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## ORLANDO, FL JUNE 23-24, 2011

Rosen Plaza Hotel  
9700 International Drive  
Orlando, FL 32819  
407-996-1735  
ASCE Hotel Rate: \$92 Single/Double

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## Design and Operation of Bioreactor Landfills



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## Locations Please check one

Orlando, FL/June 23-24, 2011 81522011

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Newly Updated!

# DESIGN AND OPERATION OF BIOREACTOR LANDFILLS

Orlando, FL / June 23-24, 2011

"ASCE provides the most specialized speakers for every seminar that I've attended."

- Karl Finke, Branch Office Director, Andrews Engineering, Inc., Warrenton, MO

"This seminar is very informative and an excellent refresher. I learned a lot of new things. The real cases and examples that were presented were most helpful. The new theories presented were great aspects of this seminar."

- Riad Touati, Project Engineer, GEC, Orlando, FL

"This seminar was very good for introducing me to a new and relevant topic. The methods and limits of bioreactors were very helpful."

- Robert Grefe, WIS Department of Natural Resources, Madison, WI



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# DESIGN AND OPERATION OF BIOREACTOR LANDFILLS

## PURPOSE AND BACKGROUND

Every year, an increasing number of municipal solid waste (MSW) landfills are operated as bioreactors for the environmental and economical benefits. The benefits include: greater and faster settlement of the waste resulting in more airspace; optimization of existing disposal sites; faster gas generation which can increase the gas-to-energy revenue; potentially faster improvement in the leachate quality reducing the post-closure care period; and reduction in the discharge of leachate to wastewater treatment plants which can reduce the loading of heavy metals and other persistent contaminants to bio solids.

In order to operate a landfill as a bioreactor, liquid or leachate injection is one of the most common strategies. However, addition of liquids to a landfill requires a thorough understanding of the mass balance, subsurface hydraulics, leachate level control, waste properties, and the impact on the slope stability of the landfill. There is a lack of widely accessible consistent information on bioreactor landfills. Hence, the key objectives of this two-day course are to teach: (1) design and operation of subsurface leachate/liquid injection systems with field-scale testing and monitoring; and (2) how to carry out slope stability analysis for landfills operated as bioreactors. Pros and cons of subsurface liquid injection systems consisting of horizontal trenches, vertical wells, and permeable blankets will be discussed. Monitoring and optimizing the performance of such systems using field sensing techniques will be included. Slope stability analysis will include various types of landfill failures, landfill failure case history review, design and operational factors influencing landfill stability, leachate head calculations, and effect of leachate level and leachate injection on landfill failure.

## LEARNING OUTCOMES

- Design various types of subsurface liquid injection and gas extraction systems
- Field instrumentation of bioreactor landfills to monitor physical and chemical parameters including pressures, temperatures, water contents, settlement, liquid mass balance, and state of degradation of the waste.
- Calculate maximum leachate head in multilayer drainage media
- Know the translational failure analysis method and how that the properties of the waste and liner components and leachate level affect landfill stability
- Use computer software for calculating the maximum leachate head in multilayer drainage media and conducting translational failure analysis

## ASSESSMENT OF LEARNING OUTCOMES

Students' achievement of the learning outcomes will be assessed through a series of case studies and problem-solving exercises.

## SEMINAR BENEFITS

- Learn the engineering design, installation, and operation of state-of-the-art subsurface liquid injection and gas extraction methods for landfills and associated field instrumentation to monitor the long-term performance of the system
- Quantitatively evaluate the financial and environmental benefits of operating landfills as bioreactors using appropriate monitoring system coupled with analysis
- Learn calculation of maximum leachate head in multilayer drainage media for bioreactor landfills
- Learn slope stability analysis and case histories which are critical for "wet" landfills
- Obtain computer software regarding calculation of maximum leachate head in multilayer drainage media and translational failure analysis of landfills and learn how to use the software
- Gain an insight into the distribution of injected liquids in waste, impact on water balance of the landfill, and effect of landfill operations
- Receive information on state-of-the-art computer modeling methods and research to simulate liquid injection or slope stability of bioreactor landfills
- Leave the course with a powerful capability for designing, monitoring, and diagnosing problems associated with bioreactor landfills

## WHO SHOULD ATTEND?

Landfill designers, operators, installation contractors, and environmental regulators will benefit from this seminar.

## SEMINAR INSTRUCTORS

**MILIND V. KHIRE, Ph.D.**, is an Associate Professor of Civil & Environmental Engineering at Michigan State University. He earned his Ph.D. from the University of Wisconsin-Madison. He has over 15 years of geotechnical consulting experience in the U.S. and Australia. The majority of his current research is focused on the design and operational aspects of liquid injection systems and hydraulic and thermal properties of solid waste landfills. Most of Dr. Khire's projects are field-based. He has published around 60 technical papers and U.S. Patents on research related to landfills and an edited book on Waste Management. Dr. Khire's research is supported by the National Science Foundation, the Department of Energy, Environmental Research & Education Foundation, and Waste Management, Inc. He is the recipient of the Croes Medal and JGGE Exemplary Service Award from the American Society of Civil Engineers.

**XUEDE (DAN) QIAN, Ph.D.**, is the Statewide Geotechnical Engineering Specialist of the Michigan Department of Natural Resources and Environment, Environmental Resource Management Materials Division. He received his Ph.D. in Geotechnical Engineering from the University of Michigan, Ann Arbor in 1990. He has been working as an adjunct faculty in the Department of Civil and Environmental Engineering at the University of Michigan, Ann Arbor since 1995 and has instructed a landfill design and construction course. He has been actively involved in geotechnical and environmental engineering research and has participated in many landfill design, construction, and remediation projects during the past 20 years with universities, regulatory agencies, and consulting firms. Dr. Qian has authored more than 70 technical papers in the geotechnical and environmental fields. He is also the principal author of the textbook (published by Prentice Hall) entitled "Geotechnical Aspects of Landfill Design and Construction" which is widely used in the industry and academia.

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## Summary Outline

TIME: 8:30am – 4:30pm

### Bioreactor Landfills - pros and cons

- Liquid Injection
- Air Injection
- Water Balance

### Chemical and Biological Considerations

- Gas Production
- Rate and magnitude of waste decomposition
- Leachate Quality and Post Closure Implications

### Liquid Injection System Designs

- Horizontal Trenches
- Vertical Wells
- Permeable Blankets (new alternative)
- Influence of Operational Conditions on Design

### Gas Extraction System Designs

- Horizontal Trenches
- Vertical Wells
- Permeable Blankets (new alternative)
- Influence of Operational Conditions on Design

### Field-Scale Testing, Implementation, and Monitoring

- Field Parameters – Water Content, Pore Water Pressure, Temperature, etc.
- Sensors and Dataloggers
- Data Collection and Interpretation

### Estimation of Maximum Leachate Head for Bioreactor Landfills

- Methods for Calculating Maximum Leachate Head
- Effects of Base Grade and Pipe Slope on Maximum Leachate Head
- Equivalent Hydraulic Conductivity for Unconfined Seepage in Multilayer Media
- Calculation of Maximum Leachate Head in Multilayer Drainage Media

- Landfill Failure Case History Review
- Rotational Failures
- Translational Failures

### Translational Failure Analysis for Non Leachate Seepage Condition

- Method Development
- Discussion of Various FS-Values
- Difference Analysis between FStrue and FSave
- Simplified Method for Non Leachate Seepage Condition

### Case Study regarding Landfill Failure due to Leachate Recirculation

- Examples of Leachate Related Failure
- Summary of Fifteen Large Landfill Failures

### Effect of Leachate Level on Landfill Failures

- Leachate Head Scenarios
- Calculation of Pore Water Pressures for Various Seepage Cases
- Method Development for Various Leachate Seepage Condition

### Design and Performance Considerations for Landfill Stability

- Material Shear Strengths
- Leachate Head and Pore Pressure Buildup
- Landfill Geometry – Design of Waste Filling Sequence

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