Educational Workshop On the Landfill Bioreactor Process

Hosted by The
U.S. Environmental Protection Agency (EPA)
And
Buncombe County General Services Department

Renaissance Hotel
Asheville, North Carolina
June 12, 2000

MEETING SUMMARY

Attendance

Twenty-four people attended the educational workshop on landfill Biorectors sponsored by the Buncombe County General Services Department and the U.S. Environmental Protection Agency (EPA). The list of attendees is included as attachment 1.

Catherine Allen of the Marasco Newton Group (MNG) facilitated the meeting and Tara Galloway also of MNG took the workshop notes.

Meeting Purpose

The purpose of the workshop was to learn how landfill bioreactors work. Dr. Debra Reinhart, Associate Dean for Research for the College of Engineering and Computer Science at the University of Central Florida was invited to give a presentation and to answer questions about landfill bioreactors.

Opening Statements

Ms. Wanda S. Green, Buncombe County Manager
Buncombe County Manager, Wanda S. Green, opened the meeting by welcoming participants and thanking the group for attending this educational workshop. She stated that landfill bioreactors are beneficial as landfills and emphasized that the purpose of the workshop was to gain a better understanding of how landfill bioreactors operate. Ms. Green encouraged participants to ask questions.

Ms. Sherri Walker, US EPA Headquarters, Project XL Coordinator
US EPA Headquarters Project XL Coordinator, Sherri Walker, introduced herself as a representative from the Washington, DC EPA Office of Policy and Environmental Innovation. Ms. Walker explained that Project XL is a program that encourages regulated entities such as businesses, local, state and federal facilities to propose innovative projects that produce superior environmental performance over existing regulatory requirements. She stated that the purpose of the workshop is to answer questions regarding landfill bioreactors, to get a better understanding of the Buncombe County Project XL landfill bioreactor proposed project, and to have the opportunity to meet with EPA and Buncombe County officials to discuss the proposed project.

Ms. Michelle M. Cook, US EPA Region IV, Project XL Coordinator
US EPA Region IV Project XL Coordinator, Michelle M. Cook, explained that she was video taping the workshop as an educational tool for other similar XL projects. Ms. Cook explained that Buncombe County and EPA organized the workshop to answer questions and explain the project in terms that everyone understands. She stated that the invited expert on landfill bioreactors would explain the technical terms associated with the project and encouraged participants to pose questions.

OVERVIEW OF THE LANDFILL BIOREACTOR PROCESS

Dr. Debra R. Reinhart, Associate Dean for Research, College of Engineering and Computer Science, University of Central Florida
Dr. Debra R. Reinhart is an expert on landfill bioreactors and is co-author of a book on how to design and operate landfill bioreactors. She gave a slide presentation explaining how landfill bioreactors work and what is required to operate a bioreactor landfill. Dr. Reinhart's presentation can be found on the EPA website for this project at the following address http://www.epa.gov/projectxl/buncombe/bioreactor.pdf. The following is a detailed summary of her presentation.

Definition of Landfill Bioreactor
"Bio" represents the living organisms within the landfill and "reactor" means controlling the process. The primary goal of a landfill bioreactor is to stabilize waste and promote the transformation of the waste so that it will degrade more rapidly.

Dr. Reinhart defined a landfill bioreactor "as a sanitary landfill operated for the purpose of transforming and stabilizing the readily and moderately decomposable organic waste constituents within five to ten years following closure by purposeful control to enhance microbiological processes. The bioreactor landfill significantly increases the extent of waste decomposition, conversion rates and process effectiveness over what would otherwise occur within the landfill."

Advantages of a Landfill Bioreactor

Landfill bioreactors increase the potential for waste to energy conversion. This means that organic materials within the landfill can be converted to methane. The methane produced from the landfill can be used as a cheap source of energy. Storing and treating the water entering and flowing to the bottom of a landfill, defined as leachate, is also beneficial in operating a landfill bioreactor. Recirculating leachate is a good method because leachate is treated as it flows through the landfill. Treating and storing excess leachate on site is more efficient than transporting off site; however, at times there might be excess leachate that needs to be transported off site for treatment. Landfill bioreactors are also economically beneficial. For example, the landfill settles faster when controlled, after which additional waste can be deposited. Therefore, airspace is economically valuable and will increase the rate of degradation when properly controlled. Another benefit of a landfill bioreactor is improved sustainability of landfill sites. This means that successfully operated landfill bioreactors may eliminate a source of pollution in the future.

Difference between Leachate and Recirculation of Leachate within a Landfill Bioreactor

Leachate must be managed or treated. Some facilities use the method of recirculating leachate as an alternative to storing or transporting excess leachate offsite for treatment. In contrast to other methods of managing leachate, landfill bioreactors use recirculation to control the biological processes within the landfill.

Controlled Components within a Landfill Bioreactor

The composition of waste must be controlled to ensure that optimal anaerobic conditions exist for the micro-organisms. Micro-organisms are sensitive to temperature, moisture, and chemical conditions. The purpose of a landfill bioreactor is to optimize the conditions for the micro-organisms. Waste composition can be controlled by keeping toxic materials out of the landfill. It is difficult to control temperature, so temperature is not usually controlled. Shredding waste is another method that increases the decomposition process, but is expensive. Moisture is a significant contributor to the degradation of waste and essential for the survival of micro-organisms.

Hazardous wastes have a negative effect on micro-organisms and are therefore disposed of separately.

The Water Process in a Landfill Bioreactor

As precipitation enters a landfill it either evaporates, runs off, or is absorbed by the landfill. Leachate, the liquid that flows through the waste, is collected and stored for controlled recirculation. Storage is an essential part of the process and the amount of leachate pumped back into the landfill must be controlled. This process continues until the landfill is closed. Depending on the local weather conditions, excess leachate may occasionally need to be transported off site for treatment, but not nearly as much if leachate is recirculated.

History of Landfill Bioreactors

Approximately 200 landfills were identified for recirculating leachate in 1988; however, many discontinued the process because the design was inadequate. The biggest problem for the landfills was that they did not involve engineers in the design process. In 1993, Dr. Reinhart surveyed states and determined that 20 landfills recirculated leachate. The Solid Waste Association of North America (SWANA) conducted another survey in 1997 and found 130 landfills recirculating leachate. To date there has been a significant increase in landfills recirculating leachate; however, less than five percent utilize the process. Dr. Reinhart believes that this process is the trend for future landfills and with further demonstration projects such as this one in Buncombe County, additional landfills will consider this method.

Regulations

Using leachate to wet the landfill uniformly is the most compatible with current regulations. RCRA Subtitle D requirements for municipal landfills currently allow facilities to recirculate leachate**.** The use of water to wet landfills is not compliant with current regulation; however, EPA is in the process of considering the use of sources other than leachate. There are a few states that resist landfill bioreactor operations, but evaluate the potential for operation on a case by case basis.

Technical Concerns with Landfill Bioreactors

In EPA Region 6, Texas presented a concern with the long term fate of metals because they are not biologically degradable. Dr. Reinhart's performed her Ph.D research on what happens to metals in a landfill. She determined that metals are trapped in landfills, but perhaps in time release of such materials might change. Dr. Reinhart also suggested that there is lack of data to determine whether or not metals negatively impact the operation of landfill bioreactors. EPA requested additional data for reassurance of reduced environmental risk and liability. EPA pointed out that landfill bioreactors are more difficult to operate than a conventional landfill. There are questions to think about like recirculation operation, gas capture, external leachate, and recapturing space. Another issue is will there be time to recapture the space. The design of a landfill bioreactor is theoretical, but there are still gaps in the information. There is also a question as to whether or not something needs to be added to the waste prior to depositing it into the landfill to increase the rate of degradation.

Components of a Landfill Bioreactor

The necessary components of a landfill bioreactor include: a composite liner; appropriate density for water penetration; an adequate recirculation system; sufficient gas collection; and an appropriate final cover system which will enable the use of the site in the future. Alternative liners have been used in place of the standard liners. The waste should not be tightly packed. The density of the waste must allow for water to flow through the landfill. It is essential to have an appropriate system that distributes the moisture throughout the landfill. Organisms will convert organic materials to gas; therefore, gas must be collected quickly to control odors.

Methods of Recirculating Leachate
Dr. Reinhart presented five traditional methods for recirculating leachate. Methods such as spraying leachate directly on waste as it is placed, using a sprinkler, or using a fire hose are effective but labor intensive. Ponds have been unsuccessful. Vertical and horizontal injection wells are the most common approaches. Horizontal trenches are very effective and easy to construct. An example of a concrete perforated many hole worked OK by it tended to release water at the bottom. A more effective approach for recirculating leachate is a horizontal system. This method utilizes perforated piping to distribute leachate effectively through the waste.

Amount of Leachate that Needs to be Recirculated
The amount of leachate needed to promote environmental degradation is dependant upon the density of the materials entering the landfill and the moisture content. A calculation exists to determine the amount of leachate needed; however, it is assumed that every pound of waste entering the landfill is wetted and that water is pushed through the waste which is difficult to do. The wetter the waste is initially the less water that will need to be added. A key issue for recirculation is leachate storage. Storing excess leachate is an economical advantage in times when water resources are low and also minimizes the need for transporting the excess leachate offsite for treatment.

Leachate Recirculation and Collection System Design
Design of the recirculation system is a critical issue. There are several models available that provide information relating to the spacing of trenches and the amount of water circulated. A typical collection system, RCRA Subtitle D, will have a clay liner with plastic on top and collection pipe surrounded by porous material with sand on top. The leachate will flow through sand and drainage material to the pipe.

How Will Leachate Recirculation Effect the Leachate Collection System (LCS)?
This is a topic where research is needed. It is known that leachate collection systems fail under prolonged use; however, this is usually attributed to leachate systems that have not been well designed. There is a concern that long-term use will tend to clog or slow the flow of leachate. Unlike a conventional landfills that normally collect a large volume of liquid for a short period of time, landfill bioreactors LCSs operate longer.

How to Determine Whether the LCS is Performing
Currently, states have not defined performance standards to determine the effectiveness of recirculation systems measure by the head on the liner. When studying landfill bioreactors there is a need to know how the leachate collection system is performing. The head on the liner can be estimated by observing the water level of an external ..... Pressure transducers are currently installed as an experimental device in Florida landfills to determine head on the liner. Alternative methods for measuring head on the liner are being explored because there is a twenty percent failure rate with the transducers. In order to maintain the leachate collection system, regularly flushing material out of the leachate collection system is recommended to ensure that the system is

operating efficiently and to prevent clogging.

Gas Production
Dr. Reinhart presented a graph comparing landfills with same amount of waste, a dry landfill not recirculating leachate, a moderately wet landfill, and a really wet landfill. Gas production within a dry landfill and a landfill bioreactor is volumetrically the same, but the rate of gas produced is different. Within a dry landfill gas is produced over a longer period of time, whereas, a landfill bioreactor produces more gas in a shorter period of time. The gas produced within the landfill must be collected in order to be used as a source of energy. Gas can be collected by, the leachate collection system, gas collection wells, or trenches installed under the final cap. Landfill bioreactors may have odor problems due the increased release of gas in a short amount of time.

Daily Covers
The use of a daily cover after depositing waste is important to control odors. Alternative daily covers have been used such as a reusable tarp, foam, or compost. Moisture must be able to flow through the cover to avoid side seeps.

Impact on Landfill Operation
There are many complexities with the operation of a landfill. Leachate recirculation must be compatible. Predetermining the location of access roads, monitoring the landfill for the rate of settlement, and inspecting the landfill for side seeps and odors will be necessary.

Settlement Issues
There are materials such as metals that cannot be broken down. Europeans have utilized landfill bioreactors by rapidly flushing water through the system. Some landfill bioreactors have experienced approximately two times as much settlement as traditional dry landfills. Waste compaction is an issue and some facilities have packed waste in as tightly as possibly. Water tends to be transmitted horizontally instead of vertically in a compacted system which decreases the settlement rate. Settlement rates vary but are higher than a conventional landfill. Facilities need to fully document all data for further reference.

Nonindigenous liquids
There is an interest in recirculating liquid that did not originate in the landfill. Areas with limited rainfall could benefit from the use of wastewater or groundwater that is not a usable resource as water source.

Leachate Quality
There is some concern when you recirculate leachate that the characteristics of the leachate might change. Materials dissolve in the leachate and the micro-organisms consume the organic material within the leachate. Organic materials are essential waste for landfill bioreactors. The organic material dissolves in the leachate and is consumed by micro-organisms; therefore increasing decomposition of waste. Leachate quality improves through the recirculation.

Recovery of Composted Materials
There is hope that by degrading waste faster the contents will be recovered and landfill site can be reused for other purposes. Some people hope that by operating a landfill bioreactor there will be no need to site another landfill. The landfill will never be 100 percent recoverable. There will be waste that can not be recovered in the landfill and must remain at the site.

Economic Impacts
A landfill bioreactor will have additional capital and operating costs as compared with conventional. These costs are balanced by benefits including; gas production, recovered space, and the possibility of reducing environmental impact in the future. As data are collected from the sites, there might be other specific cost benefits.

QUESTION AND ANSWER

Question
When you first open up the system, leachate is moving through the system and micro-organisms are focusing on solids and the leachate might have the biological reactions strong enough to start decomposing the actual liquid matter. In the early stages of a landfill bioreactor will you see a temporary spike in the leachate organics?

Answer
Focusing on the organic portion of the question, the amount of leachate taken off site is only a fraction of what was taken off site prior to recirculation. To combine the volume and concentration that the mass of the organics that has to be transported off site is also much less. There is some concentration of organics while the landfill is open. The amount leaving the boundaries is much less. For conservative compounds, there are mechanisms that assimilate these compounds such as sulfates and carbonates. Recirculation of the leachate allows for the recapture of compounds that were missed the first time around. Other substances that might be considered as toxic would be trace organics such as nail polish or dry cleaning materials which will be treated because the biological conditions will be optimized within the landfill. There will be items that enter the landfill that will remain in the landfill. A landfill bioreactor with optimum conditions will reduce the amount of materials that come out of the landfill. This has been proven in the lab. Leachate quality is improved when recirculated.

Question
Are the micro-organisms producing biproducts that molecularly bind to the items that are considered toxic so that when the leachate is recirculated there is a chemical bond?

Answer
Micro-organisms are taking waste and turning it into compost. Compost is humic material that is very complex (huge molecules)and tend to bind leachate constituents. There is no question under the condition of a landfill bioreactor that the ability to degrade waste is

improved.

Question
What makes the shredding of waste costly?

Answer
Shredders are costly. For example, a landfill in Central Florida using the shredding process shreds the waste six hours at a time which is a cheaper. It costs $32/ton to landfill. The landfill is saving half the airspace so they can get more waste into the landfill; therefore, they are saving $10/ton. A question is to whether the water is flowing through the landfill efficiently when waste is compacted.

Question
Are they compacting on that landfill?

Answer
Yes, and this is a concern.

Question
What is the deciding point for gas collection?

Answer
It depends on why the gas is collected. Odor is a deciding factor to consider. Economically, it might be beneficial to wait until the production is high enough for energy production. Gas is also collected for regulatory purposes.

Question
Do alternative waste reduction programs such as recycling have an impact on landfill bioreactors?

Answer
Yard waste and other organic materials are sources of moisture which contributes to decomposing waste. Paper products take a long time to degrade so there may not be a relative impact.

Question
Is there a specific recommendation for the composition of waste entering the landfill so that the landfill bioreactor can operate at maximum capacity?

Answer
Decreasing the amount of toxins and increasing moisture.

Question
Using an alternative liner has tested to be more or just as protective as the composite liner. What sort of safeguard recommendations should be considered that will demonstrate protectiveness?

Answer
The liner must allow for the appropriate amount of leachate to enter and exit the system.

Question
How is using an alternative liner going to impact the environment and how effective is it going to be as opposed to the composite liner?

Answer
What we are doing is degrading the waste quicker, improving the quality of the leachate, and reducing the toxicity of the leachate.

Clarification point
Does this conform to a certain degree in the early stages of the leachate development and early stages of the landfill bioreactor? Because, as mentioned in the presentation on the curve, as the probe begins to come down at the closure there will be less of an impact on the liner except for a physical stand point.

Response
In Buncombe County Landfill there are two older cells that are not receiving new waste so the concentration in the leachate may not be seen. The curve in the presentation represents new waste.

Clarification point
The idea is to minimize the impact on the alternative liner so that the leachate is shared throughout the landfill instead of concentrating on one cell at a time where there would be a larger burden on the liner.

Response
The first two cells that are currently inactive have the composite liner and the alternative liner will be the standard in other areas. It is difficult to determine the difference in performance between the two liners.

Clarification point
There is a lot of slope at the Buncombe County Landfill and stone is being used to maintain the water flow.

Question
In terms of slope, will the variables remain the same as it is currently operating?

Answer
The pipe system at the bottom of the landfill is needed to account for the slower movement through the sand with the slope and the with high permeability of stone water flows quickly to some areas.

Question
Is there a concern for water moving too quickly through the system?

Answer
It is inevitable and difficult to control. Channels close and reopen to maintain the water flow. The more times it is recirculated areas that were not covered the first time will be penetrated.

Question
Has Buncombe County thought about designating specific areas within the landfill for industrial waste?

Answer
The county attempts to evenly deposit waste and would be concerned about differential settlement if there were designated areas.

Question
Are horizontal trenches compromised due to settling?

Answer
This is a concern; however, landfill bioreactors have not been operational long enough to determine such impacts.

Question
Are there monitoring requirements for a landfill bioreactor, leachate quality, or gas? If so, do the requirements vary with the different sites?

Answer
There is a need for additional data in order to understand monitoring requirements. EPA has requested data from operating landfill bioreactors.

Comment
EPA is not financing Buncombe County's increased monitoring costs. The program is about flexibility to encourage superior performance. The county has an opportunity to save money by using an alternative liner system. EPA has the opportunity to request the data and is asking the

county to use some of the money to invest. EPA is not making a requirement that all money made from the project be reinvested in monitoring.

Question
Will the operation of the Buncombe County project differ from facilities around the world that are currently operating?

Answer
The only difference and the reason the project is being considered as an XL project is the use of the alternative liner. EPA currently allows recirculation with composite liners but not for alternative liners. There are other projects that vary due to the vast difference in geology.

Comment
The county has saved money using the alternative liner, which is also a better liner.

Question
Will surface monitoring be done? Are there advantages in using a landfill bioreactor from a regulatory perspective?

Answer
EPA is in the process of determining monitoring parameters. There are advantages to being an XL project. The goal of Project XL is to approve projects that positively impact regulatory approach. There are experts that want to be involved with this project and that will ensure a successful landfill that will benefit the community and the state. The purpose of Project XL is to do things that will ultimately change the regulatory approach nationally.

Question
Will the landfill bioreactor extend the life of the active, open period of the cell, or overall landfill? Is the life of a typical landfill bioreactor longer than a traditional landfill?

Answer
It depends on how the site is operated. Ideally, fill would be added as the cell settles and add finishing fill to reach the final height. The cell should allow for more fill due to the faster settling rate. If the cells are small once the waste has settled it is possible to redeposit until the permanent height is reached for degradation. A landfill bioreactor might be active longer than a traditional landfill due to the rate of settling.

Question
Is Buncombe County allowed to temporary cap older cells to see if it decomposes and add additional waste later?

Answer
It is possible as long as it is not illegal. As long as it is not a final cover additional deposits can be made.

Comment
The State is in support of the project, but has not consider this a state wide initiative. EPA has approved the project and is currently in the process of developing a draft document.

Question
What information is the most valuable for the Buncombe County project? How should the system be designed?

Answer
Dr. Reinhart suggested monitoring water balance to ensure water is moving around the landfill. She also stated that gas monitoring is important.

Question
Are there instances where a landfill bioreactor should not be implemented?

Answer
Yes. If the skills and expertise are not available or if the facility does not have sufficient storage for leachate, a landfill bioreactor should not be considered. If the facility has a competent administrator and support for implementation, then there is no reason not to proceed.

Question
In some cases it has been suggested that there is better water filtration and degradation without the final cap, is this true?

Answer
It depends on the water balance. If the water is limited in the area it might be necessary.

Question
Is wastewater a safe additive when leachate is limited?

Answer
Yes, wastewater is an acceptable resource.

Question
From your experience, are you aware of any "typical" stakeholder concerns with other landfill bioreactors projects or is there known resistance to other landfill bioreactors?

Answer
There is some concern with pumping air into landfill because of the potential for explosions. However, the primary concern is with odor.

Question
Is the odor problem manageable?

Answer
Yes. Controlling gas release will limit odors.

XL Process and Next Steps

Ms. Michelle Cook
Ms. Cook explained that the Project XL process is broken down into phases. EPA receives proposals from project sponsors. After a sponsor is found to have a good record of regulatory compliance, an EPA team reviews the proposals and selects those that they feel will be successful. There must be an agreement on how the project will operate. She stated that once suggested rule changes are available, the public will have another opportunity for comment. The next public meeting is tentatively scheduled for July 13, 2000. A site-specific stakeholder plan will be distributed during the comment period. Ms. Cook concluded the meeting by thanking Dr. Reinhart and participants for a successful educational workshop.

For additional information regarding Buncombe County Project XL Landfill Bioreactor, please contact:

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Please refer to the following website for more information on this project and other XL projects, as well as the stakeholder participation guidance manual.
www.epa.gov/projectxl

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