QUARTERLY PROGRESS REPORT

March 1, 2011 to May 31, 2011

PROJECT TITLE: Comparison of Onsite Biological and Physicochemical Systems for the Treatment of Landfill Leachate with High Ammonium Content

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The objective of this study is to compare onsite biological and physicochemical systems for the treatment of landfill leachate with high ammonium content. Laboratory scale anaerobic ammonium oxidation (Anammox) and magnesium ammonium phosphate (MAP) precipitation systems are set up for this research. Organic and ammonium removal efficiency as well as treatment cost for landfill leachate collected from landfills in Northwest Florida is compared for the Anammox and MAP precipitation processes.

WORK ACCOMPLISHED DURING THIS REPORTING PERIOD:

For this research period, we continued with the Anammox experiments. The laboratory scale anaerobic-partial nitrification-Anammox reactor consisted of three sequencing CSTR batch reactors (Figure 1). The first reactor was an anaerobic reactor. The second reactor was a partial nitrification reactor with a controlled oxygen supply device. These two reactors were continuously stirred by a magnetic stirring bar. The last reactor was an Anammox reactor. The key step for Anammox was to achieve partial nitrification and obtain stable nitrite accumulation. Depending on the alkalinity and available oxygen content, it was possible to convert a fraction or even the whole load of ammonium into nitrite. We performed leachate Anammox at alkalinity of 148 mg/l, 250 mg/l, 380 mg/l, 460 mg/l and 590 mg/l as calcium carbonate and dissolve oxygen concentrations of 0.03 mg/l, 0.06 mg/l, 0.12 mg/l, 0.15 mg/l, 0.19 mg/l, 0.30 mg/l, 0.40 mg/l, 0.50 mg/l and 0.60 mg/l, respectively.

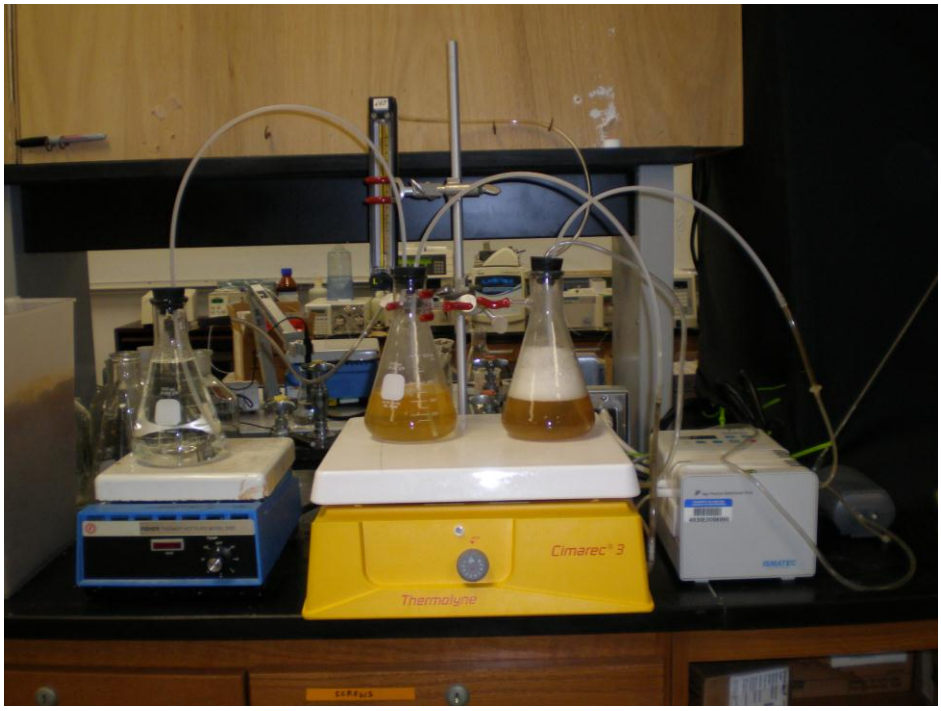

Figure 1. Anammox Experiment Setup

Nitrogen was observed to be produced during the Anammox experiment. As shown in Figure 2, nitrogen production was a function of both initial ammonium concentration and the solution alkalinity. With the increase of initial ammonium concentration, more nitrogen was produced.

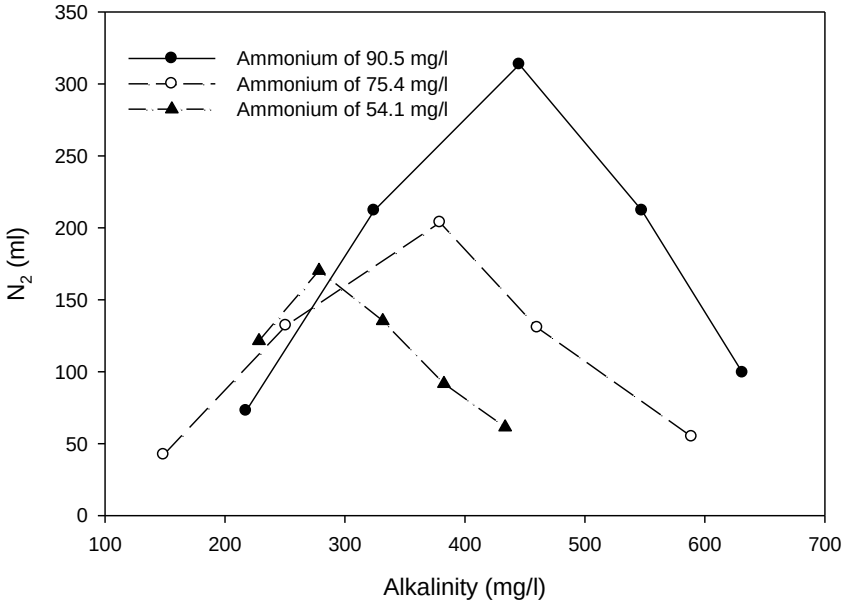

Figure 2. Nitrogen Production as a Function of Alkalinity

Initially, with the increase of solution alkalinity, nitrogen production increased. However, with the continuous increase of alkalinity, nitrogen production decreased. The optimal alkalinity was 280 mg/l, 378 mg/l and 445 mg/l as calcium carbonate corresponding to initial ammonium concentration of 54.1 mg/l, 75.4 mg/l and 90.5 mg/l, respectively.

Nitrogen production was also a function of dissolved oxygen (Figure 3). The effect of dissolved oxygen on the Anommax process or nitrogen production followed the same trend as that of alkalinity. The optimal dissolved oxygen was 0.12 mg/l, 0.14 mg/l and 0.15 mg/l corresponding to initial ammonium concentration of 54.1 mg/l, 75.4 mg/l and 90.5 mg/l, respectively.

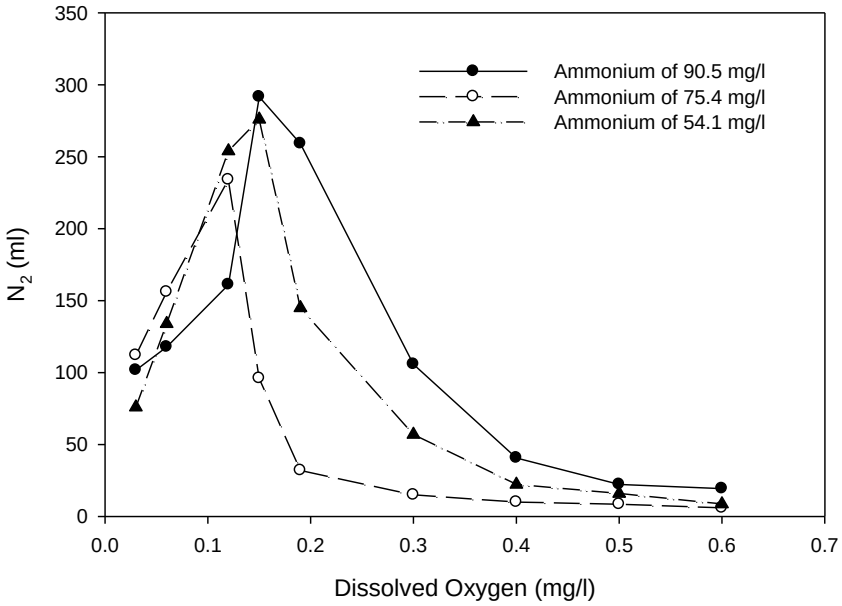

Figure 3. Nitrogen Production as a Function of Dissolved Oxygen

INFORMATION DISSEMINATION ACTIVITIES:
TAG members: Lee Martin, Peter Grasel, Michael Watts, Daniel Kuncicky and Michell Smith

TAG meetings: First TAG meeting was held on February 18, 2011 at FAMU-FSU College of Engineering. The meeting minute was available at www.eng.fsu.edu/~gchen. The second TAG meeting will be held in June, 2011.

A website has been created for this project (URL): www.eng.fsu.edu/~gchen (Landfill Leachate)

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