QUARTERLY PROGRESS REPORT

September 1 – November 30, 2011

PROJECT TITLE: *Sequential MBR-UV Treatment of Landfill Leachate(Year 2)*

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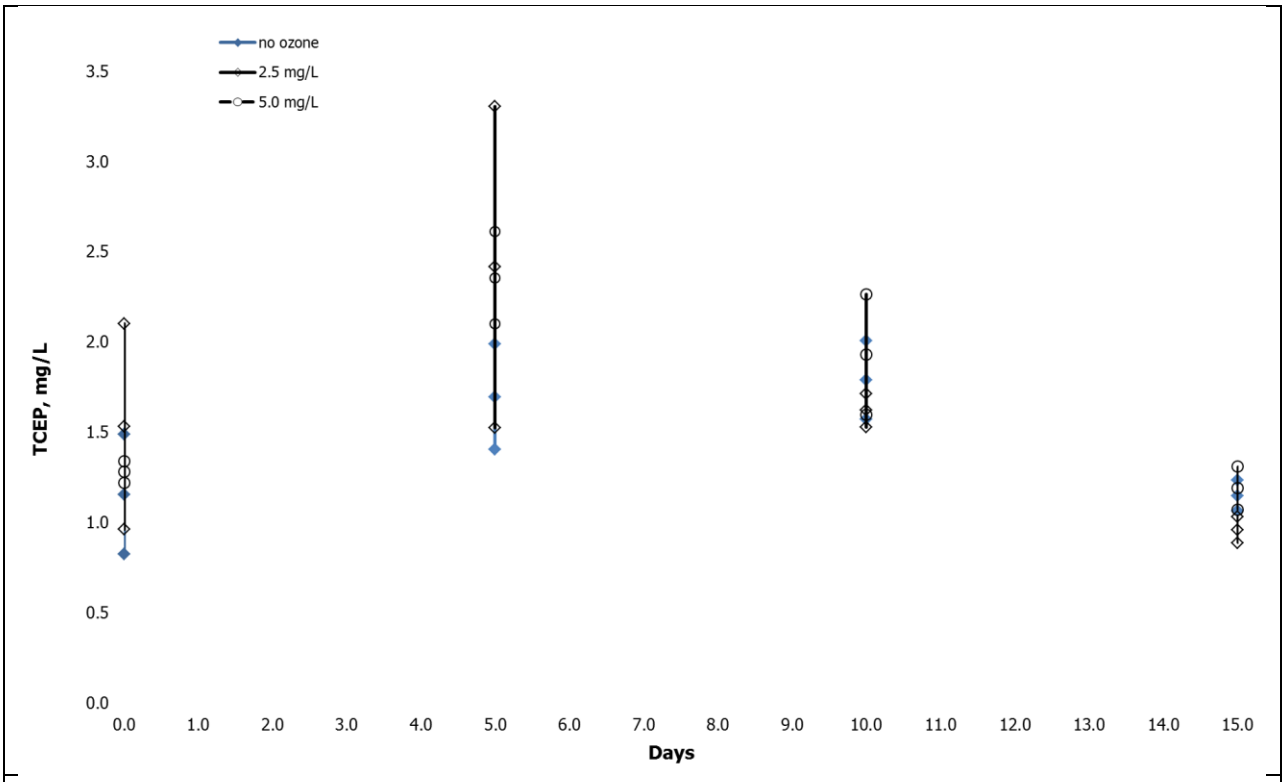
COMPLETION DATE: May 31, 2012 **PHONE NUMBER:** 850.410.6119

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: In this phase of work, samples of Leon County Landfill leachate, representing an 'old leachate', are spiked with target analytes (tris-2,butoxyethyl-phosphate (TBEP), trischloroethyl phosphate (TCEP), and 17β-estradiol (E2)), and treated with varying doses of either ozone or 'peroxone' (O_3 + H_2O_2) advanced oxidation. The max ozone dose is 8 mg/L, with all peroxone treatments receiving a spike of H_2O_2 at a molar ratio of 1.1:1 H_2O_2:O_3. The analyte concentrations are monitored at each stage of treatment with gas chromatography-mass spectrometry. Following advanced oxidation (1 – 2 seconds of contact with ozone was enough for complete dissipation of ozone residuals in the leachate samples), the oxidized samples were then mixed at 1:1 volumetric ratio with sampled anaerobic digester sludge from the T.P. Smith Municipal Wastewater Treatment Facility (Tallahassee, FL). The leachate-sludge mixture was then added to an aspiration bottle leaving 50% headspace (occupied by $N_{2(g)}$) and incubated for up to 15 days.


no ozone
2.5 mg/L
5.0 mg/L
TCEP, mg/L
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
1.0
2.0
3.0
4.0
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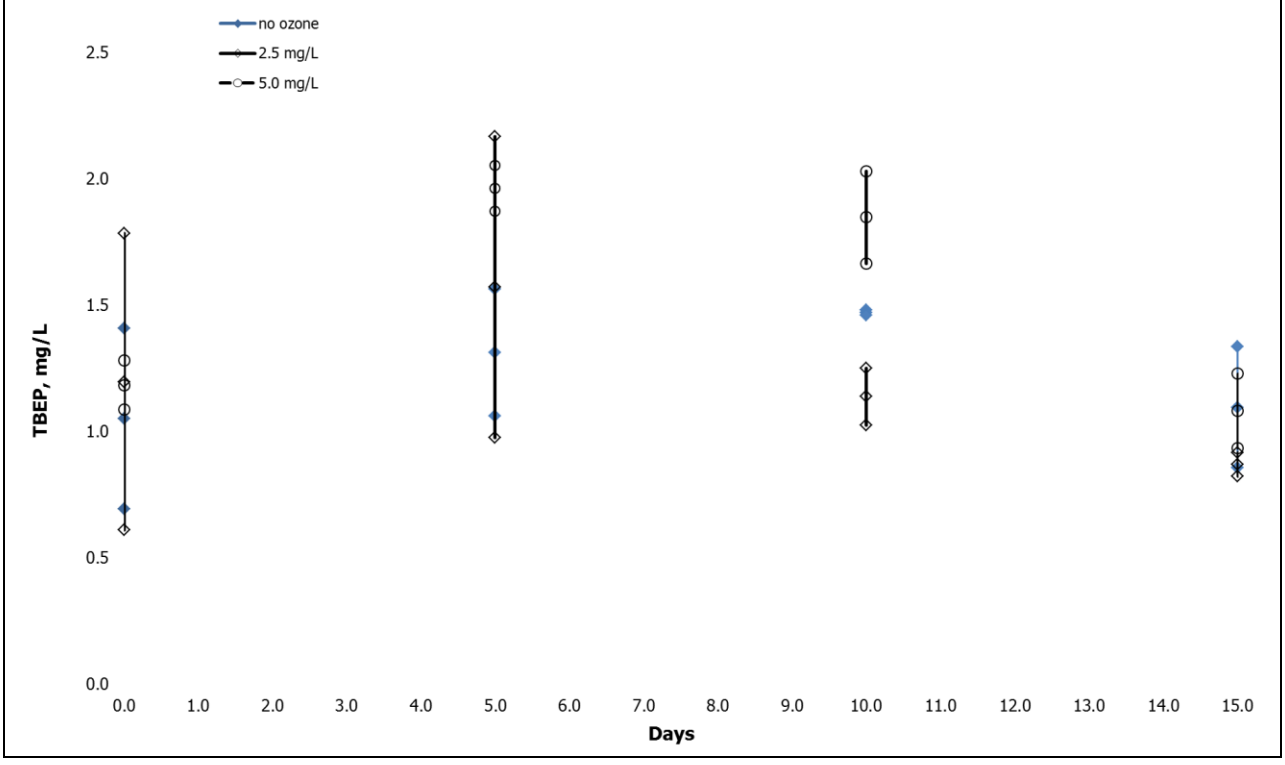
Days


no ozone
2.5 mg/L
5.0 mg/L
TBEP, mg/L
2.5
2.0
1.5
1.0
0.5
0.0
0.0
1.0
2.0
3.0
4.0
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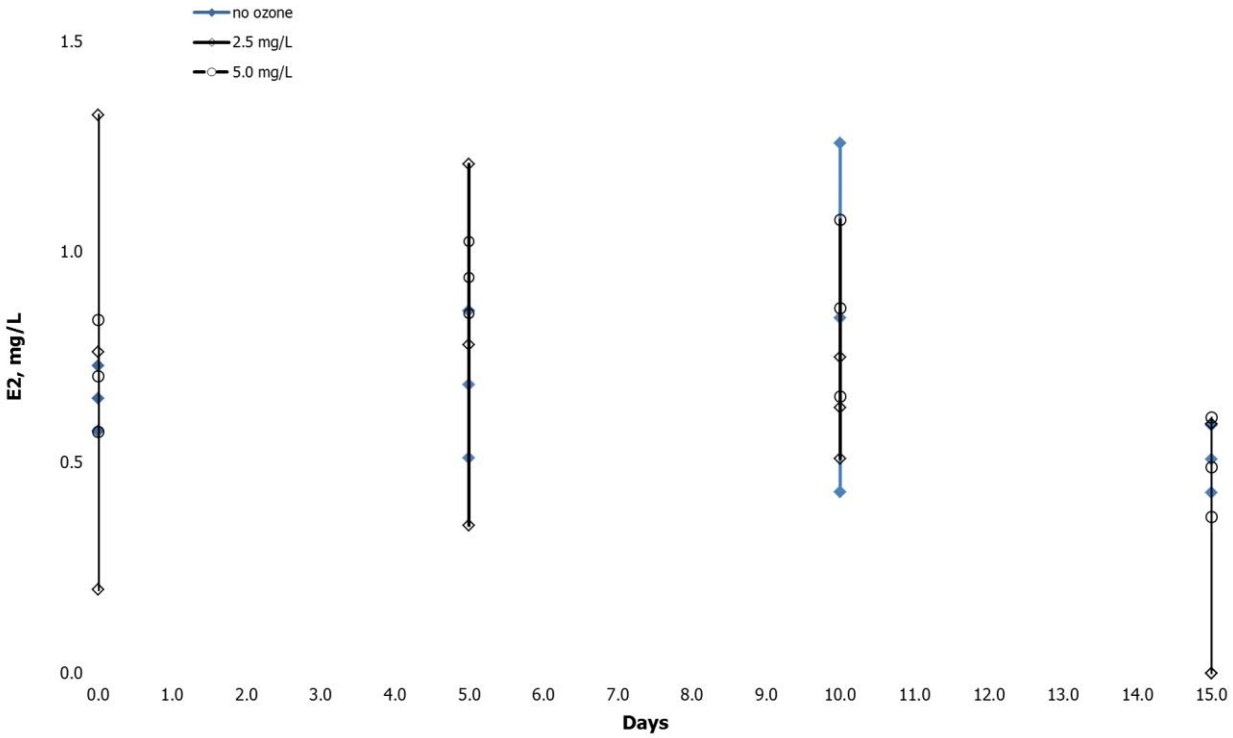

Figure 1 – TBEP, TCEP, and E2 concentrations in leachate-sludge mixture after anaerobic incubation. Leachate-sludge mixtures received varying amounts of pre-ozonation.

Only E2 was observed to decompose in the leachate-sludge mixture after 15 days. However, there is a significant degree of variance within the concentration measurements. The analyte extraction procedure has since been modified to reduce the level of sample noise, in the hopes of producing conclusive results.

NEXT PROJECT PERIOD: Evaluation of the advanced oxidation screening experiments will continue in Quarter No. 10. Samples are taken from the incubated aspiration bottles after 5, 10, and 15 days. The well-mixed sample is then processed via liquid-liquid extraction with a chlorinated solvent. The solvent phase is then analyzed for E2, TCEP, and TBEP. This sample plan allows for analysis of the 3 contaminants in the combined leachate-sludge phases.

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