Glossary of Terms

Aerobic: living or existing in the presence of oxygen

Airspace: the available space in a cell where trash is placed for disposal

Anaerobic: living or existing in the absence of free oxygen

Bioreactor: a controlled landfill or landfill disposal cell where liquid and gas conditions are actively managed in order to accelerate or enhance biostabilization of waste

Biosolids: treated residuals from wastewater treatment facilities

Cell: a contained area of the landfill where waste is deposited

Inorganic: being or composed of matter other than plant or animal

LCS: leachate collection system

Leachate: liquid that filters through MSW

LFG: landfill gas

Liner: an engineered impermeable barrier at the bottom of the landfill cell to prevent liquid from leaving the landfill

Methane: a colorless, odorless, flammable gas produced by decomposition of organic matter

MSW: municipal solid waste

Organic: relating to or derived from living things (plant or animals), containing carbon compounds

Post Closure: covers a regulated (currently 30 years) period after waste is last accepted when the owner is financially obligated to maintain the area to the designed environmental standards

Seeps: outbreak of liquids

Questions?

For more information, visit our web page at www.GoColumbiaMo.com (*GoLandfill*) or call the Solid Waste Division at 573-874-6290.

MORE INFO: US EPA

GENERAL:
http://www.epa.gov/garbage/landfill/bioreactors.htm

SPECIFIC:
http://www.epa.gov/epaoswer/nonhw/muncpl/landfill/biowork/index.htm

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BIOREACTOR LANDFILL WASTE STABILIZATION

The City of Columbia Public Works Department has begun planning for the next sanitary landfill disposal cell. As part of this planning process, bioreactor technology is being examined as a means to accelerate waste biostabilization.

City of Columbia
Public Works Department
Solid Waste Division

Tel: 573-874-6290

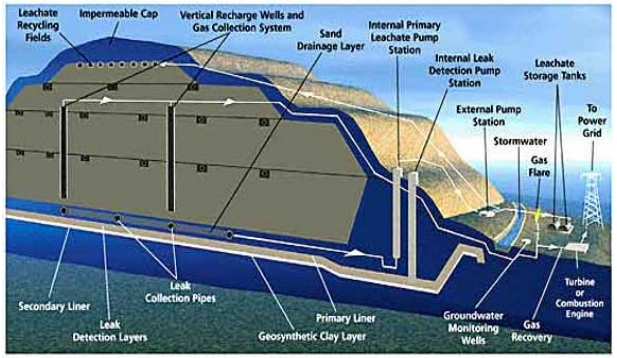
WHAT IS A BIOREACTOR LANDFILL?

A bioreactor landfill operates to rapidly transform and degrade organic waste. The increase in waste degradation and stabilization is accomplished through the addition of liquid, and in some cases, air to enhance microbial activity.

HOW IS A BIOREACTOR LANDFILL DIFFERENT FROM CONVENTIONAL LANDFILLS?

The principal difference between conventional landfilling methods and that of a bioreactor landfill is that current landfill technology has focused on waste compaction and covering, leaving the waste dry or entombed. By contrast, a bioreactor landfill introduces liquid to accelerate or enhance waste stabilization.

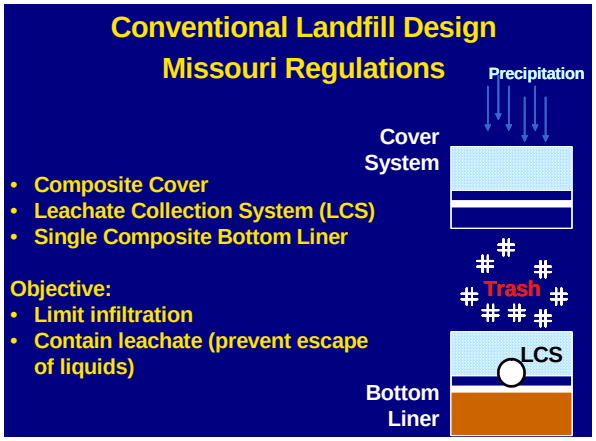
Bioreactor



WHY CONSIDER OPERATING A BIOREACTOR LANDFILL?

The key issues are:

- Decomposition and biological stabilization in years vs. decades in "dry tombs"
- Lower waste toxicity and mobility due to both aerobic and anaerobic conditions
- A 15 to 40 percent gain in landfill airspace due to an increase in density of waste mass
- Increases landfill gas generation rate
- Reduced post-closure care



WASTE STABILIZATION

Decomposition and biological stabilization of the waste in a bioreactor landfill can occur in a much shorter time frame than occurs in a conventional "dry tomb" landfill providing a potential decrease in long-term environmental risks, landfill operation and post-closure costs.

LOWER WASTE TOXICITY

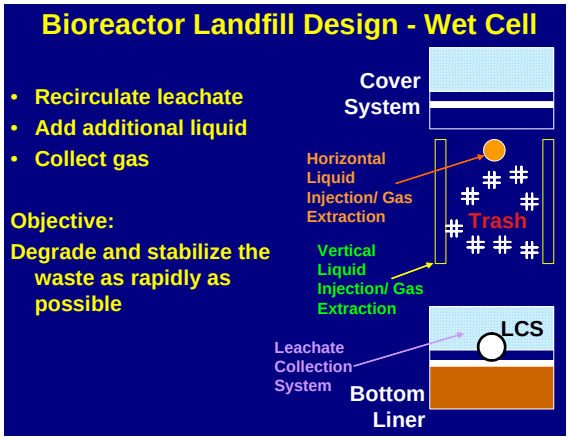
Research has shown that municipal solid waste can be rapidly degraded and made less hazardous (due to degradation of organics and the impounding of inorganics) by enhancing and controlling the moisture within the landfill under aerobic and/or anaerobic conditions.

GAIN IN LANDFILL AIRSPACE

Bioreactor landfills have greater waste capacity than conventional landfills. Due to the rapid degradation of the waste, airspace is recovered, allowing more waste to be added. Think of it like composting. You start out with a pile of leaves or grass 3 feet in height, but after the organic matter decomposes, you are left with a pile height of 6 inches and are able to refill that airspace again, and possibly again. The same is true for a bioreactor landfill, as the organic matter rapidly decomposes, more waste can be placed in its place. Organics comprise 62% of the waste going into the landfill. (Columbia 1996 Waste Characterization Study)

INCREASES THE RATE LANDFILL GAS IS GENERATED

An additional benefit of the bioreactor is that it produces landfill gas (LFG) such as methane at an earlier stage in the landfill's life and at an overall much higher rate of generation than conventional landfills. This improves the



economic potential for beneficial use of methane gas as a green energy source to generate electric and/or direct burn for energy recovery.

REDUCE POST CLOSURE AND CARE COSTS

Biostabilization is the key to reducing risks. Stable waste is lower in toxicity and mobility. This will decrease the potential long-term environmental risks and landfill operating and post-closure costs. Landfill owners are responsible to maintain environmentally safe conditions of the property for 30 years beyond the end of waste acceptance.

SPECIAL CONSIDERATIONS OF A BIOREACTOR

- Costs more to construct and operate
- Increased potential for gas emissions due to rapid waste decomposition
- Increased potential for odors
- Landfill's protective bottom liner could fail under the extra water weight
- Waste column instability due to added liquids
- Increased potential for fires

WHERE WILL THE LIQUID COME FROM?

It is estimated that it will require between 50,000 and 60,000 gallons of water be added each day to obtain the ideal moisture content. Biosolids from Columbia's Waste Water Treatment Plant could be used in lieu of current land farming. Water from on site storm water basins could be pumped into the waste. Wastewater from nearby industry could be used as a water source.