FIRST QUARTERLY PROGRESS REPORTS

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PROJECT TITLE: Biodegradability Enhancement of Bioreactor Landfill Leachate with Fenton Processes

PRINCIPAL INVESTIGATOR: Walter Z. Tang, Ph.D., P.E.

AFFILIATION: Florida International University

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PHONE NUMBER: 305 348 3046

FAX NUMBER: 305 348 2802

Email: tangz@fiu.edu

INTRODUCTION

The Hinkley Center has provided critical support for exploring the concept of Bioreactor Landfills (BL) in the past two decades and nurtured the successful story of BL at the New River Regional Landfill (NRRL), in Union County, Florida. The leachate recirculation lead to accelerated waste degradation and landfill settlement; however, prolonged leachate recirculation causes the waste mass to reach its field capacity and at this stage landfill may not need any more leachate recirculation. Leachate characteristics also stabilize and the biodegradability of the leachate decreases significantly as BOD/COD ratio of leachate decreases to less than 0.10. The reduction in biodegradability reduces the effectiveness of leachate treatment using conventional biological processes and consequently increases the treatment cost. For example, in Miami-Dade County, leachate is treated at the wastewater treatment facility and causes the reclaiming wastewater treatment cost as high as $9 per gallon in 1 GDM pilot-scale water reuse plant. For the proposed 40 MGD full-scale water reuse plant, the unit cost will still be as high as $2 per gallon due to mixing of leachate with its domestic wastewater. To reduce the cost, Fenton treatment of leachate before it is mixed with the domestic wastewater may offer a great solution to this challenging problem. The current project will study the Fenton oxidation of leachate as pre-treatment to increase biodegradability of leachate for BL. Results of the study will help obtain optimal cost-effective conditions to be used for leachate treatment using Fenton oxidation.

WORK COMPLETED THIS QUARTER

As scheduled in the proposal, peer-reviewed literature was studied and potential gaps in the leachate treatment using Fenton oxidation were evaluated. The peer-reviewed literature collected is listed in Appendix-A. The important missing piece of information observed during literature review was the optimal conditions for Fenton process. The chemical complexity of leachate makes it more challenging to determine optimal chemical (Fe^{2+}/H_2O_2) doses, pH conditions, and organic removal efficiency. Additionally, effectiveness of alternative oxidizing hydroxyl radical generating agent calcium peroxide ($CaO_2(s)$) as compare to directly using H_2O_2 for leachate treatment has also not been investigated.

Calcium peroxide may provide a more cost-effective sustainable Fenton oxidation process for leachate treatment, which rapidly generates H_2O_2 at the near neutral pH (pH: 6 to 7) conditions.

CONTINUED WORK: QUARTER TWO

Literature review will be continued in the next quarter as well. Laboratory study will also be started by characterizing the landfill leachate collected from Miami-Dade South Solid Waste Landfill. Fenton oxidation experiments will be conducted to determine the effect of H_2O_2, Fe^{2+}, and pH on the COD removal efficiency of Fenton process. The obtained results will be submitted in the second quarterly report and will be presented at the technical advisory group (TAG) meeting. A joint TAG meeting with Dr. Debra Reinhart of University of Central Florida has been scheduled for February 10, 2012 at Florida International University.

TAG Members

Walter Z. Tang, Associate Professor in CEE at FIU, 786-350-0933, tangz@fiu.edu

Shrawan Singh, Ph.D., Post-Doctor in CEE at FIU, 603-502-1842

Georgio Tachiev, Ph.D. P.E., Program Manager, ARC at FIU, Miami, FL 33174, 305-348-6732 (O), 305-632-9386 (cell)

James Ferguson, P.E., Miami-Dade Water and Sewer Department, 786-268-5775, JFERG@miamidade.gov

Debra Reinhart, PhD, PE, BCEE, Pegasus Professor Assistant VP for Research, MH 243, University of Central Florida, Orlando, FL 32816, 407-823-2315

Stephanie C. Bolyard, EPI, Graduate Research Assistant, Civil, Environmental, and Construction Engineering, University of Central Florida, 4000 Central Florida Blvd. Eng. I Room 340, Orlando, Florida, 32816, 727-505-9770, Stephanie.Bolyard@ucf.edu

Appendix-A

Peer-reviewed Literature Collected

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