F-Sand for Lake Munson

John Stainbrook; Supervising Professor: Dr. Ming Ye
Florida State University Department of Earth Ocean and Atmospheric Science

Abstract

The over 100-year history of pollution at Lake Munson has continued into modern day with sewage spills and contaminant runoff continuing to pollute Munson and the Munson Slough. This long history of pollution and neglect has negatively impacted the health of community members many of whom are suffering from cancer diagnoses and severe health and quality of life complications. My previous research with Terry Ryan and Ali Bell found statistically significant evidence (p=0, n>50) that the census tracts encompassing Lake Munson and the Munson Slough had lower life expectancies than the Leon County average. F-Sand is an affordable and naturally produced cationically charged filter media that has been successfully used in Rwanda to remove negatively charged E-Coli and Polystyrene particles from drinking water. F-sand utilizes cationically charged protein from *Moringa oleifera* seed serum extract to reverse the charge of sand and bind to negatively charged molecules. Nitrate and phosphate anions are some of the most common eutrophicating agents leading to harmful algal blooms, common place at Lake Munson.

- I have created a calibration curve comparing log-Absorbance at 198 nm wavelength to NO3-N PPM (m=1.2012, b=0.3721, R^2=.9092) on a Cary 60 UV-Vis Spectrophotometer to quantify experimental results.
- If my hypothesis that F-sand can remove eutrophicating anions from the water column is true, then harmful algal blooms could be reduced at Lake Munson with an affordable "sandbag filter" design.
- If successful, a litany of other applications such as fertilizer run off induced red tide could be explored to positively impact health.

Figure 1. (Xiong et al., 2017) Shows the mechanism of action by which cationic protein coats the surface of sand particles to reverse their charge and bind to anionic particles. *Moringa* tree and seed are shown on the left. Column sand filter experiment from the literature shown in the middle. Sand coated with positively charged moringa serum and bound negatively charged particles on the right.

Methods

1. Create a calibration curve to quantify changes in No3-N PPM relative to absorbance values on a UV-Vis spectrophotometer (Cary 60)

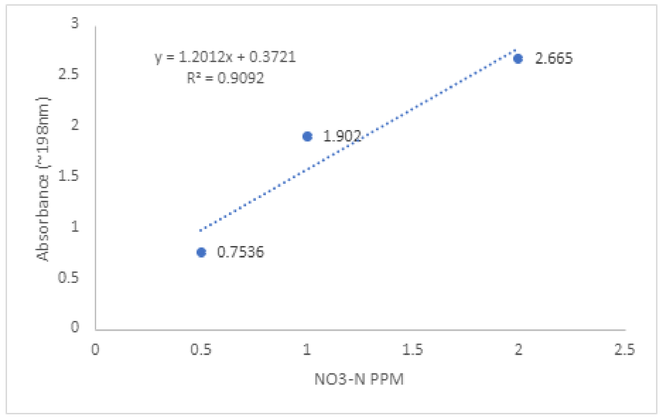

Figure 2. Shows log absorbance at 198 nm wavelength on Y-Axis (accepted NO3-N absorbance wavelength (Edwards et al., 2001)) on a Cary 60 UV-Vis spectrophotometer at three NO3-N PPM values on X-Axis (0.5, 1, 2). Linear equation on upper left represents the expected relationship, M=1.2012, between NO3-N PPM and UV-Vis absorbance at 198 nm EMS wavelength.

2. Create F-sand

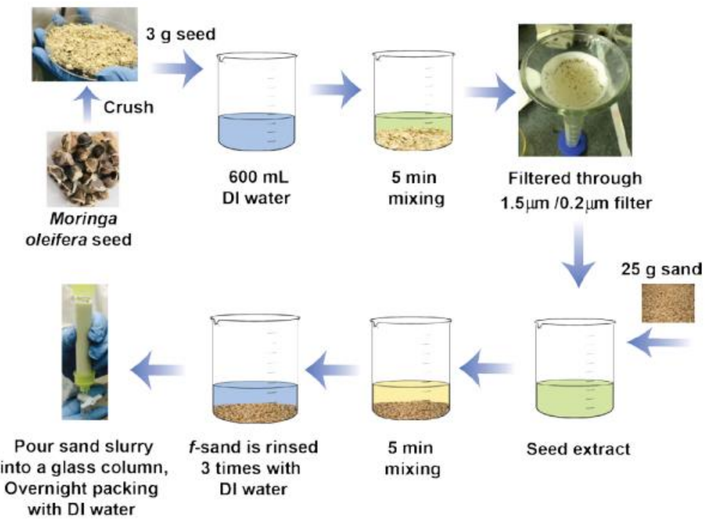

Figure 3. (Xiong et al., 2017) Shows a picturized representation of F-Sand creation.

3. Perform batch experiment with F-sand in standardized PPM NO3-N stock solution to determine F-sands efficacy at removing nitrate molecules from the water column.

Figure 4. Figure 5. Figure 6.

Figure 4. Shows multiple components of the F-Sand creation Procedure. Figure 5. shows *Moringa oleifera* extract serum and SiO2 bead substrate (sand). Figure 6. shows an early batch experiment.

Results

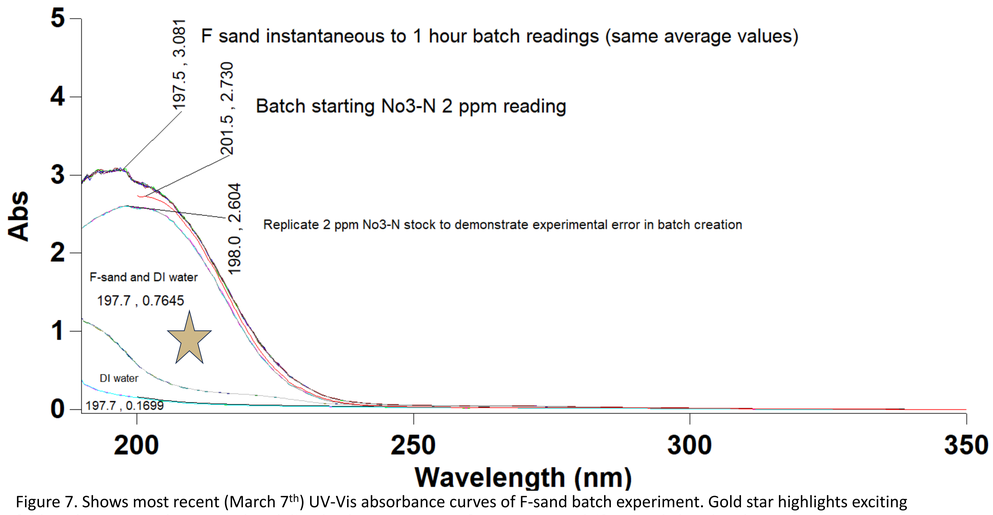

Figure 7. Shows most recent (March 7th) UV-Vis absorbance curves of F-sand batch experiment. Gold star highlights exciting finding that previously unconsidered dissolved organic matter from *Moringa oleifera* seed also absorbs at ~198 nm potentially occluding impressive results.

Discussion

Throughout my research I have had mixed results of F-Sand NO3-N absorbance values, the primary findings being marginal declines of absorbance. The most recent findings shown in Figure 7 demonstrate an exciting finding that F-sand absorbs ~ 1 log at the expected NO3-N peak(~198 nm). I believe that this has negated the ion withdrawing effects of F-sand and led to the marginal findings, suggesting the true absorbance difference may be much greater. I will conduct future work with another method of nitrate concentration determination to ascertain the true efficacy of F-sand in this application.

Literature Cited

Xiong, B., Piechowicz, B., Wang, Z., Marinaro, R., Clement, E., Carlin, T., Uliana, A., Kumar, M., & Velegol, S. B. (2018). Moringa oleifera f-sand Filters for Sustainable Water Purification. Environmental Science & Technology Letters, 5(1), 38–42.

Anthony C. Edwards, Peter S. Hooda, Yvonne Cook (2001) Determination of Nitrate in Water Containing Dissolved Organic Carbon by Ultraviolet Spectroscopy. International Journal of Environmental Analytical Chemistry, 80:1, 49-59.