



Manufacturer of Industrial and Environmental Solutions

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CTI Waste Technology Symposium

John S. Hasslen, III
President, EPG Companies Inc.

Bioreactor

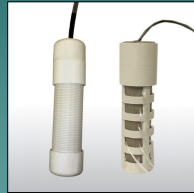
A landfill cell is considered to be a bioreactor when it is 40% moisture by wet weight.



Bioreactor

Much effort and many studies have been undertaken to try and measure the in-situ moisture of MSW landfills. Currently all in-situ moisture sensors have not proven their potential for daily operations.

- ◆ Only measures in contact area
- ◆ Some are costly
- ◆ Field calibration required
- ◆ Not repeatable
- ◆ Slow recovery



Bioreactor

When is a landfill cell a bioreactor?

I would like to suggest a different approach to measuring and monitoring liquid in a landfill.

- Use a combination of:
- ◆ Water Balance Calculation
 - ◆ Simple Sensors



Bioreactor

Water Balance Method

The following equation is used to estimate the potential moisture content of the waste mass based on the Water Balance Method:

$$PMC = \frac{(L_0 M) + P + LA - LCH}{M} \cdot 100$$

where

- PMC** = potential moisture content (estimated) of the waste mass (i.e., % moisture content on a wet weight basis)
- P** = total precipitation reaching the bioreactor cell (reported on a weight basis)
- L₀** = percent moisture entering with the waste mass (weight)
- M** = total waste mass (weight) in bioreactor cell on an "as received" basis
- LA** = total liquids added to the waste mass including re-circulated leachate (weight basis)
- LCH** = total leachate sent to off-site treatment (weight basis)

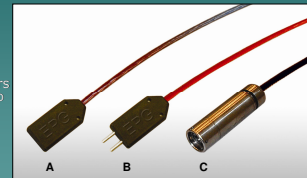


Bioreactor

Examples of Landfill-Bioreactor sensors

Research has shown that municipal solid waste can be rapidly degraded and made less hazardous by monitoring and controlling the moisture content within bioreactor landfills under aerobic and/or anaerobic conditions.

These sensors have been designed specifically to monitor and detect the temperature (A), liquid (B) and pressure (C) in bioreactor landfills. These sensors are easy to install and require no field calibration.

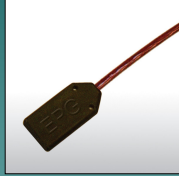


Bioreactor

Suggested sensors for Landfill Bioreactors

Temperature Sensor

- Placed in a random pattern in each lift
- Location plotted and recorded
- Senses temperature in area around sensor
- Temperature is recorded with time date stamp



Used to monitor liquid movement, bio-reaction and to prevent fires.

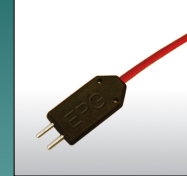


Bioreactor

Suggested sensors for Landfill Bioreactors

Liquid Detector

- Placed in a random pattern in each lift
- Location plotted and recorded
- Detects presence of liquid which should be time and date stamped
- Detects absence of liquid which should be time and date stamped



Used to determine time it takes liquid to move from injection point to sensor and then how long until it dries out.



Bioreactor

Suggested sensors for Landfill Bioreactors

Pressure Sensor

- Placed above the liner in drainage layer at the bottom of the cell
- Best if installed inside of HDPE pipe or between sheets of HDPE to protect from shock loading of compactor

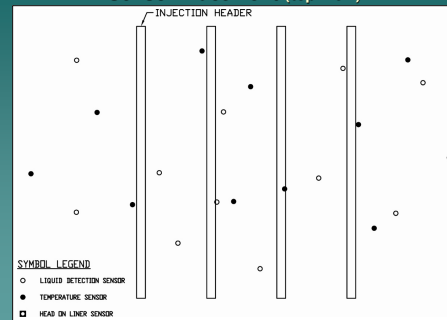


Used to monitor head on liner.



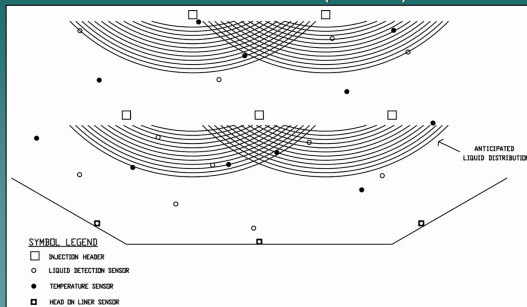
Bioreactor

Sensor Placement (top view)



Bioreactor

Sensor Placement (side view)



Bioreactor

In a bioreactor there is the need to collect & monitor data.

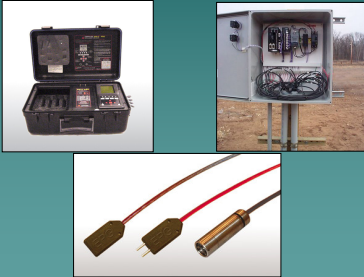
This can be done manually by connecting an electrical meter to each sensor one at a time. Record readings and then convert via lookup table in meaningful data



Bioreactor

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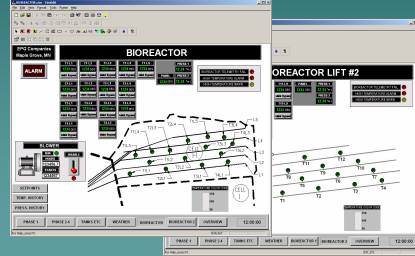
The collection process can be automated by having sensors convert to data logger which periodically down-loads to a PC.



Bioreactor

In a bioreactor there is the need to collect & monitor data.

Automated when sensors are connected to remote telemetry units and then sent to master station when they can be received and displayed on a PC. The automated system can also incorporate alarms for rapid temperature rise.



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