Impact of Landfill Leachate on Iron Release from Northwest Florida Iron Rich Soils

Gang Chen, Tarek Abichou , and Jeffrey Chanton

Department of Civil and Environmental Engineering
FAMU-FSU College of Engineering
Department of Oceanography
Florida State University

Florida A & M University

Florida State University

Iron Release in NW Florida

Central Landfill
Walton County

Fairgrounds Branch below
Auto Shred Landfill

Visible Iron Release near Landfills

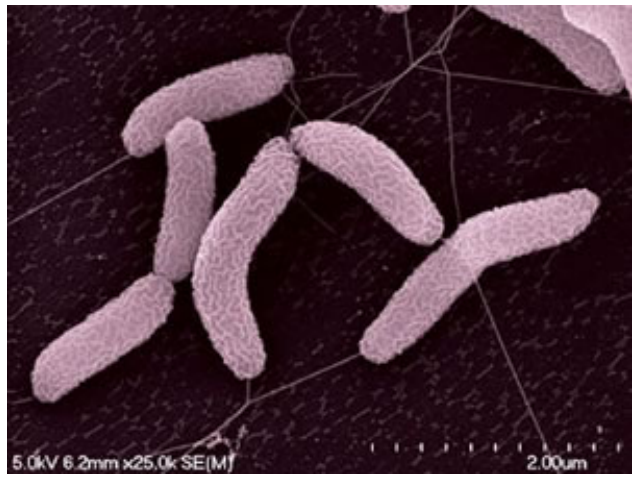
Florida A & M University

Florida State University

Roles of Microorganisms in Iron Release

NW Florida Iron Rich Soil

Carbon and Nutrient Sources



Microorganisms

Iron/Sulfur Bacteria Growth from Unlined Landfills

Florida A & M University

Florida State University

Objectives

- To provide evidence iron can be released from the iron-rich soil

- To quantify the iron release processes

Outline

- Soil sampling
- Batch experiments
- Results
- Future work
  - Column experiments
  - Soil iron quantification

Iron-Reducing Bacteria

Shewanella oneidensis **strain MR-1 growing on the surface of the iron oxide mineral hematite**

- **Iron-reducing bacteria to reduce iron oxides to ferrous iron**
- ***Shewanella oneidensis*** **strain MR-1 to conserve energy for growth with the structure Fe(III) bound in smectite clay**
- **Most of the iron on earth in the form of silicate minerals or iron oxides**

$$CH_2O + 2Fe_2O_3 + 3H_2O = CO_2 + 4Fe^{2+} + 8OH^-$$

Florida A & M University

Florida State University

Anaerobic Culture Cultivation

- Sampled soil as base consortium
- Under anaerobic conditions
- Teflon-sealed container equipped with CO_2 entrapping devices
- Mineral salts media
- Glucose as carbon source
- In the presence of simulated leachate and $Fe_2(SO_4)_3 \cdot 7H_2O$

Anaerobic Bacteria Culturing

Leon County Landfill

Florida A & M University

Florida State University

Laboratory Experiments

Leon County
Landfill Soil

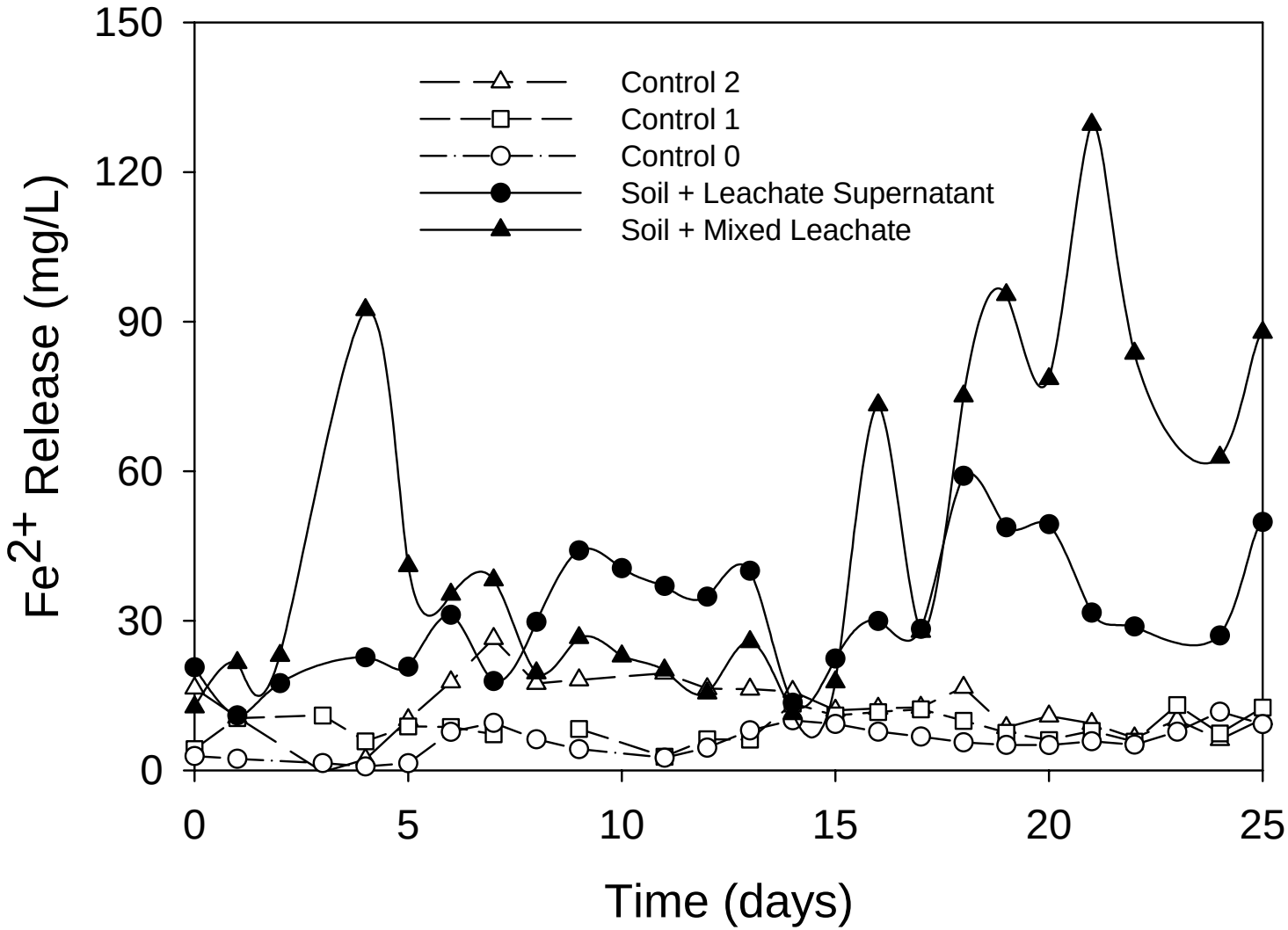
Iron Reducing Bacteria

Artificial Leachate

Florida A & M University

Florida State University

Laboratory Experiment Results



Florida A & M University

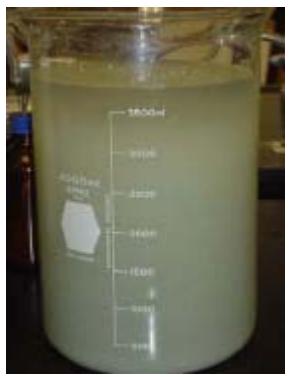
Florida State University

Low Iron Content Soil Sample

Laboratory Experiments

Low Iron Content Soil

Iron Reducing Bacteria

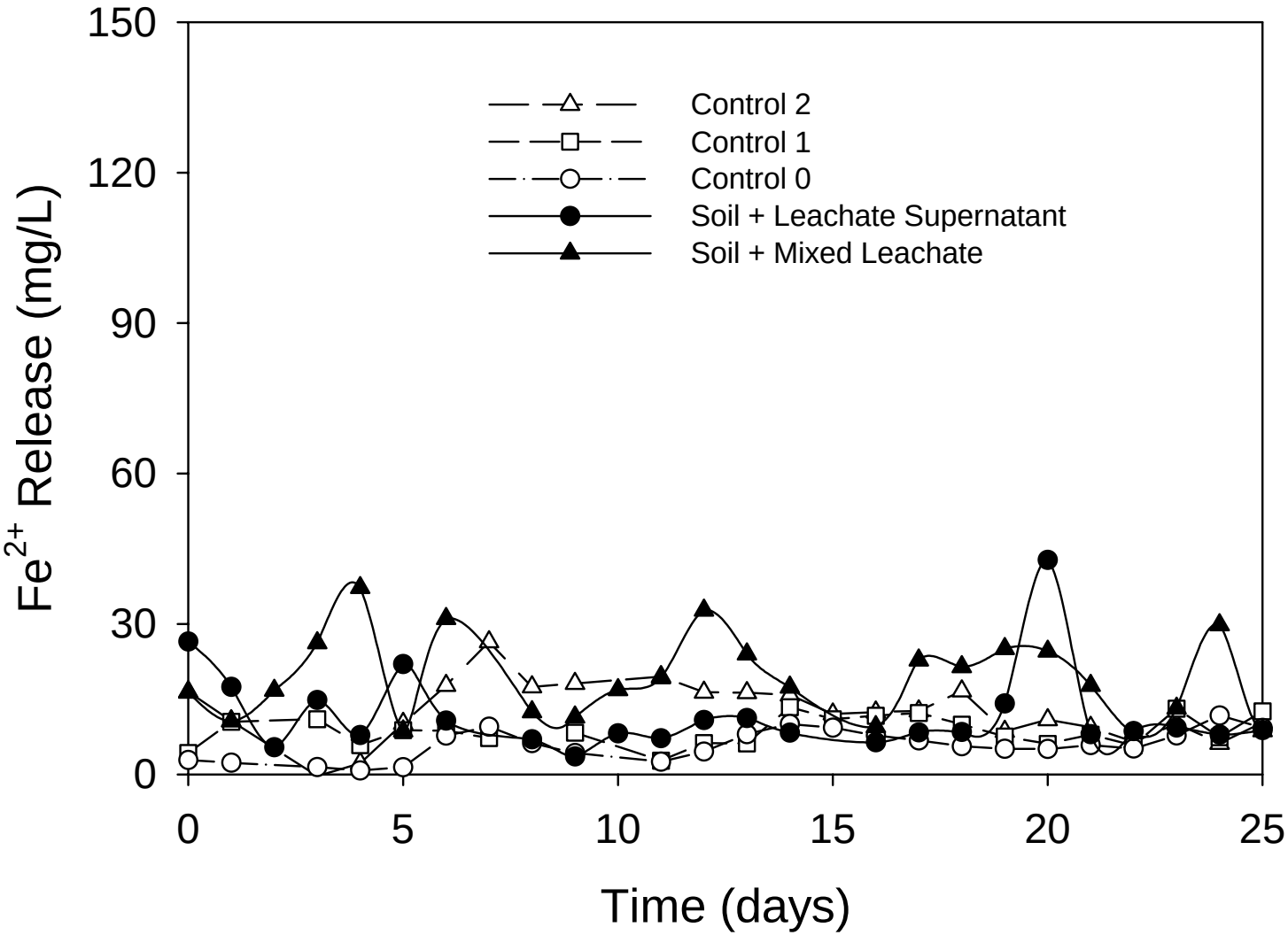


Artificial Leachate

Florida A & M University

Florida State University

Laboratory Experiment Results



Florida A & M University

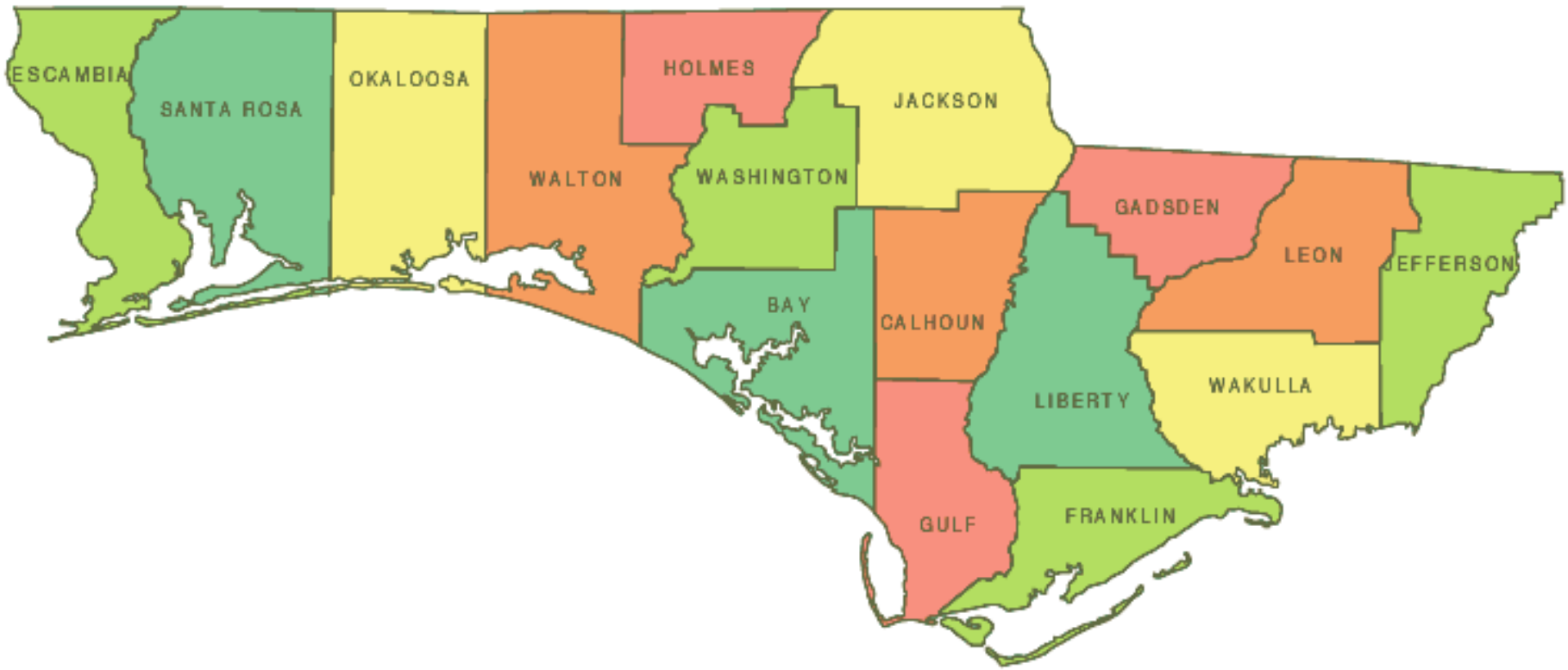
Florida State University

Soil and Leachate Sampling

Soil and leachate sampled from following landfills:

Landfill	County
Steelfield Landfill	Bay
Perdido Landfill	Escambia
Franklin County Central Landfill	Franklin
Quincy Byrd Landfill	Gadsden
Five Points Landfill	Gulf
Holmes County Landfill	Holmes
Springhill Regional Landfill	Jackson
Leon County Solid Waste Mgmt Facility	Leon
Wright Landfill	Okaloosa
Holley Navarre Landfill	Santa Rosa
Santa Rosa Central Landfill	Santa Rosa
Lower Bridge Landfill	Wakulla
Walton County Central Landfill	Walton

Representing NW Florida



Florida A & M University

Florida State University

Santa Rosa Central Landfill

Florida A & M University

Florida State University

Perdido Landfill

Soil Sampling

Santa Rosa Central Landfill

Holmes County Landfill

Soil Sampling

Franklin County Central

Steelfield Landfill, Bay County

Florida A & M University

Florida State University

Soil Sampling

Spring Hill South landfill
Jackson County

Leon County Landfill

Florida A & M University

Florida State University

Batch Experiments

Fe^{2+} O_2 Content

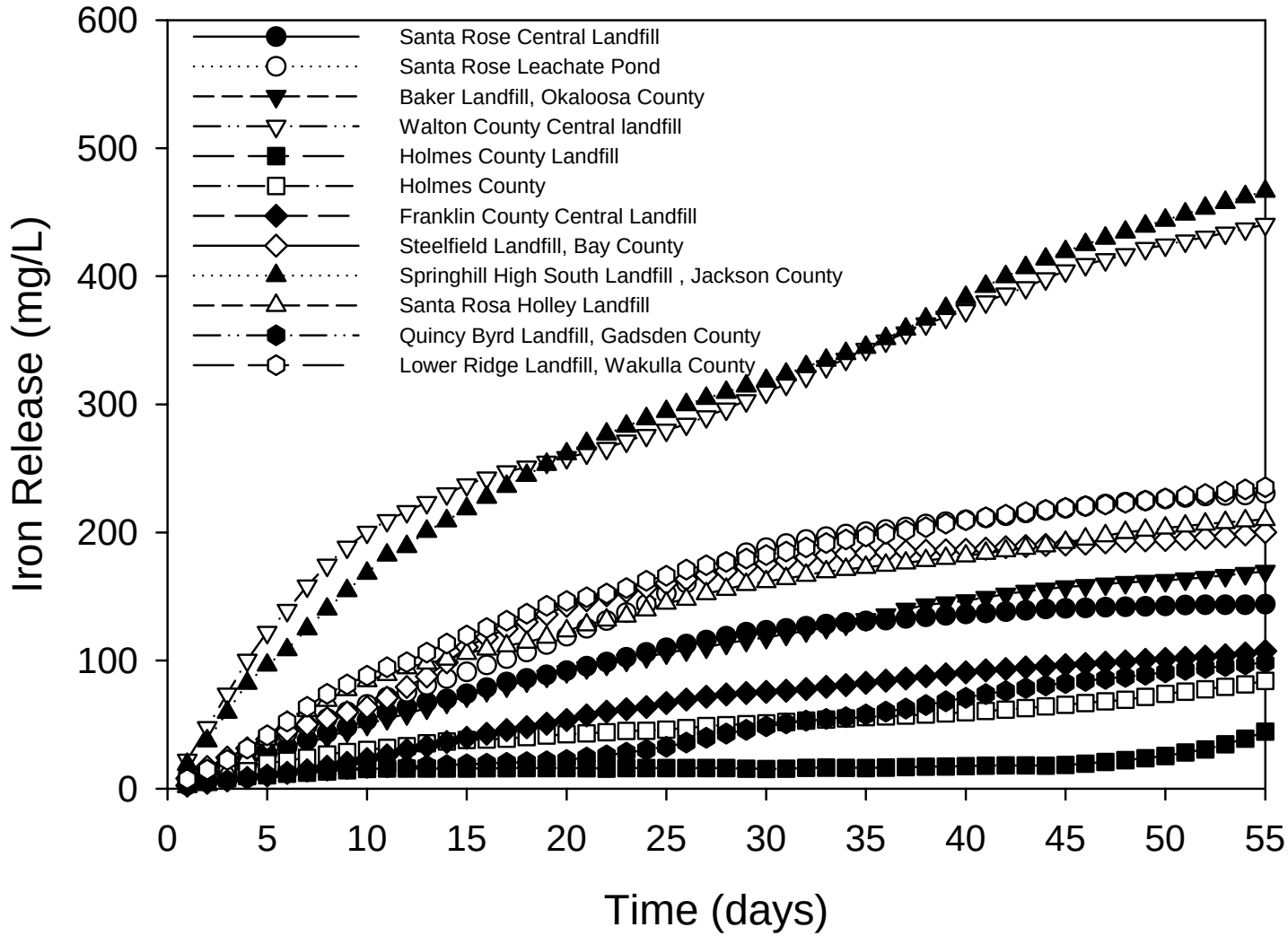
Day 1 = ?

Day 15 = ?

Day 60 = ?

Leachate

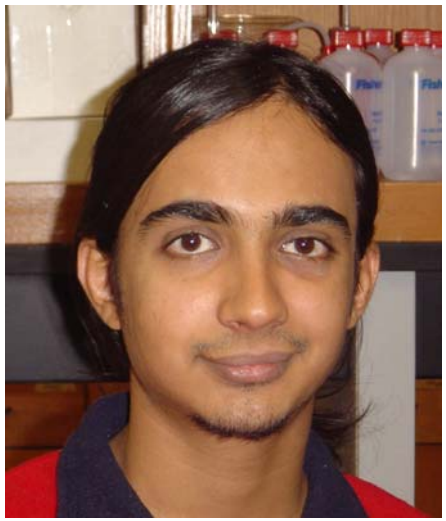
Results for 55 Days



Student Training

Microbial activity characterization nearby landfill sites

Student Training



Microbial mediated iron transformation

Dissemination

ACS
83rd Annual Florida Meeting and Exposition

Florida A & M University

Florida State University

Dissemination

www.eng.fsu.edu/~gchen

Dissemination

Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Colloids and Surfaces A: Physicochem. Eng. Aspects 302 (2007) 342–348
COLLOIDS AND SURFACES A
www.elsevier.com/locate/colsurfa

Impact of surface charge density on colloid deposition in unsaturated porous media

Gang Chen *, Tarek Abichou, Kamal Tawfiq, Pawan Kumar Subramaniam

Department of Civil and Environmental Engineering, FAMU-FSU College of Engineering, 2525 Pottsdamer Street, Tallahassee, FL 32310, United States

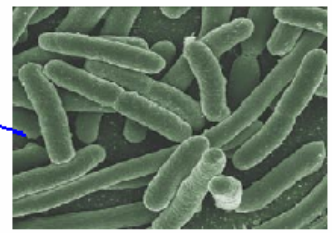
Received 6 December 2006; received in revised form 5 February 2007; accepted 27 February 2007
Available online 3 March 2007

Florida A & M University

Florida State University

Future Work

Simulated Leachate



Fe^{2+}

Low Flow Rate

Or

Long Retention Time

Florida A & M University

Florida State University

Support for Funding Acquisition from EPA

AGENCY: ENVIRONMENTAL PROTECTION AGENCY (EPA)

TITLE: "OSWER INNOVATIONS PILOT PROJECTS"

ACTION: Request for Applications (RFA) - Initial Announcement

RFA NO: EPA-OSWER-IO-06-08

Cooperative Partners. Provide names and phone numbers of individuals and organizations that have agreed to participate in the implementation of the project:

Letters of support from any partners involved with the proposal. **If the applicant is including cooperative partners as part of the project team, a letter of support from each cooperative partner is required.** The letter must be on the partner's letterhead and must be signed by a responsible official of the partner organization stating their intention to work on and/or contribute funds to the project including an estimate of the funding and time commitment. Letters of support must be provided to document any matching or supplemental funds that are described in the proposal. Letters of support must be received by the closing date and time for receipt of applications under this announcement.

Questions?