FAMU – FSU COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING
2525 Pottsdamer Street
Tallahassee, Florida

Tag Meeting No. 1

Friday, January 24, 2014
11:30 am – 1:30 pm, Room Building A 127A

Minutes

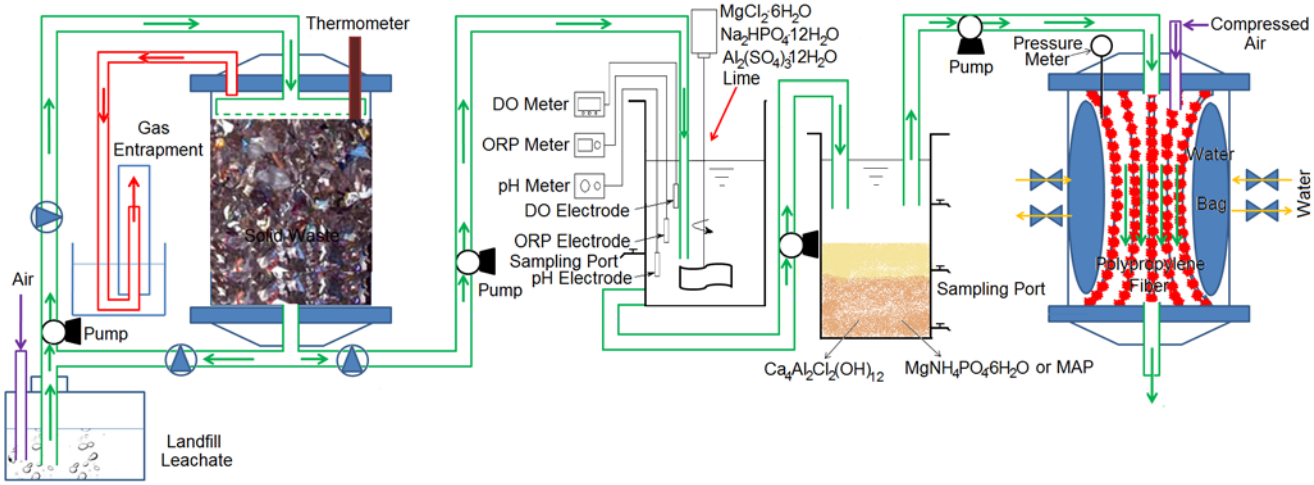
Project Title: Aerated Recirculation and Pressurized Suspended Fiber Biofiltration for the Treatment of Landfill Leachate
Tag Members: Peter Grasel, Lee Martin, John Hallas, Brian Lee Moody, Tarek Abichou and Hafiz Ahmad
In Attendance: Peter Grasel, John Hallas, Brian Lee Moody, Tarek Abichou, Henry Freedenberg, Hafiz Ahmad, Tim Vinson, Kein Vu and Weijie Xie
Principle Investigators: Gang Chen and Kamal Tawfiq

A website has been developed for this research (www.eng.fsu.edu/~gchen). All the information regarding this project has been uploaded to this site to facilitate the dissemination of the research discovery.

1. Project Overview

Detailed information is available at http://www.eng.fsu.edu/~gchen

2. Experimental Setup



3. Aerated Leachate Recirculation Investigation

After aeration, landfill leachate collected from the Leon County Landfill will be pumped to the bioreactor from the storage reservoir. Leachate aeration will be achieved in the storage reservoir

with air supply controlled by a mass-flow controller (with targeted dissolved oxygen levels of 2 mg/l to 6 mg/l). Considering the possible organic leaching from the solid waste in the bioreactor, the leachate may be recirculated for a couple of months until obvious decrease of organic contents can be observed. Then, an aliquot will be introduced to the next treatment step and the other aliquot will be aerated and recirculated. For this part of the research, dissolved oxygen (DO), pH, oxidation/reduction potential (ORP), BOD_5, and ammonium, nitrate and iron concentrations will be monitored for the leachate before recirculated into the bioreactor and after getting out of the bioreactor.

4. MAP Precipitation and Ultra-High Lime with Aluminum Process

The precipitation reaction tank is equipped with pH, DO and ORP probes and is continuously stirred by a single mechanical blade. Magnesium and phosphate will be added as $MgCl_2 \cdot 6H_2O$ and $Na_2HPO_4 \cdot 12H_2O$ and pH will be adjusted with lime. For chloride removal in the form of calcium chloroaluminate $[Ca_4Al_2Cl_2(OH)_{12}]$, $Al_2(SO_4)_3 \cdot 12H_2O$ will be added. For chloride removal research purposes, if the chloride content of the leachate sample collected from Leon County Landfill is less than 600 mg/l, leachate collected from Quincy-Byrd Landfill (Gadsden County), Baker Landfill (Okaloosa County), Santa Rosa Central Landfill (Santa Rosa County), and Santa Rosa Holley Landfill (Santa Rosa County) will be tested and used in this research.

5. Pressurized Suspended Fiber Biofiltration Performance Evaluation

The custom-made pressurized suspended fiber biofilter will have a volume of 35 L with a height to diameter ratio of 1:1.66 (height = 50 cm and diameter = 30 cm). In the pressurized suspended fiber biofilter, polypropylene fibers will be arranged to be suspended in the column. Two water rubber bags will be arranged on two side of the column, each with a capacity of 8 L. During the operation, the water bags will first be filled with water and compressed air will be supplied to the biofilter, which can be controlled by a mass-flow controller. A DO probe will be installed to monitor oxygen concentration in the biofilter. With the ongoing of the biofiltration and building up of the pressure, water will be withdrawn decrementally from the water bags to release the pore space and reduce the pressure. Organic decomposition and iron oxidizing will be monitored in the biofilter.

6. Discussion

Tim: How to monitor the microorganisms on the fiber of the biofilter?

We plan to quantify microorganisms in the biofilter based on organic decomposition using the Monod Equation. Eventually, the fiber will be sampled and microorganisms on the fiber will be quantified based on traditional culturing methods as well as ATP analysis. Furthermore, they will be identified using genetic methods (i.e., polymerase chain reaction).

Tim: Is oxygen addition required for suspended biofilter?

Oxygen is required. We expect biological contact oxidation can be achieved in the fiber biofilter. Therefore, oxygen will be added. But oxygen will be added in a controlled pattern.

Peter: Consider issues related to gas emission from landfills.

This may be a potential problem for leachare recirculation. A potential resistance of leachate recirculation may be encountered. We will take this into consideration for our design of the recirculation process.

Terak: What is the dimension of recirculation bioreactor? Any leachate generation from this reactor?

The custom-made recirculation bioreactor will have a working volume of 35 L with a height to diameter ratio of 1:1.66 (height = 50 cm and diameter = 30 cm). The reactor will be packed with solid waste that will be collected from the Leon County Landfill. After grinding and sieving (< 2 mm), the solid waste will be packed in the bioreactor. Within the bioreactor, a gas entrapment device is set up. We agree with the TAG member's concern that the leachate generation from this reactor may not reach the level of real leachate. Therefore, for this research, we will use leachate collected from the Leon County Landfill and recirculate it back to the bioreactor to simulate a scenario more close to the real landfill.

John: For the ultra-high lime with aluminum process and MAP precipitation, you may encounter a calcium precipitation problem.

For MAP precipitation, pH will be adjusted by lime so calcium is introduced. However, calcium is also required for chloride removal by the ultra-high lime with aluminum process, and subsequently, calcium precipitation may not be a major issue. But chloride removal and MAP precipitation may compete for OH^-. This is also the reason we include the correlation study of these two processes.

John: What is the range of phosphorous?

We expect to see the phosphorous content in the range from a few tens to a few hundreds. So they should be suitable for MAP precipitation without further phosphorous input. We realize that phosphorous may be a potential limiting factor for MAP precipitation.

Terak: Is recirculation a necessity?

We believe it is a necessity for leachate recirculation to reduce the organic and heavy metal loading for the following-up treatment processes. Dr. Debra Reinhart is currently conducting research on this topic. We will check with her to follow up their research and try to improve our design.

Tim: The scale issue of the recirculation bioreactor.

Since we will use leachate collected from the Leon County Landfill and recirculate it back to the bioreactor, we are able to simulate a scenario more close to the real landfill. We will consider up-scaling the bioreactor and compare the results.

Tim: Iron removal by abiotic oxidation in the fiber biofilter?

Just by abiotic oxidation and physical screening, iron removal cannot achieve the level we observe. In addition, we have observations of microbial growth on the filber. The only mechanism to achieve the removal level we observe is by biological contact oxidation, a microbial-mediated iron oxidation and adsorption process that can efficiently remove iron from the liquid phase.

Terak: For cost analysis, is it possible to promote a mobile treatment unit?

We have discussed this issue with John Hallas. It is possible. So whenever a treatment is required, the mobile treatment facility (i.e., hauled by a truck) can be relocated to the specific location. This is very beneficial for small landfills.