

Literature Review Development of Tire Wear Particles (TWP) for Municipal Stormwater Runoff Sediments



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Scope

This literature review examines the existing methods for Tire Wear Particle (TWP) identification and extraction from municipal stormwater runoff sediments. The results from this literature review will provide a better understanding of the current methods used to analyze for TWP and microplastics in municipal urban stormwater runoff sediments. The results will serve as a basis for further method development and testing of sediments for the presence of TWPs in samples. The purpose of the literature review is to examine current research and methodologies for TWP identification and extraction from urban sediments to create a method for Tire Wear Particle extraction from municipal urban stormwater runoff sediments.

Quick Facts

- Tire Wear Particles (TWP) are created from abrasion between the road and tires (Wilkinson et al. 2023). TWP is a common source of microplastic (MP) pollution in the environment (fig. 1) (Dupasquier et al. 2023).
- MPs are plastics ranging in size from 1 μ m-5mm (Miera-Domínguez et al. 2024) (fig. 2).
- TWPs are transported during rain events in stormwater making TWPs highly mobile.
- TWPs in the environment such as those from the repurposed tires in Figure 1 have become a focus of interest in MP pollution studies.
- The toxicological effects of TWPs in stormwater runoff have been shown to pose severe health risks to aquatic organisms (Issaka et al. 2023).

Methods

- A comprehensive literature review was performed using the search engine in the Web of Science database with access through UW Tacoma.

Keywords:

- "microplastics", "Tire Wear Particles", "road runoff", and "sediment extraction"
- A total of **345** scientific articles resulted from the search.

Systematic Review Software - Covidence:

- Identified **112** duplicate articles and removed them.
- **233** articles were reviewed based on their titles and abstracts. After the first review, **49** articles remained.

The articles were split among three group members evenly and reviewed based on relevance, date of publication, and methodology of TWP identification and quantification from stormwater sediment runoff.

- **25** articles remained after the secondary review.

A standard Operating Procedure (SOP) for MP extraction from sediments was identified and included.



Figure 1. Tire Reef under Old Town Dock in Tacoma Washington (Sensing 2014)

Results

Multiple methods were consistently cited for TWP extraction and analysis.

Extraction of TWP and MP (fig. 3):

- Dried sediment to remove water: 24-48 hours
- Dissolved organic matter using 30% hydrogen peroxide.
- Separated by density using salts (1.5 -1.6 g/ml)

Analysis: These methods were cited to analyze for TWPs and MPs in sediment and to determine if natural rubber (NR) and synthetic polymers were present.

- **Pyrolysis-Gas Chromatography/Mass Spectroscopy (Py-GC/MS)**
 - Composition and mass of TWPs
- **Fourier Transform Infrared Spectroscopy (FTIR)**
 - Composition of TWPs and MPs
- **Scanning Electron Microscopy (SEM)**
 - Determines composition, number of particles, size, morphology in TWPs and MPs (fig. 2)
- **Raman Spectroscopy**
 - Determines presence of carbonaceous materials in TWPs & MPs

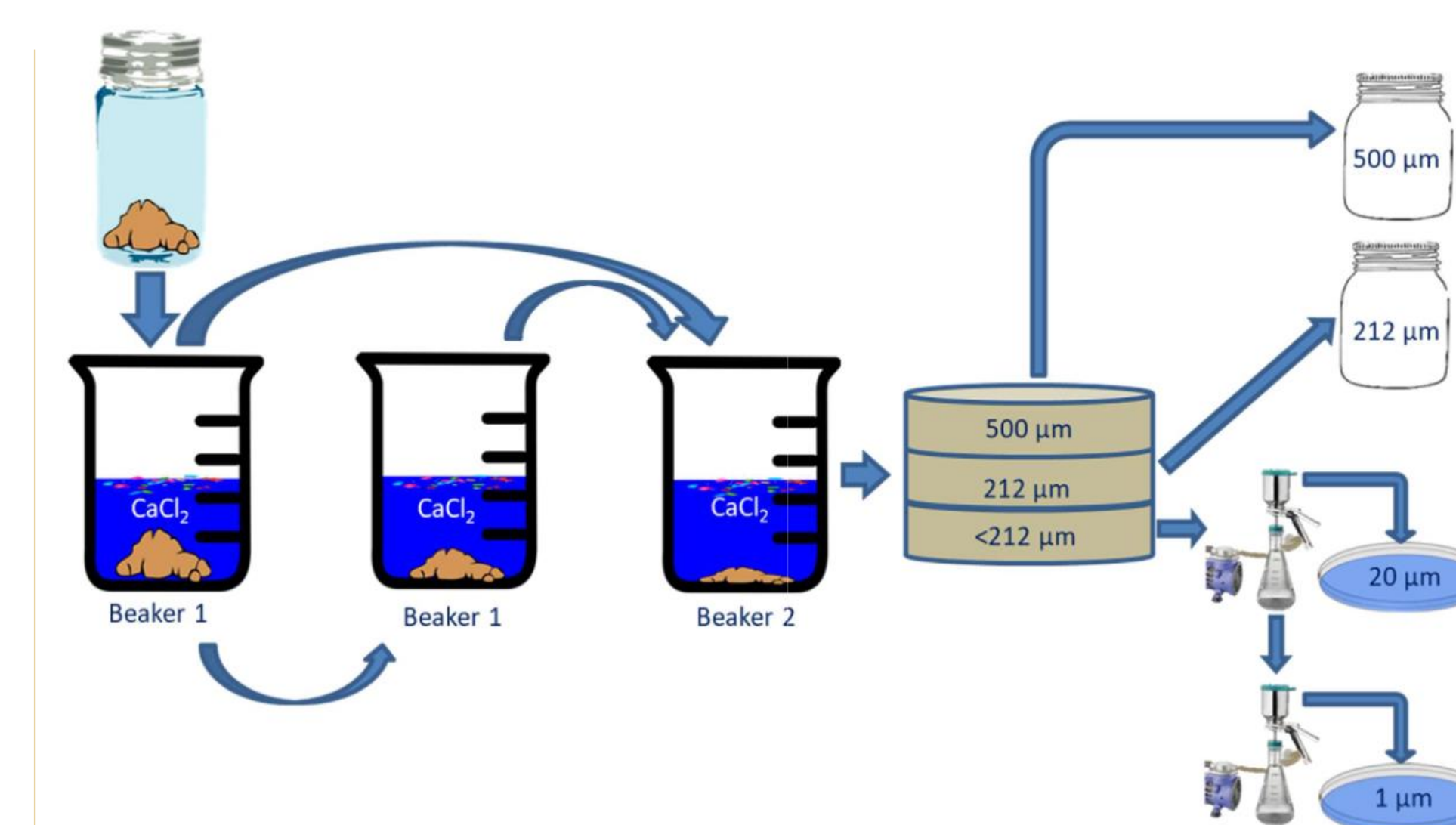


Figure 3. SOP for Microplastic Extraction from Sediments (Wong et al. 2020).

Next Steps

Moving forward additional research and testing of methods should be conducted to determine the most effective strategies at TWP and MP extraction from sediments. This work will support future TWP projects at the Center for Urban Waters (CUW).

Acknowledgements

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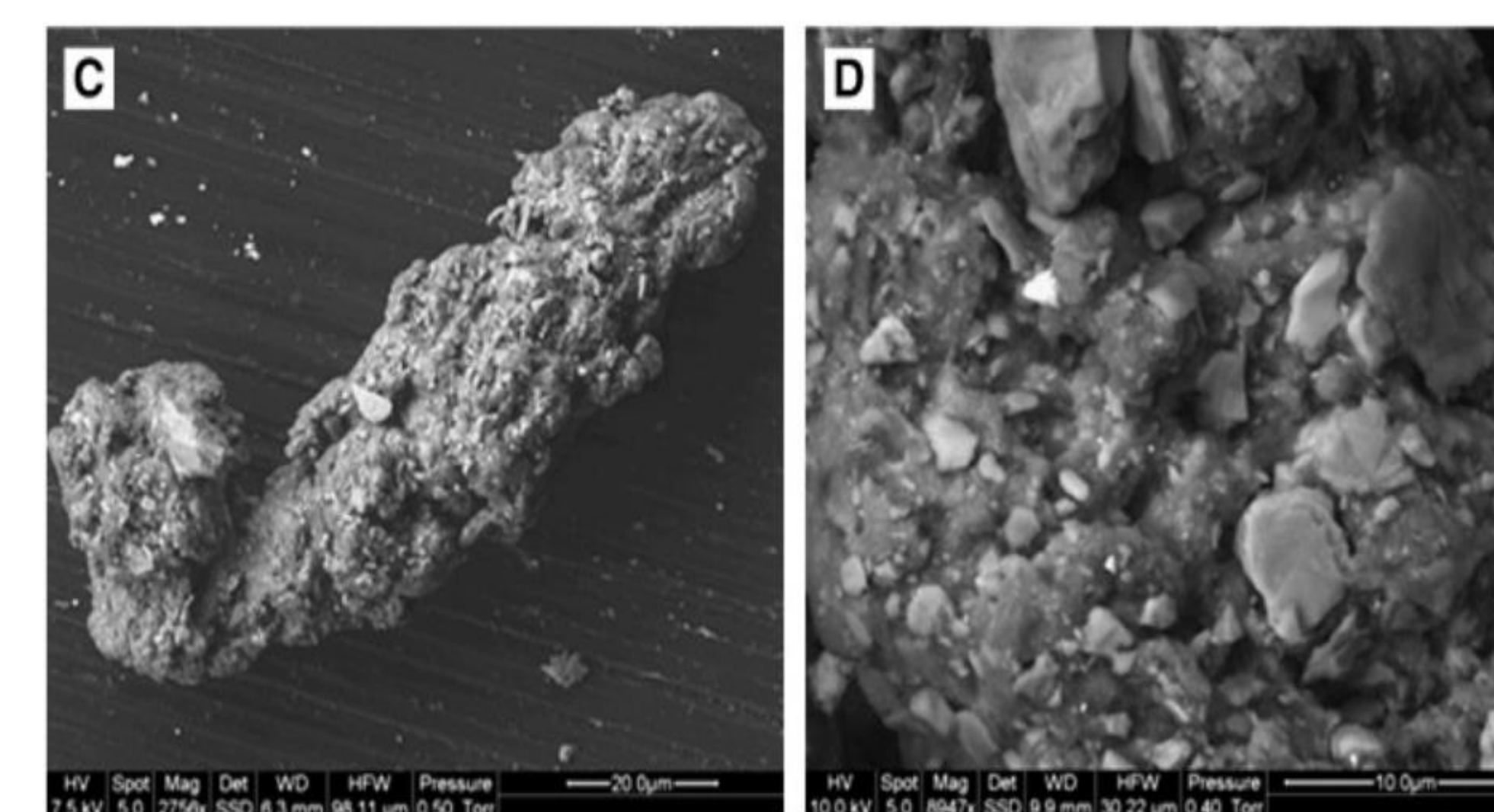


Figure 2. TWPs captured by SEM (Kreider et al. 2010).

References

