QUARTERLY PROGRESS REPORT

March 1 – May 31, 2011

PROJECT TITLE: *Sequential MBR-UV Treatment of Landfill Leachate*

PRINCIPAL INVESTIGATOR(S): Michael Watts*(mwatts@fsu.edu), Daniel Yeh(dhyeh@eng.usf.edu)**

AFFILIATION: *Dept. of Civil & Env. Engineering, Florida State University, **Dept. of Civil & Env. Engineering, University of South Florida

COMPLETION DATE: 8/31/2011 **PHONE NUMBER:** 850.410.6119

PROJECT WEBSITE ADDRESS (URL):
http://www.eng.fsu.edu/~wattsmi/UV_MBR/index.html

SCOPE OF WORK: The vast quantity of pharmaceuticals, personal-care products, and endocrine-disrupting compounds (EDCs) stored in municipal landfills poses a significant challenge to leachate-water quality. Advanced leachate treatment, utilizing combinations of biological, chemical, and physical water treatments, can be designed to protect groundwaters influenced by landfill-leachate, or provide reclaimed water for non-potable or agricultural purposes. The versatility and multiple barriers in advanced oxidation make it an attractive option for landfill leachate treatment. However, the rich concentration of leachate constituents which scatter or absorb light must be addressed with pre-treatment. A novel membrane bioreactor (MBR) system at USF, involving anaerobic biological process and ultrafiltration membranes, has been tested for removal of trace organic compounds and xenobiotic contaminants (17β-estradiol, a prevalent female hormone) from landfill leachate. This work seeks to apply state-of-the-art, advanced oxidation technology to assist MBR in removal of trace organic compounds.

CURRENT PROJECT PERIOD: While ozonation of raw leachate is not efficient/effective for direct oxidation of *xenobiotics* and endocrine-disrupting compounds, an advantage of pre-treating leachate with low mg/L-doses of ozone would be in accelerating the subsequent biological oxidation of these compounds. To test this hypothesis, raw leachate was spiked with 17β-estradiol (E2) and dosed with ozone solution up to 8 mg/L. The pre-treated samples were then inoculated with anaerobic sludge (50:50 sludge to leachate) and incubated in batch reactors with anaerobic conditions maintained (results in Quarterly Report 6). In all 3 pre-treatment conditions, raw, ozone, or *peroxone*, a significant sink of E2 was sorption to sludge solids. However, data trends indicated that by pre-treating leachate with an ozone-based advanced oxidation process, the anaerobic decomposition of E2 is accelerated (~1-log removal of E2 after 24 hrs).

In the current project period, extended incubation periods were selected to observe the fate of E2 in leachate samples for HRTs greater than 24 hours. The data presented in Figure 1 (below) is highlighted by the limited lifetime of aqueous E2. In addition, sorbed E2 is also biologically decomposed under anaerobic conditions.

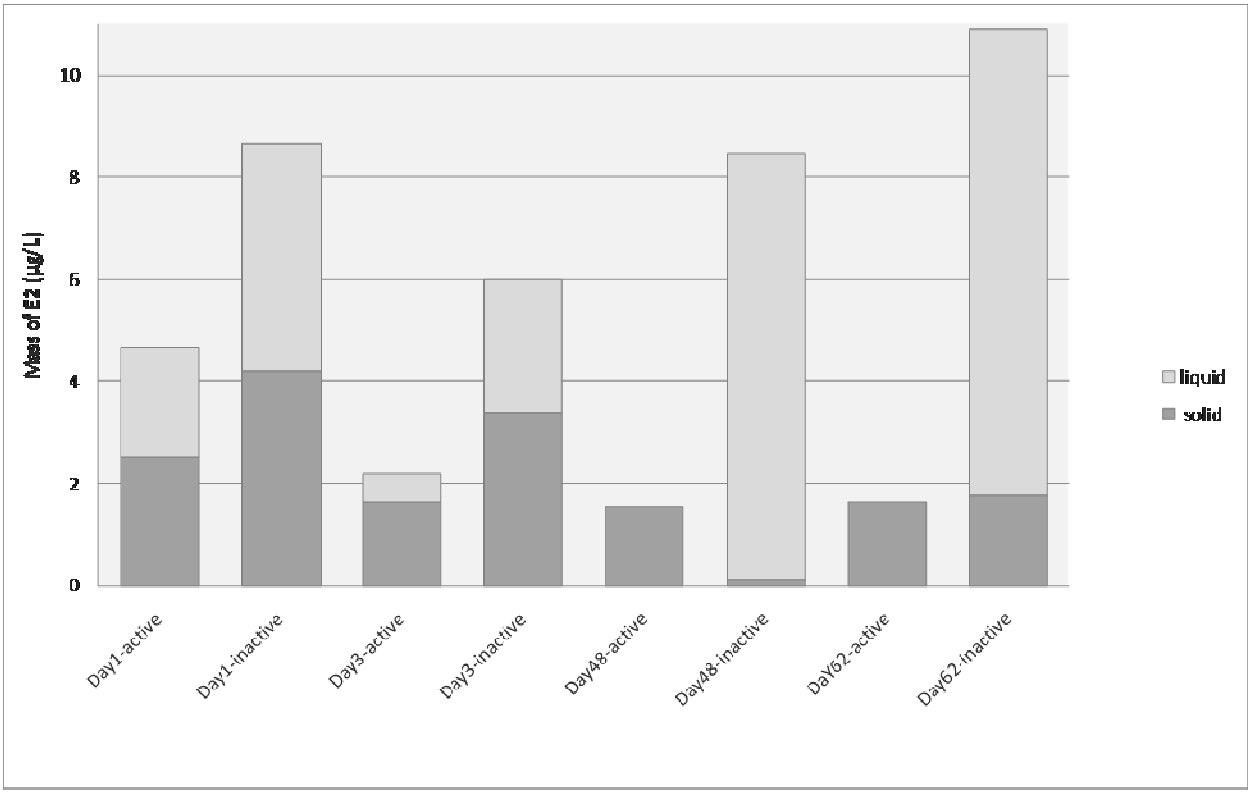

Figure 1 – Degradation of E2 in leachate under anaerobic conditions (batch) with extended incubation periods.

NEXT PROJECT PERIOD: Having established that a significant sink for E2 and BPA in anaerobic sludge systems is sorption to sludge, the project team will test another model anthropogenic leachate contaminant, the flame retardant tris-chloroethyl phosphate (TCEP). TCEP is highly water soluble, and slow to sorb to organic solids. In addition, previous collected data by the researchers has shown that it is resistant to direct ozonation. This will provide an additional opportunity to confirm the hypothesis that ozonation pre-treatments do little for direct oxidation of leachate contaminants but can accelerate their removal by biological treatment. In addition, this chlorinated organic leachate contaminant can elucidate potential dechlorination pathways provided by the O_3-anaerobic-MBR treatment schema.

TAG: Dr. Jeff Bandy (*Carollo Engineers*), Dr. Gang Chen (FSU), Dr. Daniel Kuncicky (FDEP), Hooshang Boostani (Hillsborough County), Allan Choate (Polk County), Dr. Ben Stanford (Hazen & Sawyer, P.C.).