Method Development for Extraction of Tire Wear Particles (TWP) from Municipal Stormwater Runoff Sediments

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Introduction

Tire Wear Particles (TWP) are created from abrasion between the road and tires (Wilkinson et al. 2023). TWPs are a common source of microplastic (MP) pollution in the environment (Dupasquier et al. 2023). Previous research has shown that TWPs are transported during rain events in stormwater making them highly mobile. Considering TWPs prevalence and their contribution to microplastic pollution, TWPs may have serious environmental and economic effects. There currently is no best method for the extraction and quantification of TWPs in stormwater runoff sediments.

This capstone examined existing methods for TWP extraction and identification from municipal stormwater runoff sediments. The results from this project will provide a better understanding of the current methods used to analyze for TWP and microplastics in municipal urban stormwater runoff sediments. These results will also serve as a basis for further method development and testing of sediments for the presence of TWPs in samples.

Quick Facts

- MPs are polymers ranging in size from 1µm-5mm (Miera-Domínguez et al. 2024).
- The toxicological effects of TWPs in stormwater runoff have been shown to pose severe health risks to aquatic organisms (Issaka et al. 2023).
- TWPS leach 6PPD-quinone, which has been inextricably linked to Urban Runoff Mortality Syndrome (URMS) in coho salmon (Tian et al. 2021).

Methods

- A comprehensive literature review was performed using the Web of Science database. Covidence, a systematic review tool, was used to narrowed in on 25 articles about microplastics and TWP extraction.
- A microplastic extraction method (Fig. 1) was modified and used as the basis for this project.
- Sediment samples were collected from a stormwater catchment basins from HWY 16 under the Narrows Bridge in Tacoma, WA.

Method development modified from (Wong et. al 2020)
Density Separation: Density separation using calcium chloride to separate TWPs from sediment.
Sieving: Sieved into two size fractions: >500 µm and between 212 and 500 µm.
Vacuum Filtration: Filtered onto 0.7 µm glass fiber filters.
Microscopy: Identified and extracted using a dissecting microscope.

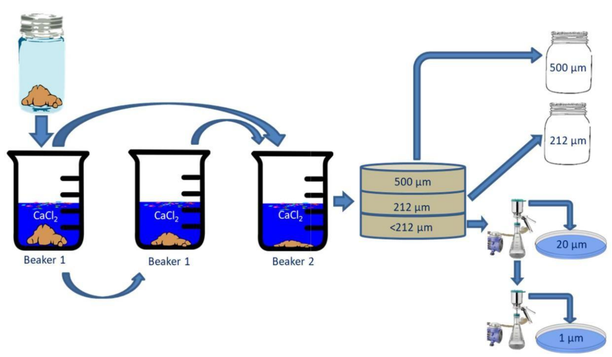

Fig. 1: SOP for Microplastic Extraction from Sediments (Wong et al. 2020).

Results

Fig. 2: Sieved material from stormwater runoff sediment.

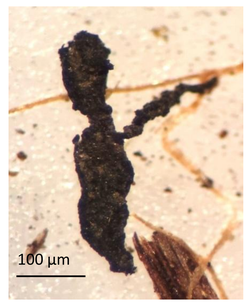

Fig. 3: Isolated TWPs 500 µm in length under a microscope.

Table 1: Locations, sediment masses, and masses of recovered TWPs.

Sample	Sediment Mass (g)	TWP Mass (g)
HWY16 downspout -1	50.012	0.003
HWY16 downspout -2	50.95	0.0506
HWY 16 downspout -3	50.00	0.0439
HWY 16 downspout -4	50.00	0.1655

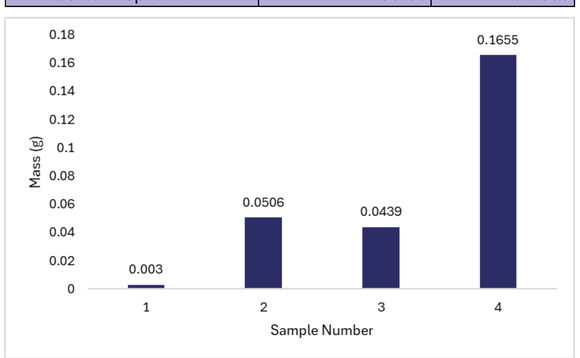

Fig. 4: Mass of TWP recovered from each HWY 16 downspout sediment sample.

Future Work

Moving forward additional research and refinement of methods are being conducted to determine the most cost- and time-effecient strategies for TWP and MP extraction from sediments.

The current density separation requires two days to complete and uses ~700 ml of calcium chloride solution per separation.

Preliminary testing of centrifuging sediment with calcium chloride solution to speed up separation time is being conducted and may reduce time and cost associated with density separation.

Figure 5: Tires under Old Town Dock in Tacoma, Washington (Sensing 2014).

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References

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