (L_o)

- 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 wellfield
- 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 over-estimate 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