College of Engineering and Computer Science
Office of the Dean
777 Glades Road, EE96, Room 308
Boca Raton, FL 33431
561.297.3400

Announces the Ph.D. Dissertation Defense of

Vithulan Suthakaran

for the degree of Doctor of Philosophy (Ph.D.)

Phosphorus Removal Using Novel Carbon Adsorbents Derived from Waste Algae: An Industrial Ecology Approach to Mitigate Algal Blooms

March 21st, 2025, 9 AM
Engineering West, EG231B Conference Room
777 Glades Road
Boca Raton, FL

DEPARTMENT:
Department of Civil, Environmental, and Geomatics Engineering

ADVISOR:
Masoud Jahandar Lashaki, Ph.D.
Daniel Meeroff, Ph.D.

PH.D. SUPERVISORY COMMITTEE:
Masoud Jahandar Lashaki, Ph.D., Co-Chair
Daniel Meeroff, Ph.D., Co-Chair
Ramesh Teegavarapu, Ph.D.
Hongbo Su, Ph.D.
Bishow Shaha, Ph.D., P.E.

ABSTRACT OF DISSERTATION
PHOSPHOURS REMOVAL USING NOVEL CARBON ADSORBENTS DERIVED FROM WASTE ALAGE: AN INDUSTRIAL ECOLOGY APPROACH TO MITIGATE ALGAL BLOOMS
High phosphate levels and warm temperatures in surface waters can stimulate the overgrowth of certain algae types, causing harmful algal blooms (HABs). HABs may adversely affect public health and have negative economic impacts due to associated healthcare costs, required clean-up activities, and tourism revenue loss. The overarching objective of this study was to convert algal biomass into chemically modified activated carbon adsorbent materials for phosphate removal. Cyanobacterial biomass was collected from Lake Okeechobee in Florida and processed before activation using fast and energy-efficient microwave heating. To improve phosphate removal, the surface of the adsorbents was modified using different mass ratios (0.5 to 2.0) of lanthanum chloride, zinc chloride, magnesium chloride, or magnesium oxide to precursor. The adsorbents were evaluated for phosphate uptake to identify performant materials for further assessment. Multiple materials modified with lanthanum chloride achieved near-complete phosphorus removal efficiency (99%+) over a wide range of initial concentrations (5, 10, and 20 mg/L). The best-performing material which was prepared with a lanthanum chloride to precursor mass ratio of 1.5 and microwave heating duration of 3 minutes achieved 90%+ phosphorus removal using a low adsorbent dosage of 0.2 g/L and a short contact time of 30 minutes. This final candidate was studied in the presence of natural organic matter (25-62 mg/L), and the results

College of Engineering and Computer Science
Office of the Dean
777 Glades Road, EE96, Room 308
Boca Raton, FL 33431
561.297.3400

showed that phosphate removal performance was not adversely affected. The research findings showed the potential of lanthanum-modified algae-derived activated carbon materials to mitigate HABs through phosphate adsorption from surface waters. The superior performance of La-modified materials for phosphate removal is due to the formation of LaPO4.H2O (also known as rhabdophane), which precipitates in water and permanently sequesters phosphorus. The research findings have the potential to not only enhance air and water quality and public health in the impacted communities but also help maintain a thriving recreation and tourism industry.

BIOGRAPHICAL SKETCH
Born in Boynton Beach, Florida
B.S., Florida Atlantic University, Boca Raton, Florida, 2021
M.S., Florida Atlantic University, Boca Raton, Florida, 2022
Ph.D., Florida Atlantic University, Boca Raton, Florida, 2025

CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2021-2025

Qualifying Examination Passed: Spring 2023

Published Papers: Suthakaran, V.; Thomas. R.; Guirard, M.; Meeroff, D.; Jahandar Lashaki, M. Developing Activated Carbon Adsorbent Materials Using Cyanobacterial Biomass as Precursor to Remove Phosphate from Surface Waters. *Algal Research* **2025***, 86,* 103901