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

Tag Meeting No. 1

Thursday, May 4, 2017
11:30 am – 1:30 pm, Room Building A 127A

Project Title: Electromagnetic Wave-Induced Heavy Metal Removal for Dewatered Biosolids Composting
Tag Members: Joe Dertien, Owete Owete, Chen Lin, Hafiz Ahmad, and Matthew Hendrix
Principle Investigators: Gang Chen, Youneng Tang and Kamal Tawfiq
In Attendance: Chen Lin, Youneng Tang, Wester Henderson, Hongying Yuan, Hua Liu, Boya Wang, Runwei Li, Simeng Li, Zhiming Zhang, Yi Xiong, and Gang Chen. Owete Owete, Hafiz Ahmad and John Schert attended the meeting through Gotomeeting.

A website has been developed for this research (http://www.eng.famu.fsu.edu/~gchen/index_files/Page570.htm). All the information regarding this project has been uploaded to this site to facilitate the dissemination of the research discovery.

Agenda

1. Project Overview
Detailed information is available at
http://www.eng.famu.fsu.edu/~gchen/index_files/Page570.htm.

2. Experimental Design and Setup
The experimental setup consists of an acrylic box with a dimension of 40 cm × 40 cm × 50cm, inside which there is a 38 cm × 38 cm × 48 cm radio-frequency (RF) resonant cavity (Figure 1).

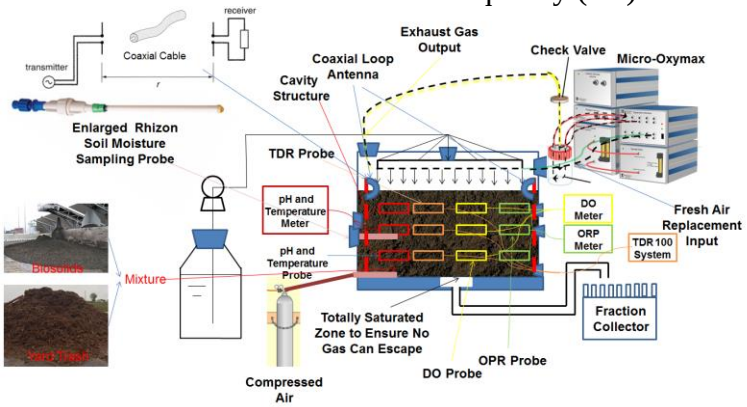

Figure 1. Experimental Setup

3. Research Plan

It is expected that biosolids can be efficiently composted with yard trash after heavy metal removal by means of electromagnetic applications. The impact factors that will be investigated are presented in Figure 2, which will include electromagnetic frequency, power (current density) and radiation pattern as well as C/N ratio.

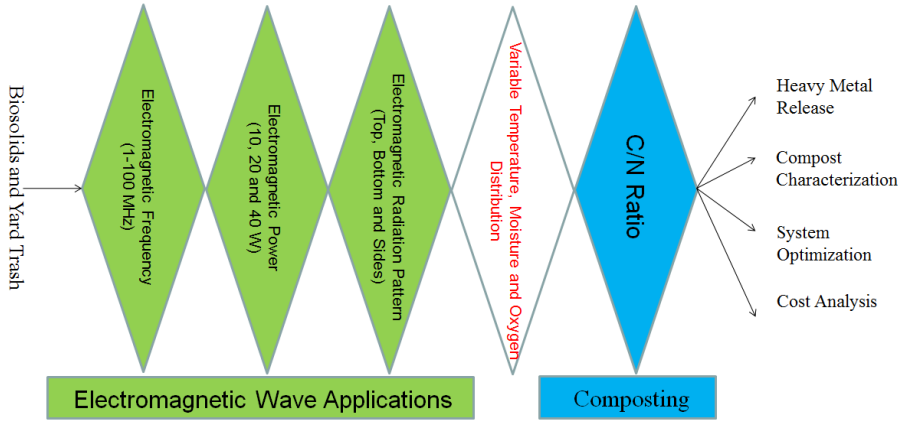

Figure 2. Expected Results with Corresponding Impact Factors to Be Investigated for Each Treatment Unit of This Research

4. Preliminary Data

5. Dissemination Plan for this Project

6. Potential Funding Sources for the Continuation of Related Research

— NSF/CBET/Environmental Engineering
— EREF

7. Discussion

7.1 The heavy metal contents in biosolids were discussed. In the biosolids collected from Thomas P. Smith Wastewater Reclamation Facility, only noticeable lead and copper were detected. Whether copper and zinc should be listed as “toxic metals” was discussed. According to USEPA, nine heavy metal pollutants commonly found in biosolids have been identified in Title 40 Part 503, including arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se) and zinc (Zn). Title 40 part 503 also describes regulations for land applications of biosolids.

Heavy metals in agricultural soil have adverse, either acute or chronic, toxic effects on the plants. For instance, the regulatory limit of cadmium (Cd) in agricultural soil is 100 mg/kg soil. Plant exposure to high levels of Cd causes reduction in photosynthesis, water uptake, and nutrient uptake. High levels of zinc (Zn) in soil inhibit many plant metabolic functions, resulting in retarded growth and causing senescence. Zn toxicity in plants also limits the growth of both root and shoot. Excess of copper (Cu) in soil plays a cytotoxic role, inducing stress and causing injury to plants. This leads to plant growth retardation and leaf chlorosis. High levels of mercury (Hg) are strongly phytotoxic to plant cells. Toxic levels of Hg can induce visible injuries and physiological disorders in plants. Lead (Pb) exerts adverse effects on morphology, growth and

photosynthetic processes of plants. High levels of Pb also cause inhibition of enzyme activities, water imbalance, alterations in membrane permeability and disturbs mineral nutrition. Excess of nickel (Ni) in soil causes various physiological alterations and diverse toxicity symptoms such as chlorosis and necrosis in different plant species, including rice. Plants grown in high Ni-containing soil show impairment of nutrient balance, which results in disorder of cell membrane functions.

Based on the discussion, the following tasks will be conducted:

- Sample other sewage treatment plants to obtain biosolids containing heavy metals that need to be removed. If no such biosolids can be found, biosolids will be spiked with heavy metals of interest.
- Survey soils that have been practiced biosolid applications to evaluate the heavy metal accumulation and long-term effects.
- Contact FDEP, Thomas P. Smith Wastewater Reclamation Facility and other agencies to see whether the data of heavy metals in biosolids are available.
- Survey major sewage treatment plants and identify the ways they handle biosolids.

7.2 Dissolved oxygen measurements by DO probes.

For the composting process, frequent turning is required. Subsequently, the gaseous phase oxygen content should be close to that of air, i.e., 21%. The dissolved oxygen measurement will be focused on the pore water oxygen content. Therefore, for dissolved oxygen measurements, pore water will be extracted and dissolved oxygen will be measured using a dissolved oxygen meter directly.

7.3 Heavy metal contents vary depending on the sampling time.

The following procedures may be followed to address this issue:

Sample in bulk and use the same sample for the research. At the same time, sample regularly and justify the heavy metal content variation in the report.