VOLUME 1

Overview of the Florida bioreactor demonstration project and the work plan

1.1 Introduction

The Florida Department of Environmental Protection (FDEP) awarded a grant to the Florida Center for Solid and Hazardous Waste Management (the Center) to conduct the demonstration of full-scale landfill bioreactor technology in Florida. The demonstration project was managed by the Florida Center for Solid and Hazardous Waste Management in accordance with this Work Plan as required by the FDEP grant award, and involved participation of various universities in the State University System.

Volume 1 gives an overview of the Florida bioreactor demonstration project. Volume 1 has five sections. The second section describes goals and objectives of the Project. The third section describes the project sites, the fourth section describes the work plan, and the section fifth shows the organization of the deliverables. Finally, the bioreactor demonstration project work plan is added as an attachment.

1.2 Project Goals

The primary goal in pursuing landfill bioreactor technology is the operation of solid waste landfills in a manner resulting in accelerated stabilization of the waste. Landfill bioreactor operation includes, among other things, the addition of moisture to the solid waste to create an environment favorable for the microorganisms responsible for waste decomposition. This approach differs greatly from the traditional Resource Conservation and Recovery Act (RCRA) Subtitle D approach of managing solid waste landfills in a fashion that discourages waste decomposition by minimizing moisture entrance into the landfill. One of the primary features of a landfill bioreactor is the recirculation of landfill leachate, or possibly other liquids, to the solid waste. The recirculation of leachate will be a major component of any bioreactor operation conducted as part of this project.

Another feature of a landfill bioreactor that has been proposed for the acceleration of waste decomposition and landfill stabilization is the addition of air. The injection of air, and thus oxygen, promotes the aerobic stabilization of the landfilled waste. This is the same process that decomposes waste in a traditional compost system. An evaluation of the use of aerobic processes for the rapid stabilization of landfilled waste will be a major focus of the project at the New River demonstration site. The project will incorporate a system that will enable both air injection and gas extraction. A temporary membrane cap will be placed on the surface of the landfill to allow the capture of the majority of the gas emissions from the landfill. Wells will be constructed in the bioreactor to allow not only leachate recirculation, but also, air injection, and gas extraction.

1.3 Project Sites

Research conducted as part of this project was performed at a number of different landfill sites in cooperation with their respective owners and operators. The sites included the New River

Regional Landfill in Union County owned and operated by the New River Solid Waste Association; the Tomoka Farms Road Landfill operated by Volusia County; and the Polk County North Central Landfill operated by Polk County; Alachua County Southwest Landfill operated by Alachua County; and Highlands County Landfill operated by Highlands County.

1.3.1 New River Regional Landfill

The FDEP selected the New River Regional Landfill (NRRL), in Union County, Florida, as the site to conduct a full-scale landfill bioreactor demonstration project comparing both aerobic and anaerobic waste decomposition processes. Demonstrating bioreactor landfill technology in cells 1 and 2 at the NRRL included the recirculation of leachate, the injection of air into portions of the landfill cells, and the ability to collect all gaseous emissions from the landfill. The landfill bioreactor was instrumented for collecting *in-situ* measurements of such parameters as leachate head on the liner, and moisture content and temperature of the waste. This project resulted in a full-scale landfill being operated as a solid waste treatment system. The information and data collected allows the technology to be fully evaluated as a method for managing solid waste in Florida. More information on the site can be found in the following references.

Appendix C. Theses and Dissertations

- Jain, P. (2005). "Moisture addition at bioreactor landfills using vertical wells: mathematical modeling and field application." Ph.D. Dissertation. University of Florida, Gainesville, FL.

Appendix. G. Periodic and Technical Reports

- New River Regional Landfill Bioreactor Demonstration Project Biennial Report, 2006.
- New River Regional Landfill Bioreactor Demonstration Project Biennial Report, 2004.

1.3.2 Tomoka Farm Road Landfill

The Tomoka Farms Road Landfill in Volusia County houses a number of solid waste disposal units, including an operating Class I unit for disposal of municipal solid waste. The current operating unit is 30 acres in area. The liner system is a double-liner system equipped with a primary leachate collection system and a leak detection system. Leachate is currently pumped into a leachate equalization and storage facility. The landfill operator was considering implementation of bioreactor technology. A series of instruments were placed on top of the liner in one area of the lined cell. Project components included in the site are a series of pressure transducers for the measuring head on the liner, and a series of earth pressure cells for measuring overburden pressure exerted by the landfilled material (waste plus cover soil). More information on the site can be found in the following references.

Appendix. G. Periodic and Technical Reports

- Research and Data Report for the Alachua County Southwest Landfill, Prepared for Alachua County Public Works Department, 2007

1.3.3 Polk County North Central Landfill

The Polk County North Central Landfill (PCNCL) is located in Polk County, Florida. The facility has a total area of approximately 2200 acres, of which 700 acres are permitted for landfill use. Phase II in PCNCL is a lined 43-acre cell divided into eight equal-size subcells with a saw tooth bottom liner system design. Phase II is an "as-built bioreactor." Horizontal injection lines (HILs) are operated to add leachate. The recirculation of leachate into Phase II is uniformly controlled by a state-of-the-art Supervisory Control and Data Acquisition system (SCADA). The SCADA system controls and records leachate flow rates, injection pressures of HILs, and total volume of leachate injected into the landfill. In addition, at Phase II, research on pore pressures around the HILs continues. More information on the site can be found in the following references.

Appendix C. Theses and Dissertations

- Larson, J.A. (2007). "Investigations at a bioreactor landfill to aid in the operation and design of horizontal injection liquids addition systems" Master's Thesis, University of Florida, Gainesville, FL.

Appendix. G. Periodic and Technical Reports

- The Second Annual Report for Cooperative Research and Development Agreement between U.S. EPA and Hinkley Center for Solid and Hazardous Waste Management, 2008

1.3.4 Alachua County Southwest Landfill

The Alachua County Southwest Landfill (ACSWL) is located in Alachua County, Florida. The unit of 27 acres in ACSWL is a composite-lined Class I landfill and is being operated as a bioreactor. The Alachua County Southwest Landfill (ACSWL) has been the subject of several research projects involving leachate recirculation. From 1990 to 1992, the site operators recirculate leachate using infiltration ponds using horizontal injection lines from 1993 through 1997 and subsurface trenches from 2003 to the present. Research on reverse osmosis (RO) treatment technologies is conducted to treat part of the leachate produced. More information on the site can be found in the following references.

Appendix. G. Periodic and Technical Reports

- Research and Data Report for the Alachua County Southwest Landfill, Prepared for Alachua County Public Works Department, 2007

1.3.5 Highlands County Landfill

The Highlands County Landfill is located near Sebring, Florida and is permitted to operate as a bioreactor landfill on Cell 1A and Cell 1B that occupy 18.5 acres. On this site, the historic and current performance of the gas collection and leachate recirculation system located in cells 1A and 1B were evaluated. Also, landfill gas generation was estimated. Results collected in the current cells were used to help to design, construct, and operate the gas collection and leachate recirculation system of cell 3. More information on the site can be found in the following reference.

Appendix. D. Theses and Dissertation

- Spafford, M. (2002). "Performance evaluation of landfill liner systems using pressure transducers." Masters Thesis, University of Central Florida, Orlando, FL.

1.4 Objectives on the Work Plan

The work plan was designed to conduct the Florida bioreactor demonstration projects effectively. This work plan was changed dynamically as new information was obtained and other sites became available for participation in the research effort. The work plan describes the project's goals and objectives along with the activities and deliverables necessary for meeting each of the project's objectives, and provides a Site Management Plan (SMP) for each research site, and overall project cost estimates. The primary overriding goal of the Florida bioreactor demonstration project is as follows:

The design, construction, operation, and monitoring of a full-scale landfill bioreactor in Florida in a manner that permits a complete and fair evaluation of this technology as a method of solid waste management in Florida, with appropriate consideration of science, engineering, environmental and economic issues.

The objectives of the landfill bioreactor demonstration are to:

1. Design and operate the bioreactor technology using innovative techniques and concepts.

2. Design and operate the bioreactor technology in at least one site in such a manner as to enable the control and measure all major inputs and outputs.

3. Evaluate the use of aerobic bioreactor landfill technology and compare the aerobic approach to the use of anaerobic bioreactor technology in at least one site.

4. Instrument the landfills to permit in-situ monitoring of bioreactor activity and to measure previously unmeasured information (e.g. leachate head on the liner effectiveness).

5. Monitor the landfills in a manner that allows the measurement and impact of bioreactor activities and to allow control of the waste treatment process (e.g. leachate and gas composition and generation, waste characteristics, and settlement).

6. Collect data through instrumentation, field monitoring, and laboratory analysis that will enable the project team to assess the success of the project, the feasibility of this technology for other sites, and to enable the future design and operation of landfill bioreactors in Florida.

7. Develop standardized design and operation procedures for this technology.

8. Further define and quantify the true costs and benefits of landfill bioreactors.

9. Provide a resource and training ground for students in the State University System, landfill operators, and engineers in Florida.

1.5 Organization of the Deliverables of the Florida Bioreactor Demonstration Project.

The deliverables consist of ten volumes and nine appendixes. In Volumes 2-10, each volume represents each objective of the project. The volumes guide readers to products of the project. The volumes summarize specific objectives, researches, results, and conclusions.

- VOLUME 2. Deliverables to Meet Work Plan Objective 1: Design and Operate the Bioreactor Using Innovative Techniques and Concepts.

- VOLUME 3. Deliverables to meet work plan objective 2: Design and operate the bioreactor in a manner allowing the control and measurement of all major inputs and outputs.

- VOLUME 4. Deliverables to meet work plan objective 3: Evaluate the use of aerobic bioreactor landfill technology and compare the aerobic approach to the use of anaerobic bioreactor technology.

- VOLUME 5. Deliverables to meet work plan objective 4: Instrumentation of the landfill bioreactor to permit in-situ monitoring of bioreactor activity and to measure previously unmeasured information.

- VOLUME 6. Deliverables to meet work plan objective 5: Monitor the bioreactor in a manner enabling the measurement the impact of bioreactor activities and to allow control of the waste treatment process.

- VOLUME 7. Deliverables to meet work plan objective 6: Collecting data through instrumentation, field monitoring, and laboratory analysis enabling the project team to assess the success of the project, the feasibility of this technology for other sites, and to enable the future design and operation of landfill bioreactors in Florida.

- VOLUME 8. Deliverables to meet work plan objective 7: Develop standardized design and operation procedures for this technology.

- VOLUME 9. Deliverables to meet work plan objective 8: Further define and quantify the true costs and benefits of landfill bioreactors.

- VOLUME 10. Deliverables to meet work plan objective 9: Provide a resource and training area for students in the state university system, landfill operators, and engineers in Florida.

Eight appendixes include all products of the Project.

1. A. Permit Application Documents and Drawings

2. B. Construction Photos
3. C. Theses and Dissertations
4. D. Peer-Reviewed Journal Articles and Conference Proceedings
5. E. Presentation Materials
6. F. Raw Data
7. G. Periodic and Technical Reports
8. H. Bioreactor Workshops

Attachment

BIOREACTOR DEMONSTRATION PROJECT

WORK PLAN