

# QUARTERLY PROGRESS REPORT

May 1, 2014 to July 31, 2014

**PROJECT TITLE:** Aerated Recirculation and Pressurized Suspended Fiber Biofiltration for the Treatment of Landfill Leachate

**PRINCIPAL INVESTIGATOR(S):** Gang Chen and Kamal Tawfiq

**AFFILIATION:** Department of Civil and Environmental Engineering, FAMU-FSU College of Engineering

**COMPLETION DATE:** May 1, 2014 to July 31, 2014    **PHONE NUMBER:** 850-4106303

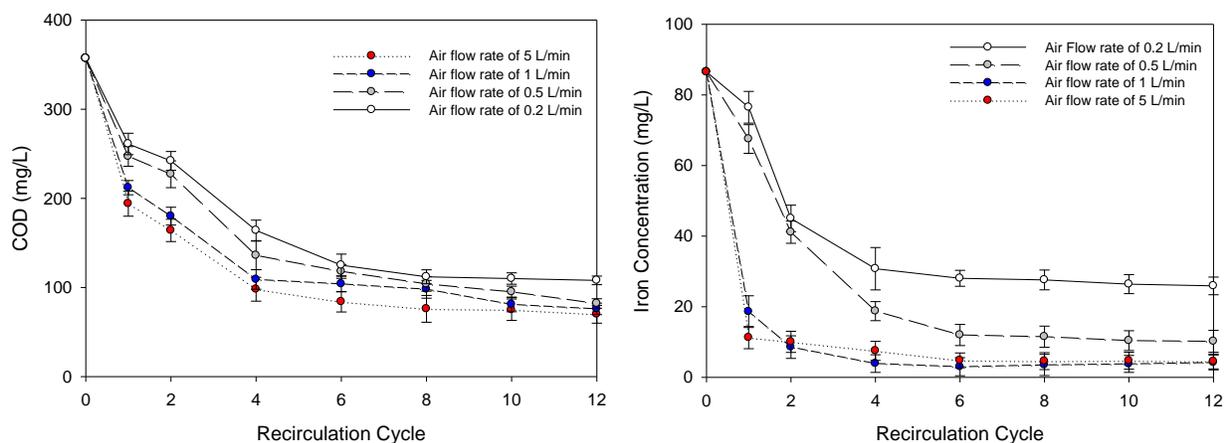
**PROJECT WEBSITE ADDRESS (URL):** <http://www.eng.fsu.edu/~gchen> (Biofilter)

**EMAIL ADDRESS:** [gchen@eng.fsu.edu](mailto:gchen@eng.fsu.edu); [tawfiq@eng.fsu.edu](mailto:tawfiq@eng.fsu.edu)

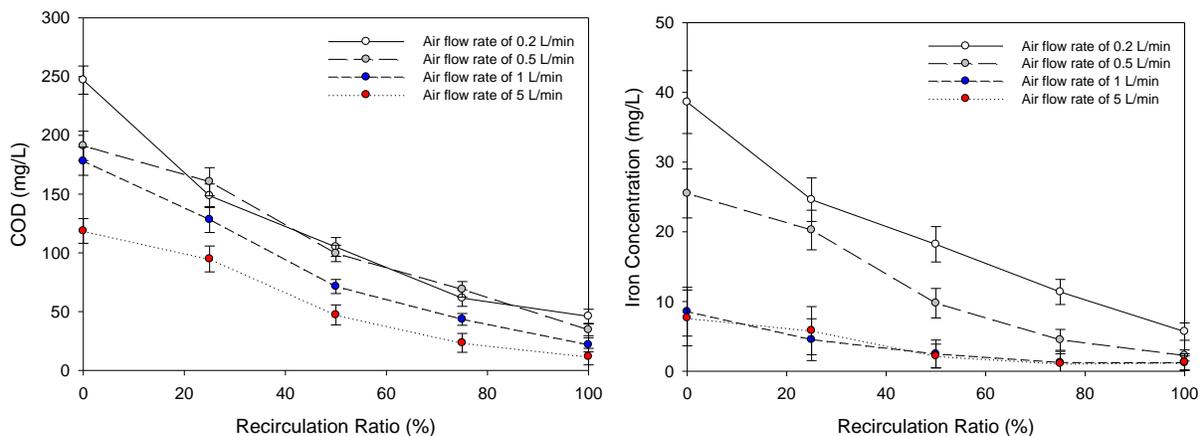
In this research, leachate from landfills in Northwest Florida is to be treated by aerated recirculation, MAP precipitation, ultra-high lime with aluminum process, and suspended fiber biofiltration. The suspended fiber biofilter is designed to be operated under pressurized aeration conditions to achieve biological contact oxidation, which can remove organic compounds and iron more efficiently. For this period time, the effects of recirculation cycle and aeration rate on COD and iron removal were investigated for landfill leachate.

## **Work Accomplished During This Reporting Period:**

Landfill leachate collected from the Leon County Landfill was aerated before being re-circulated to the recirculation reactor, after which an aliquot was introduced to the next treatment step and the other aliquot was aerated and re-circulated. The re-circulated leachate was aerated at an air flow rate of 0.2 L/min, 0.5 L/min, 1 L/min and 5 L/min for 15 min before being re-circulated to the reactor. For the recirculation ratio of 50%, the effect of recirculation cycle was investigated. Both COD and iron concentration were monitored for up to 12 recirculation cycles. A higher air flow rate resulted in better COD and iron removal (Figure 1). However, for iron removal, there was no further improvement with the increase of air flow rate once the air flow rate was greater than 1 L/min (Figure 1). This observation implied that air flow rate of 1 L/min was enough to oxidize ferrous iron in the leachate. Based on the experimental results, it was discovered that recirculation cycle had positive effect on COD and iron removal. After around 4 recirculation cycle, the effluent leachate quality became stable, i.e., no further COD and iron reduction was noticeable. At this stage, recirculation ratio was further studied. Specifically, recirculation ratio of 100%, 75%, 50%, 25% and 0% (with corresponding 0%, 25%, 50%, 75% and 100% added fresh leachate) was tested. Similarly, higher air flow rates resulted in better COD and iron removal for the same recirculation ratio (Figure 2).

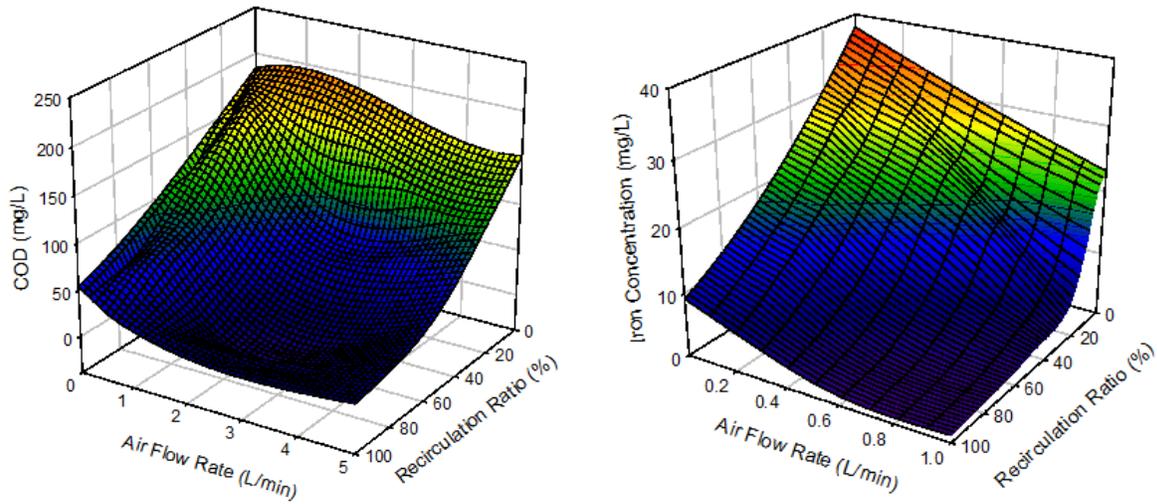


**Figure 1. COD and iron removal as a function of recirculation cycle**



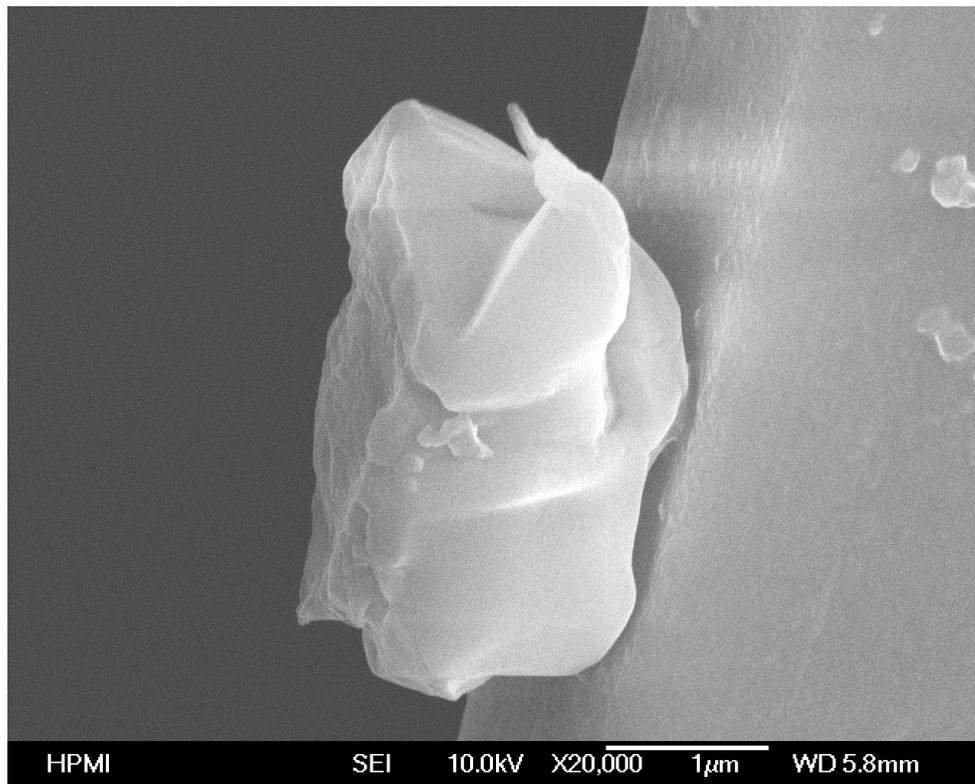
**Figure 2. COD and Iron removal as a function of recirculation ratio**

From the 3-D plot of COD and iron removal as a function of air flow rate and recirculation ratio, it can be observed that the effect of recirculation ratio on COD and iron removal was more pronounced at lower air flow rates and smaller recirculation ratios than those of higher air flow rates and greater recirculation ratios (Figure 3).



**Figure 3. 3-D plot of cod and iron removal as a function of recirculation ratio and air flow rate**

Using an Electronic Scanning Microscope, crystal structure of iron deposited on the polypropylene fiber in the pressurized biofilter was also captured (Figure 4).



**Figure 4. Crystal structure of iron deposited on polypropylene fiber**

Recirculation ratio and aeration rate on leachate treatment will be further investigated in the recirculation reactor. Impact of dissolved oxygen, alkalinity and pH on iron and organic removal within the pressurized biofilter will also be studied.

**Information Dissemination Activities:**

**Metrics:**

1. List graduate or postdoctoral researchers funded by this Hinkley Center project

Last name, first name	Rank	Department	Professor	Institution
WeijieXie	M.S.	Civil and Environmental Engineering	Gang Chen	Florida State University
Kien Vu	Ph.D.	Civil and Environmental Engineering	Gang Chen	Florida State University

2. List undergraduate researchers working on this Hinkley Center project

Last name, first name	Department	Professor	Institution
Emily Nabong	Civil and Environmental Engineering	Gang Chen	Florida State University

3. List research publications resulting from this Hinkley Center project

Wang, B., Tawfiq, K. and Chen, G. “Aerated Recirculation and Pressurized Suspended Fiber Biofiltration for the Treatment of Landfill Leachate”, Environ. Technol. To be submitted (2014).

4. List research presentations resulting from this Hinkley Center project

Lee, Y. and Chen, G. “Aerated Recirculation and Pressurized Suspended Fiber Biofiltration for the Treatment of Landfill Leachate”. 99th Annual American Society of Microbiology Southeastern Branch Conference, Auburn, AL. Nov 7, 2013.

5. How have the research results from this Hinkley Center project been leveraged to secure additional research funding?

“Advanced Oxidation, Recirculation and Pressurized Suspended Fiber Biofiltration for the Treatment of Landfill Leachate” by Gang Chen and Kamal Tawfiq has been submitted to Environmental Research and Education Foundation in response to Environmental Research and Education Foundation Issues Targeted Request for Proposals: High Need Topics in Solid Waste Research.

6. What new collaborations were initiated based on this Hinkley Center project?

We have initiated collaboration with John Hallas from Talquin Electric Cooperative, Inc. and Hafiz Ahmad from Florida State University at Panama City Campus from this research.

7. How have the results from this Hinkley Center funded project been used (not will be used) by the FDEP or other stakeholders? (1 paragraph maximum).

We share the results with FDEP through TAG members of Lee Martin, FDEP Subsection Manager, and Peter Grasel, who is in charge of Ground Water Modeling and Monitoring and Old Landfills. In addition, we discuss the results with Talquin Electric Cooperative, Inc., which operates seven wastewater treatment plants as well as Leon County Solid Waste Facility.

**TAG members:** Peter Grasel, Lee Martin, John Hallas, Brian Lee Moody, Tarek Abichou and Hafiz Ahmad

**TAG meetings:** First TAG meeting was held on January 24, 2014 at FAMU-FSU College of Engineering. The meeting minute will be available at [www.eng.fsu.edu/~gchen](http://www.eng.fsu.edu/~gchen). The second TAG meeting will be scheduled in August at FAMU-FSU College of Engineering.