November 2008
Progress Report

Title: Developing a Guidance Manual for reducing greenhouse gas emission, odors, and non-methane hydrocarbons from landfills.

Update:
The guidance manual is now being written after the literature review is complete. The manual now has the flowing sections:

Section 1: Basics of Landfill Gas. This section is a brief summary written in a simple language that explains the bio-chemistry of the generation of landfill gas, the different phases on the gas generation inside landfills, and the evolution of the chemical composition of landfill gas. This section ends with describing the factors affecting methane generation in landfills and how they relate to typical management practices of such facilities.

Section 2: This section describes the migration of landfill gas from landfills and how maximizing collection of landfill gas has been the main focus of all previous activities undertaken to develop best management practices to maximize gas collection or harvesting. These practices address:

- New cell design and impacts on LFG collection, including design of gas collectors in bottom liner systems, protection against gas escaping through liner anchor trenches, etc.
- Use of leachate collection and removal system (LCRS) components for LFG control.
- Landfill construction impacts on LFG systems and how to minimize.
- Landfill operational and phasing impacts on LFG systems and how to minimize, including waste acceptance practices, waste placement activities, and cell development.
- Designing, constructing, and operating LFG systems at sites with leachate recirculation or at bioreactor landfills and minimizing liquids impacts while enhancing LFG system design to accommodate increased gas production.
- Cover design and practices and impacts on LFG collection, including daily cover, alternative daily covers (ADCs), intermediate cover, final cover, synthetic versus soil covers, and closure phasing.
- Closure and post-closure activities and impacts on LFG system and how to minimize.
- Types of biocovers and their comparative value for methane oxidation.
- Biocover design criteria.
- A brief qualitative analysis of the GHG emissions reduction potential from organic waste diversion based on published literature on the subject.

This section end by showing how maximizing collection can is not enough to reduce emissions from landfills. “Collection systems are never 100% efficient. Emissions can escape the landfills from around wells and along routes of installed landfill equipments. Some report that gas utilization and/or flaring systems associated with active gas collection begins to falter and fail periodically leading to high emissions. Historical practice suggests that collection systems may operate less than half the time that landfill gas is produced because these systems are economically and operationally feasible only when methane concentrations are high. As low level methane production may continue for a long time, the net accumulation of methane during the non-collection period is not negligible. One methane concentrations fall below 35 to 40% and the total production rates are below 30 to 50 m3 per hour, the treatment of landfill gas in combined heat and power plants becomes technically and economically not feasible (Haubrichs and Widmann 2006). When methane concentrations reach 20 to 25%, and landfill gas flow rates dip below 10 to 15 m3 per hour, the most suitable treatment methods become high temperature flaring. Below these values, the treatment of poor landfill gas becomes more expensive and complex (Huber-Humer et al 2008). Fluidized combustion or catalytic oxidation are two possible options for such quality of landfill gas**."**

One of the most promising technology is the use bio-oxidation to destroy the "not collected" gas.

Section 3: This section starts with explaining how biological oxidation of methane, NMOCs, and hydrogen sulfide occurs in landfill settings. It then lists and explain the factors affecting bio-oxidation in landfill setting and especially factors known to inhibit biological oxidation. For field scale implementation, the challenge is to provide suitable conditions for oxidizing organisms to thrive and maximize oxidation. At the same time, the rate of biological oxidation depends on temperature, and water content. Many landfills also passively vent landfill gas to prevent its horizontal migration. These passive vent pipes serve as direct conduits from deep within the landfill to the atmosphere. Passive biofilters that uses oxidizing bacteria to reduce passive vent landfill gas release can be incorporated into LFG management plans. Such biofilters can be contained in cylinders open at the top to allow air to diffuse into it from above. The cylinder can contain a porous substrate for the bacteria to grow upon. As LFG passes though this scrubber, entering at the base, CH_4 and non-CH_4 organic compounds would be oxidized. This system could also be used in later stages on larger landfills when active recovery is no longer economically feasible. As landfills age, they produce less CH_4 and at some point it will no longer be economical to power the pumps that extract the CH_4 and direct it to engines and flares. The engineering challenge for the design of biofilters is to keep the gas permeability of the filter media high enough so the presence of the biofilter does not hinder the flow of gas through vent pipes. This can be performed by using coarse grained compost and by keeping the compost at target water content.

Section 4: Biocovers (underway)- design guidelines

Section 5: Biofilters (underway) - design guidelines

Section 6: Biocells (underway) - design guidelines

Principle Investigators: Tarek Abichou FAMU-FSU College of Engineering
Jeff Chanton, Florida State University

Project Website: http://www.eng.fsu.edu/~abichou/guidance