QUARTERLY PROGRESS REPORT

December 1, 2011 to February 29, 2012

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

PRINCIPAL INVESTIGATOR(S): Gang Chen, Amy Chan Hilton and Kamal Tawfiq

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

COMPLETION DATE: December 1, 2011 to February 29, 2012

PHONE NUMBER: 850-4106303

PROJECT WEBSITE ADDRESS (URL):
http://www.eng.fsu.edu/~gchen/index_files/Page2301.htm

EMAIL ADDRESS: gchen@eng.fsu.edu; abchan@eng.fsu.edu; tawfiq@eng.fsu.edu

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 as well as organic compound decomposition and nitrogen removal from 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 Ammonium Oxidation/MFC Reactor

Power generation and landfill leachate treatment were tested in the ammonium oxidation/MFC reactor. The laboratory scale continuous ammonium oxidation/MFC reactor included an in-line ammonium oxidation column (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*. During the operation, collected landfill leachate was introduced to ammonium oxidation column for ammonium to be oxidized to nitrate, after which, the leachate was introduced to the anodic chamber for organic decomposition.

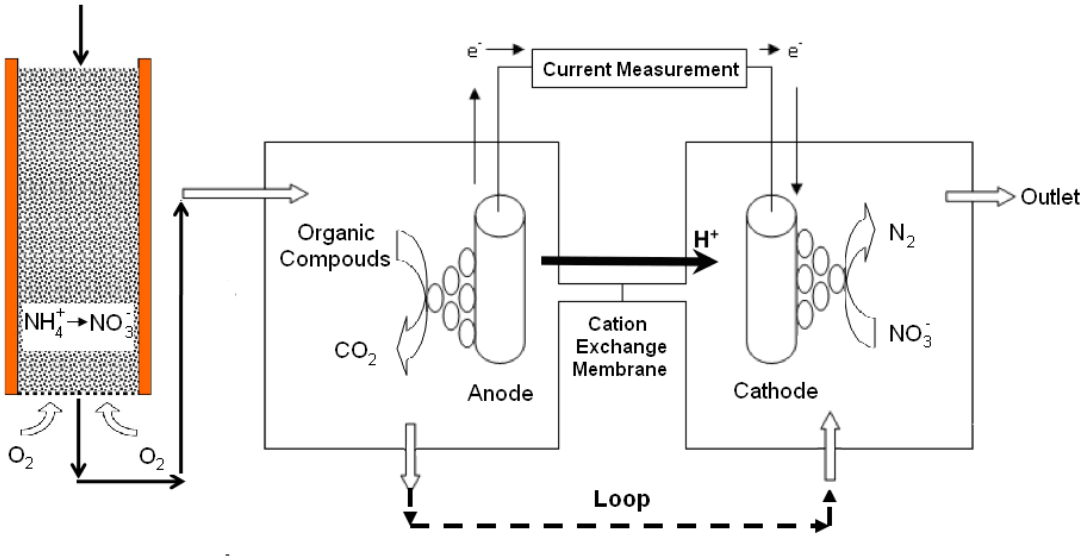

Figure 1. Ammonium Oxidation/MFC Reactor Setup

In the ammonium oxidation/MFC reactor, glucose or landfill leachate was continuously supplied and uninterrupted current was produced (Figure 2). The input glucose was 250 mg/l (~ 266 mg/l COD). Landfill leachate was diluted to a BOD_5 value ~ 250 mg/l and total nitrogen of ~ 120 mg/l. The power generation was low as compared with our previous MFCs. When glucose was used as the carbon source, the ammonium oxidation/MFC reactor only generated half of the power of our previous systems that was designed for organic decomposition only (~ 25 mW/m^2 versus ~50 mW/m^2). Less than 10 mW/m^2 of power was generated when landfill leachate collected from Leon County Landfill was used.

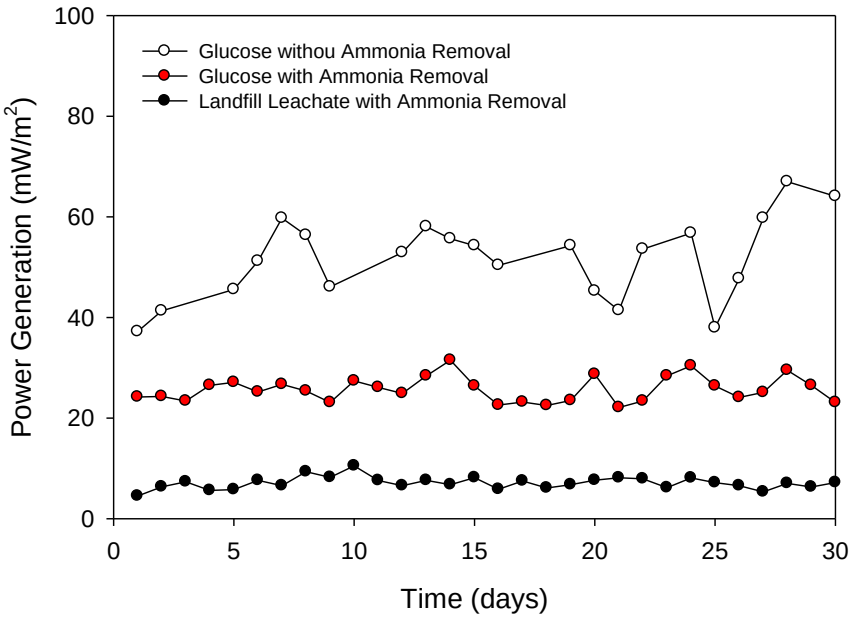

Figure 2. Power Generation of the Ammonium Oxidation/MFC Reactor

Ammonia removal was obvious for the ammonium oxidation/MFC reactor. With an input total N of ~ 120 mg/l, above 90% of nitrogen was removed with an effluent N concentration below 8 mg/l (Figure 3).

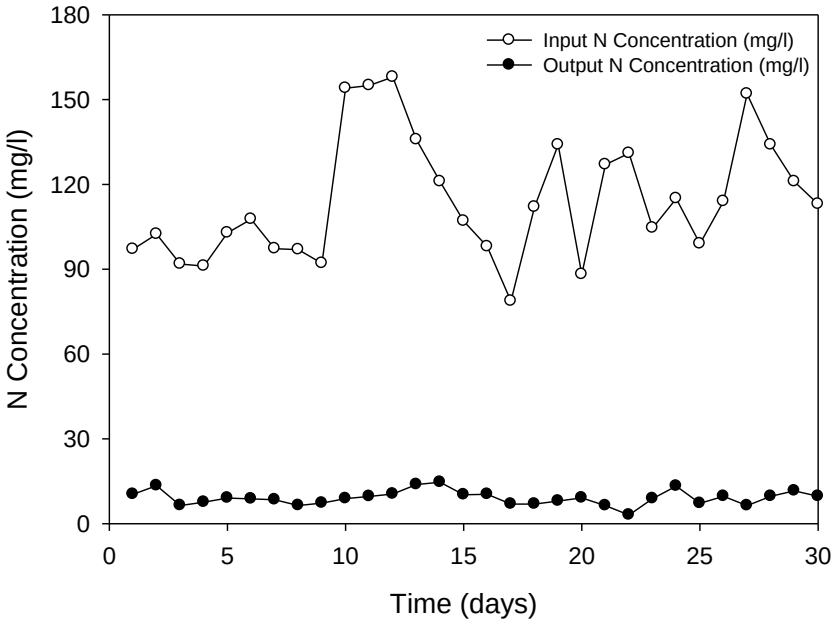

Figure 3. Nitrogen Removal of the Ammonium Oxidation/MFC Reactor

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

TAG meetings: First TAG meeting was held on January 27, 2011 at FAMU-FSU College of Engineering. The meeting minute will be available at www.eng.fsu.edu/~gchen.

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.