

PROJECT facts

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

Carbon Sequestration

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INTELLIGENT BIOREACTOR MANAGEMENT INFORMATION SYSTEM (IBM-IS) FOR MITIGATION OF GREENHOUSE GAS EMISSIONS AND CARBON SEQUESTRATION

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Background

There is growing concern that the buildup of greenhouse gases (GHG) in the atmosphere is leading to global climate change with undetermined consequences. Most of the attention to date has focused on controlling emissions of carbon dioxide (CO₂), the most common GHG. However, interest in controlling other GHGs, particularly methane, is increasing. Methane is of concern because it is more than 20 times more effective in trapping heat in the atmosphere than CO₂. Landfills are the largest source of anthropogenic methane, accounting for approximately 30 percent of emissions. One promising approach for mitigating methane emissions is to operate landfills as "bioreactors" where water and gas flows are intelligently controlled to maintain optimal conditions related to waste degradation and control of methane releases.

Description

A bioreactor landfill is defined as any landfill or landfill cell in which liquid or air is injected in a controlled fashion into the waste mass to accelerate or enhance biostabilization of the waste. Operation of a bioreactor landfill involves controlling the conditions within the landfill so that the rate of reaction and conversion of waste is optimized. Bioreactor cells can be either anaerobic or aerobic. Anaerobic cells involve the addition of liquid to the waste in order to increase methane production, which can then be captured for use as an energy source. Aerobic cells are characterized by the injection of liquid and air to the waste, resulting in a reduction in methane generation. The rate of decomposition of waste observed in aerobic cells is faster than that in anaerobic cells.



PARTNERS

University of Delaware

Yolo County Department of
Planning and Public Works

IEM Corporation

Hydro Geo Chem, Inc.



Figure 1 - Anaerobic Cell at the Yolo County facility

The University of Delaware will demonstrate a management program, the Intelligent Bioreactor Management Information System (IBM-IS), that manages a network of automated sensors and control points to manage and control bioreactor landfill gas extraction and liquid addition. This system will help control and optimize the biological conditions in the waste to allow for more rapid and complete decomposition of the waste and minimize the release of methane by controlled injections of air and liquids. The IBM-IS will mitigate methane emissions associated with barometric pressure fluctuations and potentially reduce fugitive methane emissions to below 10 percent, compared to the 15 to 30 percent typically released without such a system. Bioreactor landfilling will lead to an estimated reduction in GHGs equivalent to 55 to 110 million tons of CO₂ at a cost of \$3 to \$13/ton of carbon.

Primary Project Goal

The primary goal of this work is to develop and demonstrate an IBM-IS program to control landfill gas extraction, air injection, and liquid addition in bioreactor landfills with an accompanying reduction in releases of methane to the atmosphere.

Objectives

The objectives of this project are to:

- Couple new in situ measurement techniques with new and existing computer models of landfill processes in the demonstration of the IBM-IS
- Develop and test an IBM-IS for mitigating fugitive methane emissions from a new anaerobic landfill cell with a permeable earthen cover
- Develop and test an IBM-IS for controlled injection of air and liquids to maintain optimal conditions for suppression of methane generation in an aerobic landfill cell



Figure 2 - Aerobic Cell at the Yolo County facility

COST

Total Project Value
\$814,798

DOE/Non-DOE Share
\$599,373 / \$215,425

Benefits

The major benefit of this project will be the advancement of controlled landfill technology with the concomitant reduction in methane emissions. Widespread application of controlled landfilling may reduce anthropogenic methane emissions by 10 to 20 percent. Because methane is such a powerful GHG, this could have a major effect in mitigating climate change effects.

Accomplishments

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WEBSITE

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- Construction of a new anaerobic bioreactor were completed in Fall 2005
- Laboratory testing of waste properties is taking place
- Numerical models of fluid flow in bioreactors are being developed



Figure 3 – Apparatus for measuring solid waste properties at the Yolo County facility