Methane to Markets

Group Discussion

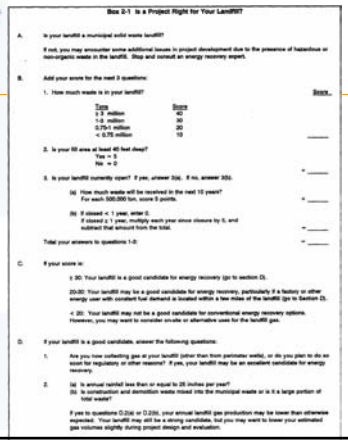
Methane to Markets

Screening For Project Potential

- Identify the goals of the project
- Screen the project for energy recovery potential
- Use modeling to estimate the landfill gas generation potential; based on the results:
  - Select the appropriate technology(s)
  - Identify the design criteria
  - Monitoring, operations and maintenance

2

Methane to Markets



3

Methane to Markets

Estimate LFG Quantity

Method A: Simple Approximation

- Annual Landfill Gas Generation (cf) = 0.10 cf/lb x 2000 lb/ton x Waste-In-Place (tons)
- Example: A landfill with one million tons of waste in place:
- Annual LFG (cf) = 1,000,000 tons x 0.10 cf/lb x 2000 lb/ton= 200,000,000 cf/y or ~550,000 cf/day
- Note: Need to account for the uncertainty associated with this estimate. Use +/- 50%. Therefore, the annual LFG quantity is in a range of of 275,000 to 825,000 cfd for this example.

4

Methane to Markets

Estimate LFG Quantity

Method B: First Order Decay Model

$$LFG = 2\ L_0 R\ (e^{-kc} - e^{-kt})$$

- LFG = Total amount of landfill gas generated in current year (cf)
- L_0 = Total methane generation potential of the waste (cf/lb)
- R = Average annual waste acceptance rate during active life (lb)
- k = Rate of methane generation (1/year)
- t = Time since landfill opened (years)
- c = Time since landfill closure (years)

5

Methane to Markets

Estimate LFG Quantity

Default values for Method B

- k = rate factor yr^-1
  - Dry 0.02; AP42 0.04; NSPS Wet 0.05; Bioreactor up to 0.70
- Lo = methane yield per unit of mass
  - 100 cu m/kg = 1.6 cu ft/lb
  - 170 cu m/kg = 2.6 cu ft/lb

6

Estimate LFG Quantity

Example for Method B

Landfill has been open for 25 years; still accepting waste; and average annual waste acceptance rate of 40,000 tons

- The first order decay model would yield a rough estimate of 310 million cubic feet of landfill gas per year, or about 850,000 cfd (using the NSPS k and L0 values).
- Note: Need to account for the uncertainty associated with this estimate. Use +/- 50%. Therefore, the annual LFG quantity is in a range of 425,000 to 1.3 million cfd for this example.

7

Suggested Model Modifications for Chinese Landfills

Method A: Simple Approximation

Annual Landfill Gas Generation (cf) = 0.10 cf/lb x 2000 lb/ton x Waste-In-Place (tons)

Use 0.02 for landfills in arid environments <25" rain/year

Use 0.08 for landfills in wet environments >25" rain/year

Example:a landfill with one million tons of waste in place in a dry environment:

Annual LFG (cf)= 1,000,000 tons x 0.02 cf/lb x 2000 lb/ton= 40,000,000 cf/yr or ~110,000 cf/day or 76 SCFM

- Need to account for the uncertainty associated with this estimate. Use +/- 50%. Therefore, the annual LFG quantity is in a range of of 55,000 to 165,000 cfd for this example.
- This modification is based on limited data from several Chinese landfills. More data is needed to improve modeling accuracy.

8

Estimate LFG Quantity

Default values for Method B

- k = rate factor yr^{-1}
  - Chinese LF 0.03
  - No data was evaluated for wet landfills
- Lo = methane yield per unit of mass
  - Estimate based on other Chinese LF's

64 cu m/kg = 1.0 cu ft/lb High Range

0.7 cu ft/lb Low Range

9