PHYSICAL AND CHEMICAL LIMITATIONS REGARDING EXTRACTION METHODS OF MICROPLASTICS FROM CONSUMER AND COMMERCIAL SOAP PRODUCTS

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Abstract

Each year, over 300 million tons of plastic are produced and added to our planet. Comprehensive research on how to extract and treat microplastics that are developed for use in consumer and commercial soaps, such as hand soaps and body scrubs, has not been conducted. Microplastics, defined as plastic fragments less than five millimeters in length, contribute to significant pollution to both plants and animals in aquatic environments, and are a human health hazard. Due to their size, the ability to extract microplastics from soap samples has proven difficult. Multiple methods of separation and their limitations are discussed in this study. Density separation using different salt solutions and digestion methods were carefully analyzed and examined for highest extraction yield. The results of this project will include the most effective methods, chemicals, and procedures for extracting microplastics found in consumer and commercial soap products. In addition to providing the most reasonable extraction methods, the results of this study will allow for further investigation to occur regarding the biogeochemistry of microplastics, as well as provide separation methods that can be applied to large scale operations, such as wastewater treatment plants.

Goals and Objectives

- To determine which chemical is most effective in density separation and list potential complications
- Research chemicals and methods to be potentially used in wastewater treatment plants as a way to extract microplastics from storm/wastewater
- Research heavy metal interactions with microplastics

Figure 1: Microplastic Samples
Source: United States Environmental Protection Agency (USEPA)

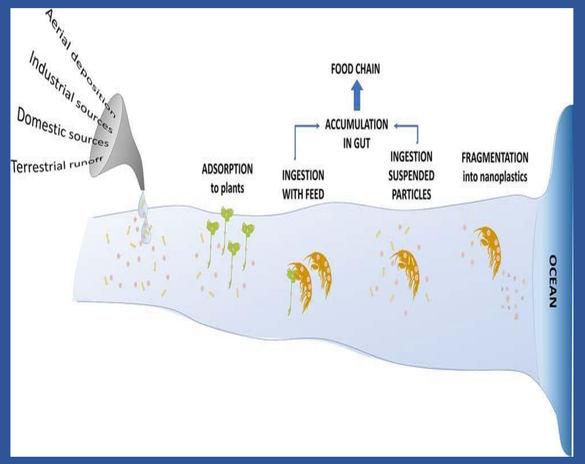

Figure 2: Transport of Microplastics throughout the Aquatic Environment
Source: United States Environmental Protection Agency (USEPA)

What is the best process to extract microplastics from wastewater, and also prevent them from entering ecosystems across the globe?

Data Analysis

- Sodium chloride (NaCl) solution yielded the highest amount of microplastics: 96%
- Sodium iodide (NaI) solution yielded the second highest extraction amount: 93%
- Potassium chloride (KCl) solution yielded the lowest amount: 89%
  - Respective percents are “x” amount of microplastics out of 100 total microplastics (precisely counted) in soap sample
  - 3 replicates per solution
- Sodium chloride is the chemical of choice when it comes to extracting microplastics from consumer and commercial soaps
  - Cost effective, safe, and already exists in salt-containing waterways such as oceans
- Cost of each salt from Sigma Aldrich Chemical Supply (2.5kg)
  - NaCl: $121.00
  - NaI: $879.00
  - KCl: $200.00

Major Findings & Conclusions

- Density separation is a useful tool to extract microplastics from consumer and commercial soap products
- Sodium chloride is the chemical of choice as it is cost effective and has a high yield
- Safe method and can be easily conducted in both the field and laboratory
  Allows for further research on the biogeochemistry of microplastics to be conducted
- Potential use of density separation methods in wastewater treatment plants

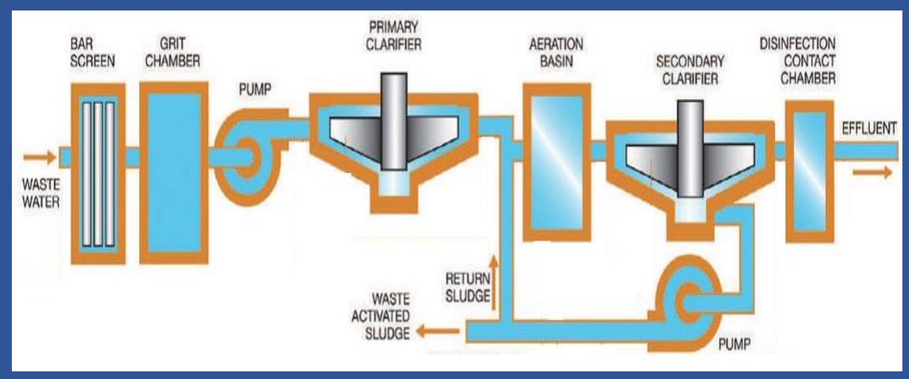

Figure 2: Diagram of steps involved in wastewater treatment
Source: Westlund Water Solutions