Field Sampling & Lab Methods

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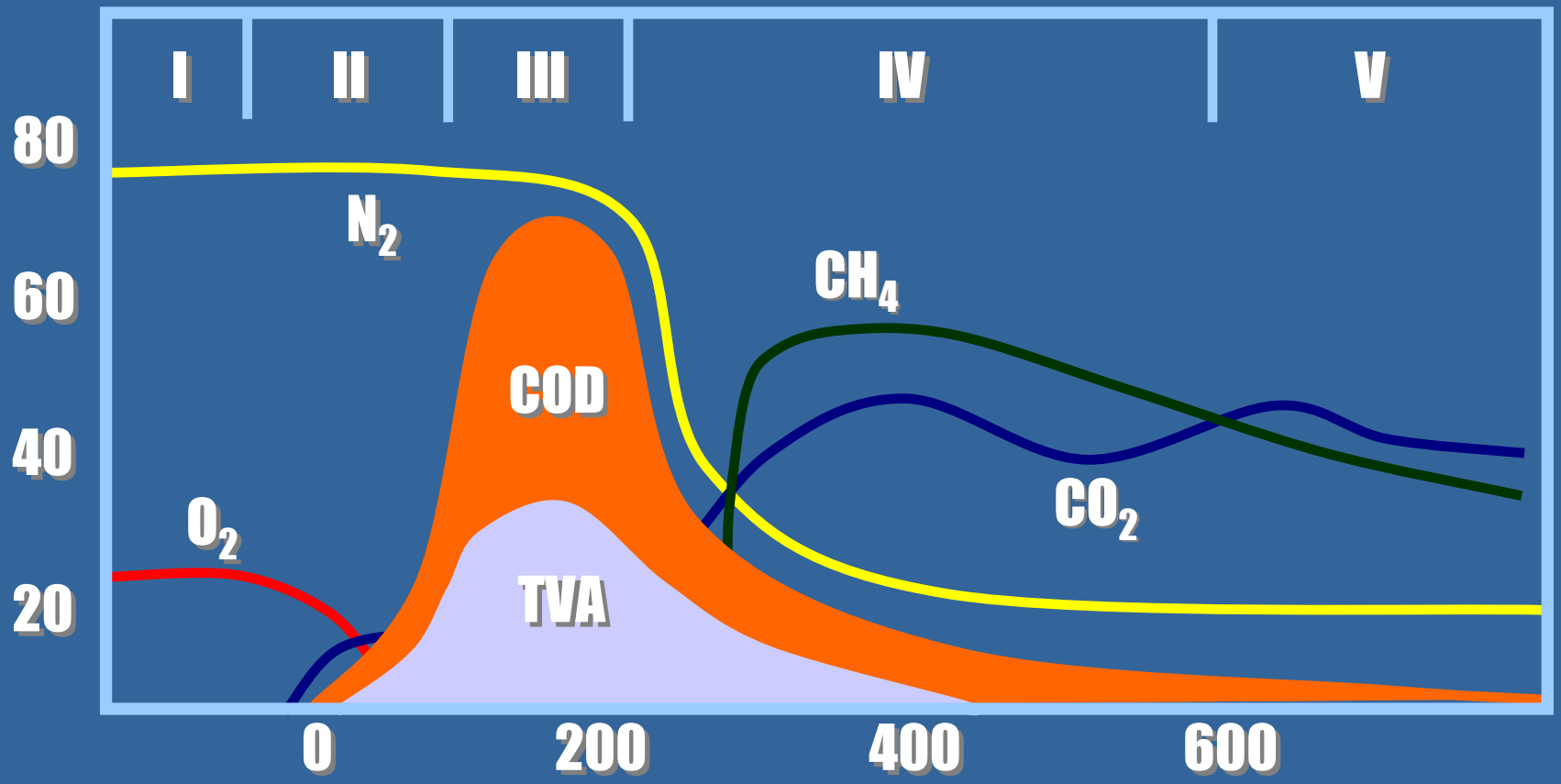
Introduction

- 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_2O and hydrocarbons)
  - Replicates, maintenance, calibration, use a written SOP, and record keeping.

OUTER LOOP BIOREACTOR STUDY

GAS SAMPLING INFORMATION FORM

Date: |__|__|__|__|__|__| (MM DD YY) **Name:** ____________ **Signature:** ____________

INSTRUMENT CALIBRATION

Instrument: ☐ **GEM 2000** ☐ OTHER:

Time of calibration: |__|__:__|__|

Calibration Gases: [50% CH_4 : 35 % CO_2 : 15% N_2]

[96% N_2 : 4% O_2]

Time of calibration check: |__|__:__|__|

Results of calibration check (% v/v):

CH_4: |__|__.__| CO_2: |__|__.__| O_2: |__|__.__| Balance: |__|__.__|

CH_4: |__|__.__| CO_2: |__|__.__| O_2: |__|__.__| Balance: |__|__.__|

QUALITY CONTROL

One sample duplicate must be collected for each day of sampling. The QC requirements are: CH_4 ±10% RPD, CO_2 ±10% RPD, and O_2 ±30% RPD.

Sample I.D.: |__|__|__| |__|__|__| CH_4: |__|__.__| CO_2: |__|__.__| O_2: |__|__.__|

|__|__|__| |__|__|__| CH_4: |__|__.__| CO_2: |__|__.__| O_2: |__|__.__|

$$RPD = \frac{|C_1 - C_2|}{0.5(C_1 + C_2)} \times 100$$

RPD: |__|__| |__|__| |__|__|

Sample I.D.: |__|__|__| |__|__|__|

Time: |__|__:__|__| Sampler: ____________ Sampling Method: ☐ TEDLAR BAG ☐ DIRECT CONNECTION

Gas Temperature: |__|__.__| (°C) Data Logged to GEM 2000? ☐ (IF DATA ARE NOT LOGGED TO THE GEM 2000 RECORD VALUES BELOW)

CH_4: |__|__.__| CO_2: |__|__.__| O_2: |__|__.__| Balance: |__|__.__|

Static Pressure: |__|__.__| ("H_2O) Differential Pressure: |__|__.__| ("H_2O) Barometric Pressure: |__|__.__| ("Hg)

SUMMA Cannister Sample Collected? ☐

Weather Conditions: Wind Speed: ________ Direction: ________ Precipitation: ________ Outlook: ________

Comments: ____________________________

Documentation

Landfill Gas

- 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

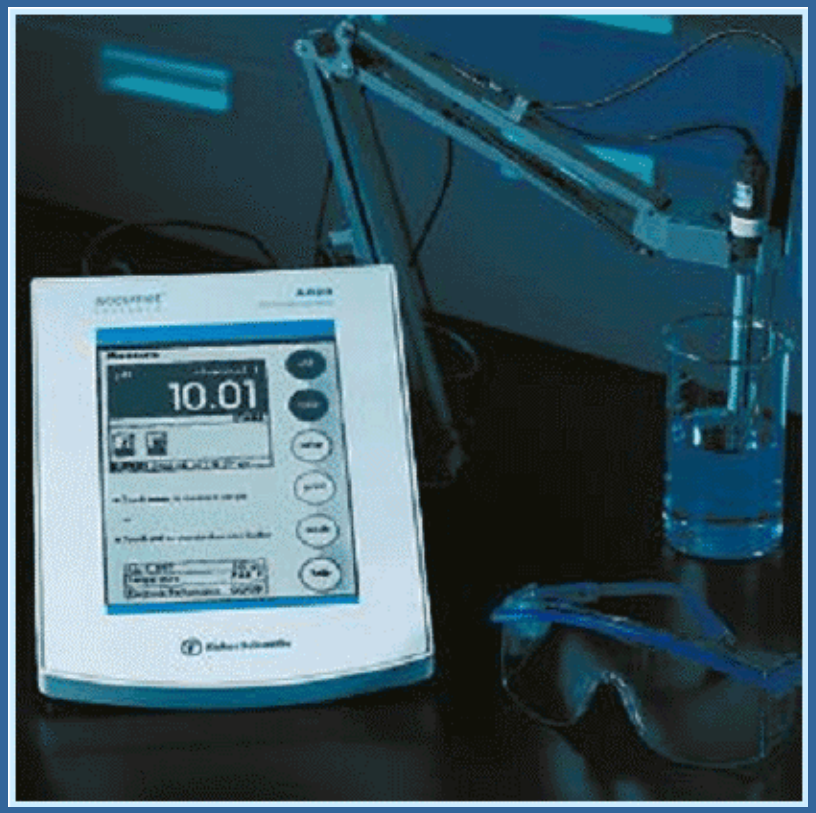
- Precipitation
- Added Liquids
- Flow meters in leachate collection sump discharge/liquid injection piping
  - Totalized flow and flow rate.
  - Full pipe flow and straight run requirements.

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

Date: | | | | | | (MM DD YY) **Name:** _____ **Signature:** _____

pH CALIBRATION

Instrument: **HI 991301** Other:

Time of calibration: | | : | |

Calibration Buffer (s.u.): 4.01 7.01 10.01

Time of calibration check: | | : | |

Result of check with 7.01 buffer: | . | |

CONDUCTIVITY CALIBRATION

Instrument: **HI 991301** Other:

Time of calibration: | | : | |

Calibration Solution (mS/cm):

84 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, chloride, sulfate, TDS.

Sample I.D.: | | | | | | |

Time: | | : | | Sampler: _____ Purge Volume: | | | | (gal.)

pH: | . | | (s.u.) Conductivity: | | | | | | (mS/cm) Temperature: | | . | (°C)

Sample Appearance: Turbidity: _____ Color: _____ Odor: _____

Weather Conditions: Wind Speed: _____ Direction: _____ Precipitation: _____ Outlook: _____

Comments: _____

Documentation

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

Compositing and Temperature

Waste pH Measurement

Sonic Drilling

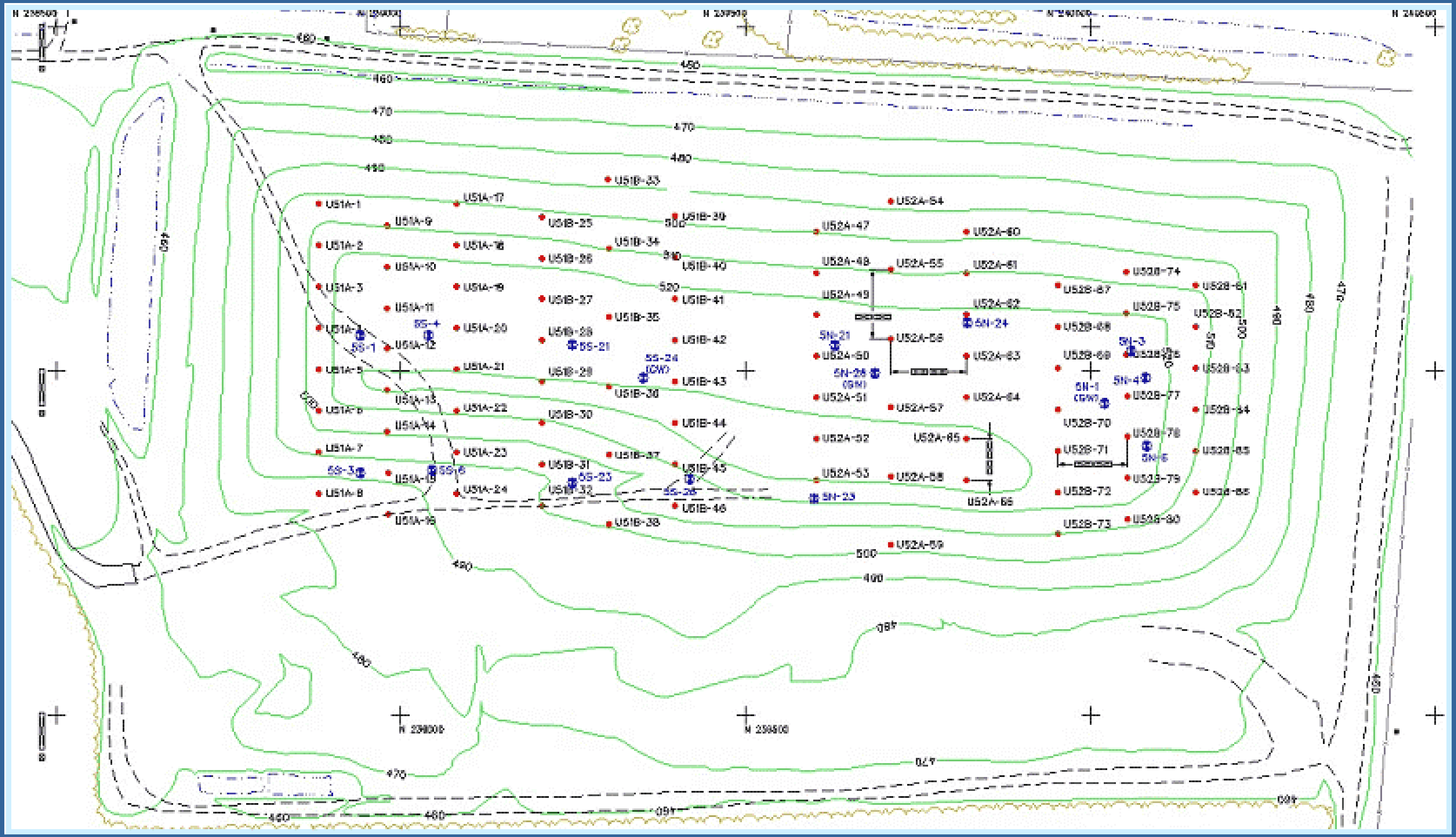
Solids Characterization

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

Waste Settlement

- Survey
- GPS
- Flyover
- Settlement Plates

GPS Surface Survey



Final Points

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