URCA – RESEARCH SUPPORT PROPOSAL
Spring 2020

Analysis
Analysis and Characterization of Microplastics in Water Treatment Plants

Student Name and Department: Skylar Rose,
Civil and Construction Engineering

Student Email: srose14@students.kennesaw.edu

Anticipated Student Graduation Date (month, year): May 2020

Faculty Mentor(s) Name and Department (list all faculty mentors associated with this project):
Amy B. Gruss, Civil and Environmental Engineering
Marina Koether, Department of Chemistry and Biochemistry

Faculty Mentor(s) Email (list all faculty mentors' emails):
agruss@kennesaw.edu
mkoether@kennesaw.edu

Is the student currently enrolled in directed studies/directed methods/or other relevant research course designation with the listed faculty mentor?

Yes [x] **No** [ ]

Course CRN (if applicable): CE 4400

Credit Hours: 3-0-3

Has the student completed all relevant safety and/or ethics training to conduct the specified research activity?

Yes [x] **No** [ ]

Faculty Member Statement (Written by faculty, 300 words max):

Skylar Rose is my first undergraduate researcher at KSU, and this will be the first time applying for URCA research support. I have the confidence I will be successful in this endeavor of leading a student in research because of my experience mentoring undergraduate students at the University of Florida (UF). As a graduate student I received UF's Graduate Student Mentor

Award, where I was selected out of the entire university for my work guiding undergraduate research.

I am a new faculty member, beginning in 2016, and did not receive any seed money or startup funding upon being hired to KSU. These funds are necessary for me to obtain preliminary data for an external NSF grant proposal that I am currently working on. I have experience gaining funds which subsequently produced journal articles and conference presentations. I received two CETL awards as part of a faculty team focusing on sustainability, which funded 1 paper in a peer-reviewed journal (with a 2.75 impact factor) and 5 conference presentations, including an international presentation at the Worlds Sustainability Forum in Beijing, China.

Once my undergraduate student and my team have collected enough data for an article, I have the confidence that we will be able to publish successfully as I have published four peer-reviewed journal articles during my first three years here at KSU.

Institutional Impact Statement (Written my faculty, 200 words max):

Ms. Rose's project directly ties into KSU's research themes of *Computing and Technology*, and *Sustainable and Safe Communities*. We are not only using technology to developing an effective methodology for analyzing microplastics, but through this research we will create sustainable and safe communities by clarifying the drinking water system from microplastics that can have harmful long-term health effects.

Additionally, this interdisciplinary project between Dr. Koether (Department of Chemistry and Biochemistry) and myself (Department of Civil and Construction Engineering) is a small aspect of a larger project that also includes Dr. Daniel Ferreira (Department of Ecology, Evolution, and Organismal Biology) who will study the potential leaching of microplastics from water sludge applied to croplands, and Dr. Bharat Baruah (Department of Chemistry and Biochemistry) who will study the use of nanoparticles to better detect microplastic contamination. We will be submitting the Interdisciplinary Innovation Initiative (I^3) grant for this collaborative research this spring.

Upon collection of preliminary data, we will pursue external funding from NSF's Environmental Engineering program which is part of the Chemical, Bioengineering, Environmental and Transport Systems Division. Results will be published in peer-reviewed journal articles.

Student Impact Statement (Written by faculty, 400 words max):

Ms. Rose is an exceptional undergraduate student who is planning on pursuing a career in the competitive environmental engineering consulting track. Currently, consulting companies have their pick of recent graduates. It is essential that candidates have additional research or work experience in order to stand-out. Providing this undergraduate research opportunity will benefit Ms. Rose in her job hunt but will also set her apart from her peers since she will be focusing on emerging contaminants that many of her future clients are concerned about.

Ms. Rose has already completed key coursework to be able to complete this study, such as Environmental Engineering Design and Environmental Engineering Microbiology. She received an A in both classes and exhibited an understanding of the big picture and critical

thinking skills – which is why she was selected to be involved in this project. Through this prosses she will gain skills such as technical report writing, experimental design and performance, and she will also present the findings at KSU's Symposium of Student Scholars this Spring.

Project Narrative (700 words max across each section below):

Background

Plastic pollution is a growing public concern for some time due to its effect on our environment and oceans. The plastic is commonly ingested by sea animals and have been witnessed within fish, turtles, and even birds. Based on the increasing prevalence of microplastics in the environment, they are now present in potable water, which in turn is then ingested by humans. Microplastics can be defined as pieces of synthetic polymers that can typically be measured to be smaller than five millimeters. Microplastics can stem from sources such as beauty products containing microbeads, polystyrene foam packaging, and the deterioration of disposable plastic items (plastic straws or other various debris). Much of this waste stream enters natural water bodies, which is the source of our drinking water. However, little is known about the microplastics contaminating our water treatment facilities (Olabode & Dhanasekar, 2019).

It is believed that current treatment technology at water and wastewater treatment plants do not easily remove microplastics. This lack of treatability allows the microplastics to return to bodies of water, and even drinking water. Achieving the creation of a monitoring program would allow for better clarification of how microplastics can be removed from our water systems. However, this would require the establishment of standardized methods and guidelines – there is still a research gap in developing these methods. Currently there is no standard for microplastic sampling and analysis methods in engineered systems such as water and wastewater treatment plants. The National Oceanic and Atmospheric Association (NOAA) has created methods for sampling using ocean water, which we will try and implement with the water and sludge byproduct samples in order to develop methods that could be used within the treatment plants (NOAA, 2015). Characterization of microplastics is also necessary in order to better understand the source of the pollution and aid in the prevention of it from entering our drinking water system. This research is crucial in filling a gap in the literature on how to analyze and characterize microplastics at treatment plants in order to protect public health.

Key Research Question and/or Creative Project Goal

The goal is to development a standard method for quantifying and identifying plastic particles within both drinking water and untreated sludge from treatment plants.

Methods

It is outlined to use the methods determined by the NOAA debris program, and applying the different approaches used on ocean water to drinking water and untreated sludge. There is a large research gap present for standard field and laboratory methods required for quality

assurance within the water treatment plants; therefore, it is necessary to formulate these methods through the research planned.

Quantification will be performed as a multistep process. First, the sample will be sieved and washed. Solids collected from the sieve will be dried and weighed. Any organic material will be oxidized, and a density separator will be used to isolate the plastics.

Classification will be performed on advanced instrumentations such as Fourier transform infrared spectroscopy (FTIR) and Ramen spectroscopy instruments.

Results (or Anticipated Results)

This research will determine the most effective analytical and quantifiable methods for identifying microplastics in our drinking water system. With the creation of these new methods, strategies can be assembled for removal of these microplastics during water treatment, both in water and wastewater treatment facilities.

Conclusion/Discussion

The determination of these standard methods for collecting, identifying, and analyzing the microplastics is essential for improved removal of these particles. With methods in place, engineered water treatment plants will be able to advance removal efficiency and decrease exposure of these microplastics. With the funds it will be possible to obtain the materials necessary to begin the trials in order to formulate the approach on how to combat the prevalence of microplastics.

Budget Table and Justification

CATEGORY	AMOUNT
PERSONNEL	$0
EXPENDABLE SUPPLIES	$182
NON-EXPENDABLE SUPPLIES	$818
TRAVEL	$0
TOTAL REQUEST	$1,000

Personnel – N/A

Expendable Supplies –
Potassium metaphosphate, 500 g: Fisher 50-901-14292, $118.30/each
Iron Solution, 0.05 M: Fisher LC144802, $63.50

Non-Expendable Supplies –
47 mm diameter nylon, 300 um pore size: Cole palmer SK-06631-15, $150.90/10
1000 um pore size nylon mesh: Cole palmer SK-06631-75, $221.00/3

Stainless Steel Sieves 5.6 mm mesh: Fisher 04-881-10A, $149.10
Stainless Steel Sieve 1 mm mesh: Fisher 04-881-10L, $149.10
Stainless Steel Sieve 0.3 mm mesh: Fisher 04-881-10T, $149.10

Travel – N/A

References:

National Oceanic and Atmospheric Administration (NOAA). (2015). Laboratory Methods for Analysis of Microplastics in the Marine Environment: Recommendations for quantifying synthetic particles in waters and sediments. *NOAA Marine Debris Program*.

Olabode, L., & Dhanasekar, A. (2019). Occurrence, Removal, Fate, and Transport of Microplastics in Water Treatment. *The Conduit,* 11-14.