Critical Thinking Questions - Landfill Gas Generation Solutions

I. Landfill Gas Fundamentals

1. Answers may vary but in general the answer should address the fact that precipitation increases gas production relative to drier climates.

2. Answers may vary. Municipal waste landfills should produce more gas relative to construction and demolition landfills given the differences in degradable organic matter.

3. Answers may vary. Main products of the anaerobic degradation process.

4. Answer may vary.

5. Answer may vary.

II. Landfill Gas Production Mechanisms and Modeling

1. A landfill cell is open for three years, receiving 165,700 Mg of waste per year. Calculate the peak gas production if the landfill gas emission constant is 0.0307 yr^{-1}, the methane generation potential is 140 m^3/Mg. Assume prior to final closure methane oxidation in the cover is 20% of the uncollected methane. Use the table below. Assume Years 1-3 have only daily cover (50% collection efficiency), years 3-5 have intermediate cover (75% collection efficiency), and after year 5 a geosynthetic cover is in place (98% collection efficiency).

Year	Gas Generation, m^3	Collection Efficiency, fraction	Uncollected Methane, m^3	Uncollected and Unoxidized Methane, m^3
1	1,381,294	0.50	690,647	552,518
2	1,339,532	0.50	669,766	535,813
3	1,299,034	0.50	649,517	519,613
4	1,259,759	0.75	314,940	251,952
5	1,221,672	0.75	305,418	244,334
6	1,184,737	0.98	23,695	23,695
7	1,148,918	0.98	22,978	22,978
8	1,114,182	0.98	22,284	22,284
9	1,080,496	0.98	21,610	21,610
10	1,047,829	0.98	20,957	20,957
11	1,016,150	0.98	20,323	20,323
12	985,428	0.98	19,709	19,709
13	955,635	0.98	19,113	19,113
14	926,743	0.98	18,535	18,535
15	898,724	0.98	17,974	17,974
16	871,552	0.98	17,431	17,431
17	845,202	0.98	16,904	16,904
18	819,649	0.98	16,393	16,393
19	794,868	0.98	15,897	15,897
20	770,836	0.98	15,417	15,417
Total	20,962,240		2,919,507	2,393,449

2. Calculate the metric tons of methane generated over 20 years, assuming the ideal gas law applies and the gas is at standard pressure and temperature. Calculate the CO_2 equivalent in metric tons.

$$\frac{\left(\frac{20{,}962{,}240\ m^3 \times 44 \times 1000}{22.4}\right)}{1{,}000{,}000} = 41{,}176\ CO_2\ eq.metric\ tons$$

3. Using the GHG Equivalencies Calculator, calculate the equivalent number of barrels of oil and passenger vehicles for methane generation from a landfill over 20 years.

- Number of barrels of oil
  - 95,331
- Passenger vehicles
  - 8,817

VII. Landfill Gas Collection System Design

1. Answers may vary.

2. Answers may vary.

3. Answers may vary.