Method Development for the Extraction of Tire Wear Particles from Roadway Runoff Sediments

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Introduction

Tire wear particles (TWPs) are a source of microplastic (MP) pollution in the environment and interest in their fate and transport has become a focus of study.

This project reviewed existing MP extraction methods to be adapted for the separation of TWPs from roadway runoff sediments. The purpose was to establish a baseline concentration of TWPs in the environment. This project applied a MP method to isolate TWP in stormwater sediment samples from both King and Pierce Counties.

The results from this project will provide a better pathway to analyze TWP in stormwater runoff sediments and improve understanding of the current methods to analyze TWPs and MPs in municipal stormwater runoff sediments.

Quick Facts

- TWPs are created from abrasion between the road and tires (Wilkinson et al. 2023).
- TWP is a source of MP pollution in the environment (Dupasquier et al. 2023).
- MPs are polymers from 1µm-5mm (Miera-Domínguez et al. 2024).
- TWPs are mobilized during rain events.
- The toxicological effects of TWPs in stormwater runoff have been directly linked to severe health risks to aquatic organisms (Issaka et al. 2023, Tian et al. 2021).
- TWPs leach 6PPDQ which has been linked to urban runoff mortality syndrome in Coho Salmon (Tian et al. 2021).

Methods

- A comprehensive literature review was performed to provide a background on MP and TWP extraction methods.
- The literature review used Covidence, a systematic review tool, from a search from the Web of Science database.
- An SOP for MP extraction using density separation was identified and modified for this project (Wong et al. 2020).
- Sediments were collected from several urban stormwater collection basins in King and Pierce County.

Method development (fig. 1).

- Density separation (fig.1); three-part density separation with 1.4 g/ml calcium chloride solution (fig.2).
- Sieving (fig. 2); wet sieving on 500µm and 212µm sieves (fig. 3).
- Vacuum filtration; filtration of 500µm and 212µm size fraction on glass fiber filters.
- Microscopy (fig 3); visual microscopy using a dissection microscope to identify TWPs (fig. 4).

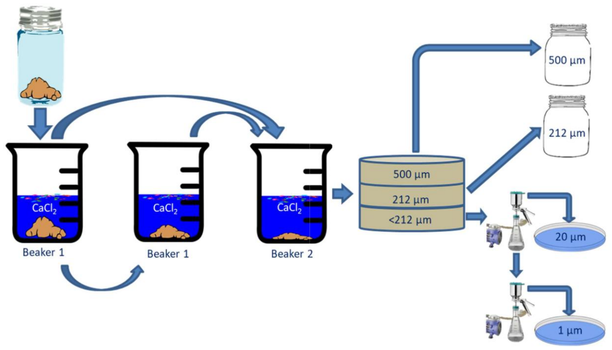

Figure 1. SOP for Microplastic Extraction from Sediments (Wong et al. 2020).

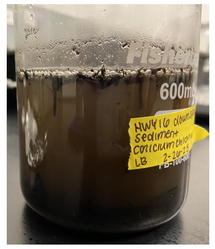

Figure 2. Density separation.

Figure 3. 500µm mesh sieve.

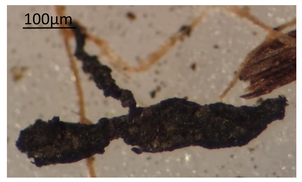

Figure 4. TWP identified by microscopy.

Results

Recovery of TWPs was 0.001- 0.0506 g TWPs per 50 g of solid stormwater sediment with an average of 0.0151 g TWP per 50 g solid stormwater sediment (fig 2. table 1). TWPs average 0.2933 ppt per subsample.

Table 1. Sample identification and TWP masses.

Sample Name	Sample Number	Sediment subsample Mass (g)	Mass Sum (g)	TWP ppt
HWY16 downspout	1	50.012	0.003	0.05999
Jonet #2 Site #2	2	50.13	0.0364	0.72611
Silver Site 1 #2	3	60.53	0.0131	0.21642
Junction #1 Site 2	4	50.02	0.001	0.01999
Thornton #1 Site 1	5	50.53	0.0018	0.03562
HWY16 downspout	6	50.95	0.0506	0.99313
Junction Sediment	7	50.12	0.0001	0.00200

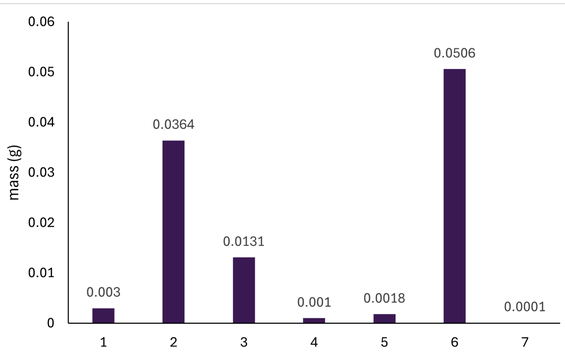

Figure 5. TWP mass extracted from each sample.

Conclusion

The method detailed in Wong et al. 2020 extracted TWPs from sediment samples. Sediment samples collected at different locations had great variability in concentration.

Future Work

Moving forward, additional research and testing of methods are being conducted to determine the most effective strategies for TWP and MP extraction from sediments. Optimization of the method to reduce time and labor is needed.
Future work testing adjusted densities for the salt solution should be completed to assess if there is an improvement in TWP recovery.
Current trials using centrifugation show potential to reduce the labor and time requirements, but more testing is needed to determine its efficacy at TWP extraction
This work will support future TWP projects at the Center for Urban Waters.

Acknowledgements

Special thanks Dr. Ed Kolodziej for support on this project and Emily Everton for obtaining the sediments used and her collaboration on this project.

References

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