PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

03/2006

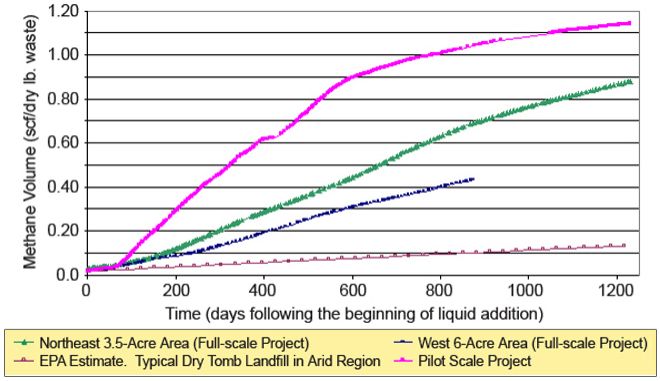
FULL-SCALE BIOREACTOR LANDFILL

Background

Sanitary landfilling is the dominant method of solid waste disposal in the United States, accounting for the disposal of about 217 million tons of waste annually (U.S. EPA, 1997). The annual production of municipal waste in the United States has more than doubled since 1960. In spite of increasing rates of reuse and recycling, population and economic growth will continue to render landfilling as an important and necessary component of solid waste management.

As a part of the Environmental Protection Agency's (EPA) Project XL program to develop innovative approaches while providing superior greenhouse gas (GHG) emissions protection, the Yolo County, CA Department of Planning and Public Works is constructing a full-scale bioreactor landfill. In a bioreactor landfill, controlled quantities of liquid (leachate, groundwater, grey-water, etc.) are added to increase the moisture content of the waste. The leachate is then recirculated as necessary to maintain the moisture of the waste at or near its moisture holding capacity. This process significantly increases the biodegradation rate of waste and thus decreases the waste stabilization and composting time to between 5 and 10 years compared to the time required within a conventional landfill (30 to 50 years or more). If the waste decomposes in the absence of oxygen (anaerobically), it produces landfill gas, primarily a mixture of CO_2 and methane, another greenhouse gas. Methane is 21 times more potent than CO_2 in its effects on the atmosphere. This by-product of anaerobic landfill waste composting can be a substantial renewable energy resource that can be recovered for electricity generation or other industrial uses.

In the initial phase of this project, a 12-acre module divided into several cells was constructed in the Yolo County Landfill. The cells contain a large array of instruments to monitor bioreactor performance. The final phase of this project pertaining to carbon sequestration involves the evaluation of full-scale performance and the potential of aerobic and anaerobic bioreactor landfill cells as tools for abating GHG emissions from organic wastes in landfills.



Yolo County Landfill Methane Production Compared to Other Landfills

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COST

Total Project Value
$1,837,351

DOE/Non-DOE Share
$592,000 / $1,245,351

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Primary Project Goal

The goals of this project are to construct, then to evaluate full-scale performance and potential of aerobic and anaerobic bioreactor landfill cells as tools for abating GHG emissions from organic wastes in landfills. The GHG abatement is accomplished by routes including sequestration of photosynthetically derived carbon in wastes, CO_2 offsets from energy use of waste-derived gas, and mitigation of methane emission from the wastes.

Objectives

- Evaluate full-scale performance and potential of aerobic and anaerobic bioreactor landfill cells as tools for abating GHG emissions from organic wastes in landfills.
- Operate and measure the performance of anaerobic and bioreactor module to desired endpoint.
- Conduct analysis and interpretation of the data.

Accomplishments

In the initial phase of this project, the landfill cells have been constructed and filled with waste. Instrumentation, monitoring, and gas collection systems are in place and used to measure and to independently record data from each cell. The data from these sensors are automatically recorded and sent to the office of the Yolo County Department of Planning and Public Works. Partitioning tracer tests using injection and extraction wells are planned to aid in assessing landfill characteristics, including moisture content.

Benefits

This process will significantly increase the biodegradation rate of waste and thus reduce the waste stabilization and composting time by 67–80% and provide a substantially improved renewable energy resource that can be recovered for electricity generation or other industrial uses. This means that the energy market could increasingly depend on this type of renewable energy providing electric power. Another benefit of the bioreactor landfill is that it generally improves the gas generation rate, decreasing the time frame of landfill gas generation from several decades to between 5 to 10 years.

Waste Containment Base Liner System