SUMMARY:
MANAGEMENT SOLUTIONS FOR LEACHATE BIOGEOCHEMICAL CLOGGING

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In 2018, the Bill Hinkley Center for Solid and Hazardous Waste Management funded a followup study to continue work on leachate clogging control technologies and understanding of leachate clogging mechanisms. Clogging of leachate collection systems can cause potentially catastrophic failures in landfill operation. The primary cause of clogging is calcium carbonate precipitation, which forms inside the pipe around a nucleus of silt, sand, microbial colonies, or other particles, although the trigger mechanism is not well understood. Over the past 4 years, FAU Laboratories for Engineered Environmental Solutions (Lab.EES) has teamed up with University of Florida and the Solid Waste Authority of Palm Beach County to conduct scientific studies on possible strategic solutions to combat biogeochemical rocking in the leachate collection system (LCS) including dilution, acid addition, and carbon dioxide offgassing. This research is needed to identify the best preventative measures and removal techniques to keep leachate collection systems clear of clogging.

Several ideas for dealing with preventative maintenance in the LCS have been proposed. These include 1) leachate dilution with ambient groundwater from the interceptor well system or other sources of fresh water, 2) acid addition, 3) disinfection, and 4) air stripping technologies. As landfills continue to expand, new cells and LCS components will be installed. It may be helpful to consider design changes for future cells that would allow for more comprehensive scale control measures such as the ability to introduce acid, dilution water, pressurized jets, or antiscalants directly into the laterals near the center of the landfill, where leachate first collects. Other engineering modifications could include utilizing shorter distances between manholes and steeper slopes for the LCS laterals or pressurizing the collection system at each header rather than relying on the use of gravity.

The objective of this study will be to determine the impacts of varying the flow regime in leachate collection pipes, applying disinfection to eliminate biofilms, and adjusting the pH to mobilize mineral deposits to determine if any of these preventative measures will negatively impact downstream disposal.

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PROGRESS REPORT
(December 2018)

Project Title: MANAGEMENT SOLUTIONS FOR LEACHATE BIOGEOCHEMICAL CLOGGING
Principal Investigator: Daniel E. Meeroff, Ph.D.
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Project website: http://labees.civil.fau.edu/leachate.html
Student: Bishow Shaha, Ph.D. Candidate

Methodology/Scientific Approach

TASK 1. Determine impacts of flow regime. FAU will conduct biweekly sampling and water quality monitoring of leachate from critical locations at the SWA facility, as required. FAU will perform a leachate bleed test using a side-by-side leachate test loop developed for a previous project, with the goal of collecting solids in the y-strainer and the spool piece to analyze using XRD/XRF analysis and microscopy. To investigate the role of flushing, several different volumes of dilution water at different flow depth/Reynold's numbers will be tested against water quality impacts (for pH, alkalinity, calcium, total dissolved solids, temperature, sulfides and sulfates to determine LSI/RI) and solids characteristics. FAU will model the water quality impacts of dilution with alternative sources other than local groundwater to achieve the goal of minimizing clogging in the gravity collection system and the deep injection well.

TASK 2. Determine impacts of biological activity trigger mechanisms. To investigate the role of biological activity, the effect of disinfection will be tested against water quality impacts (for pH, alkalinity, calcium, total dissolved solids, temperature, sulfides and sulfates to determine LSI/RI), heterotrophic plate counts and microscopic morphological analysis, and solids characteristics. FAU will also perform a laboratory test to compare disinfected leachate and controls with respect to solids analysis and water quality impacts.

TASK 3. Determine impacts of pH adjustment for precipitation control. To investigate pH adjustment impacts on scale prevention, FAU will conduct laboratory experiments for extended duration times with carbon dioxide addition to determine the water quality impacts (for pH, alkalinity, calcium, total dissolved solids, temperature, sulfides and sulfates to determine LSI/RI and buffering capacity) and solids characteristics. These experiments will also be repeated with a nitrogen gas control and a landfill gas mix (50% methane, 15% carbon dioxide, 35% nitrogen). FAU will perform a leachate field test using the side-by-side leachate test loop with the goal of collecting solids in the y-strainer and the spool piece to analyze using XRD/XRF analysis and microscopy. An acid/antiscalant/CO_2 addition chemical feed pump unit is already installed to meter the different doses of additive for this experiment. The goal is to provide guidance on how to operate an acid injection system for maximum scaling control.

TASK 4. Determine downstream impacts to leachate disposal. Using the data developed in Tasks 1-3, an assessment will be conducted to evaluate the impacts to ultimate disposal of

leachate. FAU will monitor the flows and loadings (key water quality parameters and solids) going to the deep injection wells based on monthly flow reports provided by SWA.

TASK 5. Develop final recommendations and prepare publication materials. Interim and final reports will be developed and submitted. A plan will be developed for follow-up work based on comments from reviews. Furthermore, a scholarly publication will be developed, including but not limited to, a poster and a conference paper.

Upcoming Research Tasks

TASK 1. Determine impacts of flow regime. FAU will continue biweekly sampling and water quality monitoring of leachate, leachate bleed test using the onsite test pipe network.

TASK 2. Determine impacts of biological activity trigger mechanisms. FAU will heat sterilize the leachate to identify the impacts of microbes in clogging.

TASK 3. Determine impacts of pH adjustment for precipitation control. FAU will conduct laboratory experiments for extended duration times with carbon dioxide addition to determine the water quality impacts.

TASK 4. Determine downstream impacts to leachate disposal. Using the data developed in Tasks 1-3, FAU will evaluate the impacts to ultimate disposal of leachate.

TASK 5. Develop final recommendations and prepare publication materials. Interim and final reports will be developed and submitted .

PROJECT METRICS:

1. List graduate or postdoctoral researchers **funded** by **THIS** Hinkley Center project.

Last name, first name	Rank	Department	Professor	Institution
Shaha, Bishow	Ph.D. Candidate	CEGE	Meeroff	FAU

2. List undergraduate researchers working on **THIS** Hinkley Center project.

Last name, first name	Department	Professor	Institution

3. List research publications resulting from **THIS** Hinkley Center project.

None yet

4. List research presentations resulting from **THIS** Hinkley Center project

None yet

5. List research papers that have cited any publications (or the final report) resulting from this Hinkley Center project (use format for publications as indicated in the Hinkley Center Investigators Guide).

None so far

6. List additional research funding that has been secured due to leveraging the research results from this Hinkley Center project (give project title, funding agency, amount of funding, award date, and award period)

"Investigation of Leachate Management Solutions at the Solid Waste Authority of Palm Beach County (Year III)," Solid Waste Authority of Palm Beach County, $32,500, 10/1-2018 – 09/30/2019.

7. List submitted proposals which leverage the research results from this Hinkley Center project (give the proposal title, funding agency, requested funding, date submitted)

None yet

8. List new collaborations initiated based on this Hinkley Center project

None yet

9. How have the results from this Hinkley Center funded project been used (not will be used) by the FDEP or other stakeholders in the solid waste field? Please note that the term “other stakeholders” is meant to broadly include any party or practitioner in the solid waste field. This includes county solid waste directors and their staff, municipal solid waste directors and their staff, solid waste facility design engineers, local/county/city solid waste management regulatory staff, federal solid waste regulatory staff, landfill owners and operators, waste haulers, waste to energy plant owners and operators, recyclers, composting plant owners and operators, yard waste operators, construction and demolition debris companies and organizations, county recycling coordinators, citizens and members of the academic community, etc. (1 paragraph maximum)

To date, the results have not been used by stakeholders yet.

TAG members:

Mark Eyeington, Mark Maclean, Mark Bruner, Owrang Kashef, D.V. Reddy, Craig Ash, Ravi Kadambala, Ron Schultz, Jeff Roccapriore, André McBarnette, Dan Schauer, Damaris Lugo, Amanda Krupa, Richard Meyers, Amede Dimonnay, Art Torvela, Ted Batkin

TAG meetings:

October 19, 2018 (Joint TAG meeting held at SWA in conjunction with UM)