Field Sampling & Lab Methods

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Introduction

• Sampling and Analysis Objectives
• Overview of Methods
• Field and laboratory methods useful for measuring performance of Bioreactor Landfills
• Questions
What Do We Want to Know?

• Operational Performance: Degradation State of the Landfill
  – Chemical characterization of gas, liquid and solid media indicators of waste degradation
  – Measurement of waste settlement

• Environmental Performance: Safety and Regulatory Compliance
  – RCRA, CAA and other regulatory requirements: head on liner, groundwater monitoring, LFGCCS management, and SEM
Landfill Maturation
Gas

• Landfill Gas Quality
  – Major Constituents: CH$_4$, CO$_2$, O$_2$, N$_2$
    • Gas extraction well heads, headers, or probes
    • Grab samples, direct or continuous monitoring
    • Field instruments or lab analysis using infrared, GC-FID or GC-TCD.
  – Trace Constituents: HAPs and NMOCs
    • Grab samples using Suma canisters and laboratory analysis
Gas Quality

- 50-60% CH$_4$
- 40-50% CO$_2$
  - Air infiltration
  - Oxidation
  - Interferences (H$_2$O and hydrocarbons)
  - Replicates, maintenance, calibration, use a written SOP, and record keeping.
OUTER LOOP BIOREACTOR STUDY
GAS SAMPLING INFORMATION FORM

Date: ________________________ Name: ________________________ Signature: ________________________

INSTRUMENT CALIBRATION
Instrument: [ ] GEM 2000  [ ] OTHER:

Time of calibration: ____________

Calibration Gases: [50% CH₄ : 35% CO₂ : 15% N₂]
[96% N₂ : 4% O₂]

CH₄: [ ] [ ] [ ] [ ] [ ] CO₂: [ ] [ ] [ ] [ ] [ ] O₂: [ ] [ ] [ ] [ ] Balance: [ ] [ ] [ ] [ ] [ ]

Time of calibration check: ____________

Results of calibration check (% v/v):

CH₄: [ ] [ ] [ ] [ ] [ ] CO₂: [ ] [ ] [ ] [ ] [ ] O₂: [ ] [ ] [ ] [ ] Balance: [ ] [ ] [ ] [ ] [ ]

QUALITY CONTROL

One sample duplicate must be collected for each day of sampling. The QC requirements are: CH₄ ≥ 10% RPD, CO₂ ≥ 10% RPD, and O₂ ≥ 20% RPD.

Sample I.D.: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

Sample 1.I.D.: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

CH₄: [ ] [ ] [ ] [ ] [ ] CO₂: [ ] [ ] [ ] [ ] [ ] O₂: [ ] [ ] [ ] [ ] [ ]

CH₄: [ ] [ ] [ ] [ ] [ ] CO₂: [ ] [ ] [ ] [ ] [ ] O₂: [ ] [ ] [ ] [ ] [ ]

\[ \text{RPD} = \left( \frac{C_1 - C_2}{0.5(C_1+C_2)} \right) \times 100 \]

Sample 1. ID.: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

Time: ____________ Sampler: ________________________ Sampling Method: [ ] TELDAR BAS  [ ] DIRECT CONNECTION

Gas Temperature: ____________ (°C) Data Logged to GEM 2000? [ ] (If data are not logged to the GEM 2000 record values below)

CH₄: [ ] [ ] [ ] [ ] [ ] CO₂: [ ] [ ] [ ] [ ] [ ] O₂: [ ] [ ] [ ] [ ] [ ] Balance: [ ] [ ] [ ] [ ] [ ]

Static Pressure: ____________ (H₂O) Differential Pressure: ____________ (H₂O) Barometric Pressure: ____________ (H₂O)

SUMMA Cannister Sample Collected? [ ]


Comments: ________________________
Landfill Gas Production Measurement

- Measured at flares, gas extraction headers or well heads
- Periodic or continuous measurement using orifice plates, pitot tubes, or thermal mass flow meters.
Flow Measurement

- Proper specification for device
- Calibration of pressure transducers or gauges
- Record atmospheric pressure and temperature
Liquids

- Volume and flow rate
- Chemical characterization
Leachate Production

- Precipitation
- Added Liquids
- Flow meters in leachate collection sump discharge/liquid injection piping
  - Totalized flow and flow rate.
  - Full pipe flow and straight run requirements.
Leachate Quality

Sample collection
- Collect a representative sample
- Properly preserve the sample
- Document activities and observations
- Chain of custody and appropriate shipping or storage
Leachate Quality

Field Parameters

- pH
- Electrical conductivity
- Temperature
- COD, ammonia
## Outer Loop Bioreactor Study

### Leachate Sampling Information Form

<table>
<thead>
<tr>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
</tr>
<tr>
<td>Signature:</td>
</tr>
</tbody>
</table>

### pH Calibration

- **Instrument:** HI 991301
- **Time of Calibration:** 12:12
- **Calibration Buffer (s.u.):** 4.01, 7.01, 10.01
- **Time of Calibration Check:** 4.01, 7.01
- **Result of Check with 7.01 Buffer:** 4.01

### Conductivity Calibration

- **Instrument:** HI 991301
- **Time of Calibration:** 12:12
- **Calibration Solution (mS/cm):**
  - 5,000
  - 12,880
  - 111,800

### Important Sampling Order Information:

The correct sample bottle collection order is:

1. **Critical Parameters:** COD, BOD, volatile organic acids, pH, temperature.
2. **Non-Critical Parameters:** VOCs, SVOCs, TKN, ammonia-N, nitrate-N, nitrite-N, total metals, ortho phosphate, total phosphate, chlorides, sulfate, TDS.

### Sample Information

<table>
<thead>
<tr>
<th>Sample I.D.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time: 12:12</td>
</tr>
<tr>
<td>Sampler:</td>
</tr>
<tr>
<td>Purge Volume: 1 gal.</td>
</tr>
<tr>
<td>pH: 4.01</td>
</tr>
<tr>
<td>Conductivity: 5,000 mS/cm</td>
</tr>
<tr>
<td>Temperature: 12°C</td>
</tr>
<tr>
<td>Sample Appearance:</td>
</tr>
<tr>
<td>Turbidity:</td>
</tr>
<tr>
<td>Color:</td>
</tr>
<tr>
<td>Odor:</td>
</tr>
<tr>
<td>Weather Conditions: Wind Speed:</td>
</tr>
<tr>
<td>Direction:</td>
</tr>
<tr>
<td>Precipitation:</td>
</tr>
<tr>
<td>Outlook:</td>
</tr>
<tr>
<td>Comments:</td>
</tr>
</tbody>
</table>
Leachate Quality

Laboratory Analyses
- Certified Lab (State, CLP, USACE)
- QA/QC Plans
- Audits
- Services (EDD, supplies)
Solids Characterization

- Waste stream composition
  - (MSW, C&D, sludge)
- Waste deposition records
- Sampling techniques and considerations
  - *In situ* temperature and ORP sensors
  - Moisture content
  - Component and specialized analyses
Temperature and ORP

- Type K thermocouples
- Gel filled ORP electrodes
Solids Sampling

- Randomized selection of sample locations
- Surveyed and staked
- Composite samples from each bucket
- Record temperature, appearance, depth, pH
Composting and Temperature
Waste pH Measurement
Sonic Drilling
Solids Characterization

- Moisture content
- Biochemical Methane Potential
- Cellulose, hemicellulose, lignin
- Volatile solids
Waste Settlement

Survey
GPS
Flyover
Settlement Plates
Final Points

- Use standard methods and operating procedures
- Document activities and observations