QUARTERLY PROGRESS REPORT

March 1, 2012 to May 31, 2012

PROJECT TITLE: Usage of Microbial Fuel Cell Technology in Landfills. Year II. Enhanced Organic Compound Decomposition and Nitrogen Removal

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The purpose of this study is to design and test two continuous microbial fuel cell (MFC) reactors, i.e., an ammonium oxidation/MFC reactor and a MFC/Anammox reactor for power generation, organic compound decomposition, and nitrogen removal for landfill leachate. Specific objectives of this research include:

- Landfill leachate collected from landfills located in Northwest Florida will be treated in a laboratory scale continuous ammonium oxidation/MFC reactor, which is composed of an in-line nitrification column and a MFC reactor. Impact factors such as the organic load, retention time, pH, and alkalinity as well as nitrification reaction time will be investigated.
- Landfill leachate collected from landfills located in Northwest Florida will be treated in a laboratory scale continuous MFC/Anammox reactor. Besides factors impacting organic removal such as the organic load and retention time, factors that may impact the nitrite accumulation in the Anammox reaction such as the dissolved oxygen concentration and alkalinity will be explored. The MFC/Anammox reactor will be compared with the ammonium oxidation/MFC reactor in terms of power generation as well as organic compound decomposition and nitrogen removal.

WORK ACCOMPLISHED DURING THIS REPORTING PERIOD:

Power Generation and Landfill Leachate Treatment in MFC/Anammox Reactor

Power generation and landfill leachate treatment were tested in the MFC/Anammox reactor, in which Anammox was incorporated into the cathodic chamber (Figure 1). In the MFC reactor, a graphite rod, without catalyst coating, was used as the anode. The anode was inoculated with the cultured *S. putrefaciens*. For the cathodic chamber, carbon cloth (effective area of 12.6 cm^2, 30% wet proofing) was used as the cathode. The cathode was inoculated with *G. metallireducens*. The cathodic chamber was also inoculated with Anammox consortia. During the operation, collected landfill leachate was introduced to the anodic chamber for organic decomposition. The

operation proceeded in the absence of oxygen. The treated leachate was then introduced to cathodic chamber, where controlled low level oxygen was supplied.

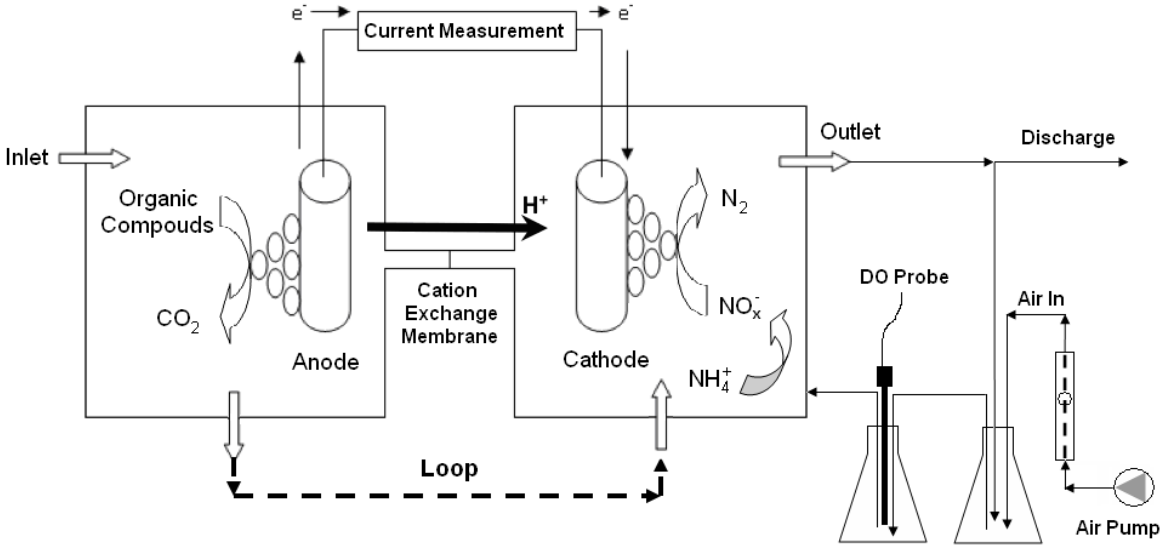

Figure 1. MFC/Anammox Reactor Setup

In the MFC/Anammox reactor, glucose and landfill leachate collected from Leon County Landfill were continuously supplied and uninterrupted power generation was observed (Figure 2). The input glucose was 250 mg/l (~ 266 mg/l COD). The landfill leachate was diluted to a BOD_5 value ~ 250 mg/l and total nitrogen of ~ 120 mg/l. Compared to the continuous ammonium oxidation/MFC reactor, the power generation from the MFC/Anammox reactor was a little bit higher for both glucose and landfill leachate.

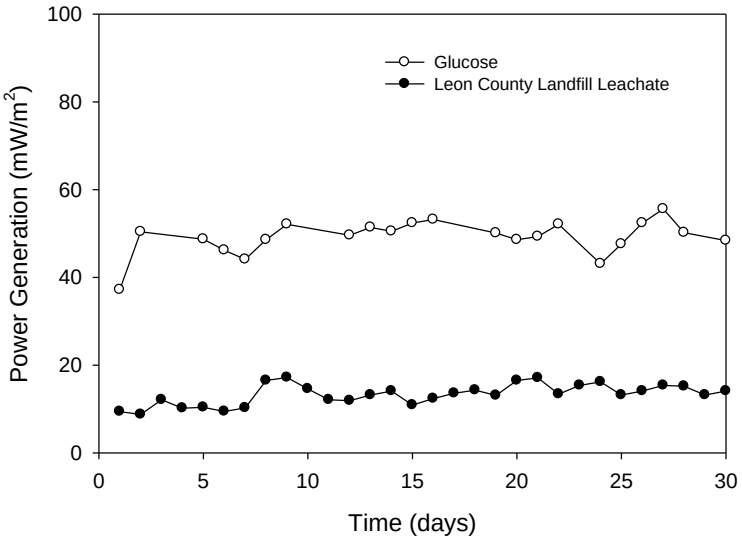

Figure 2. Power Generation of the MFC/Anammox Reactor

Ammonia removal was obvious for MFC/Anammox reactor. Similar as the ammonium oxidation/MFC reactor, around 90% of nitrogen was removed with an effluent N concentration around 10 mg/l (Figure 3).

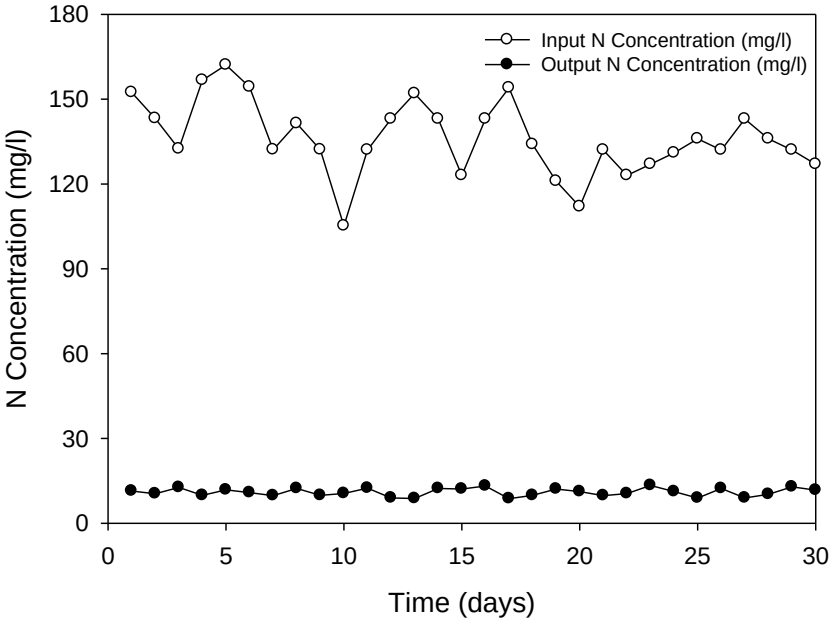

Figure 3. Nitrogen Removal of the MFC/Anammox Reactor

FUTURE WORK:
Impact factors such as the organic load, retention time, pH, and alkalinity will be investigated for both reactors. The two reactors will be compared in terms of power generation, organic compound decomposition, and nitrogen removal.

INFORMATION DISSEMINATION ACTIVITIES:
TAG members: Lee Martin, Peter Grasel, Clayton Clark, and Michael Watts

TAG meetings: Second TAG meeting will be held in July at FAMU-FSU College of Engineering. The meeting minute will be available at the project website after the TAG meeting.

A website has been created for this project (URL): www.eng.fsu.edu/~gchen (MFC Year II Details)

CONFERENCE PRESENTATION:
Subramaniam, P. K. and Chen, G., Ammonium Removal from Landfill Leachate through Anammox, 97th Annual ASM Southeastern Branch Conference, November, 2011.