

Source and Fate of Microplastics Fibers in the Ocean

A Case of Study in Newtown Creek and Flushing Bay

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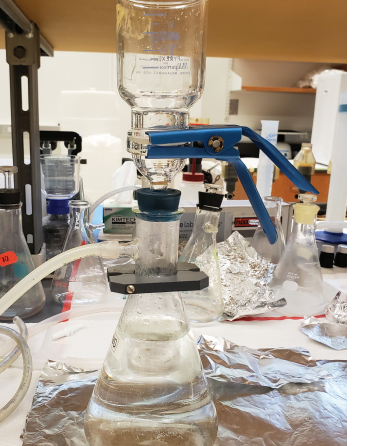



INTRODUCTION

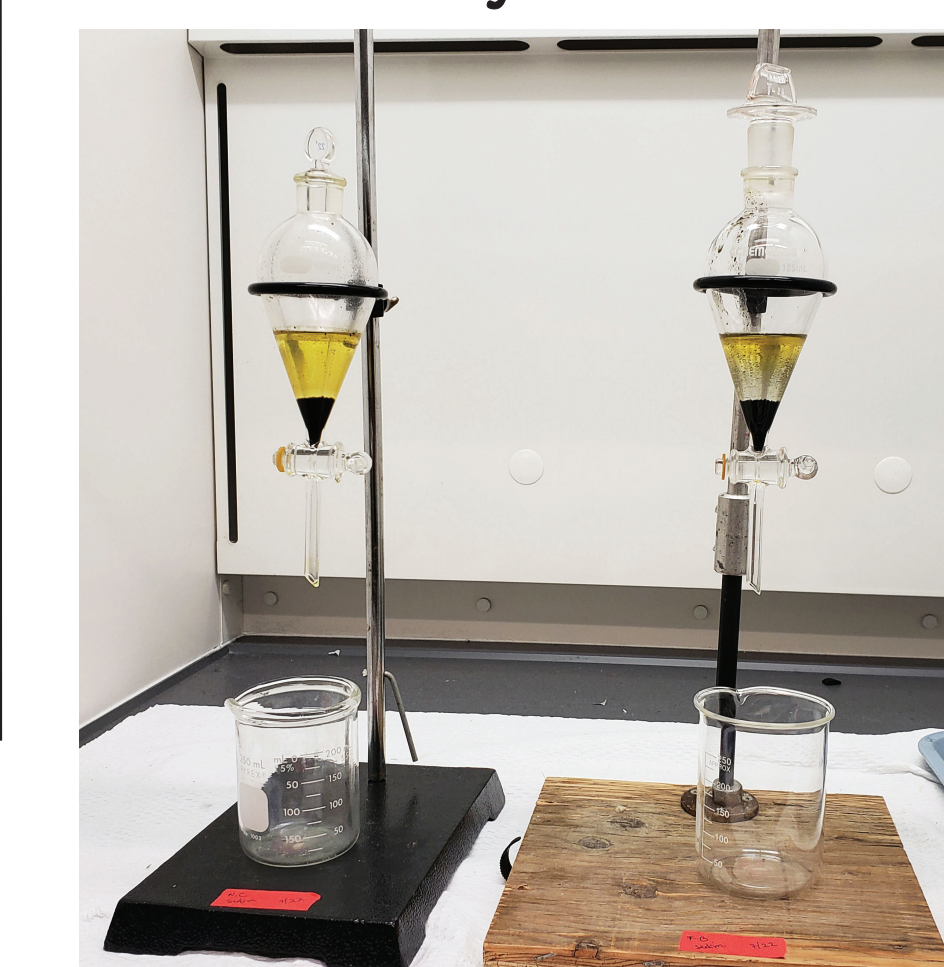
- According to recent studies, around 2.41 million tons of plastic waste enters the ocean from rivers every year.
- Surprisingly, 94% of this debris are microplastics (particles <5 mm), and 35% out of this total are synthetic microfibers.
- Wastewater treatment plants may be a potential pathway because their filtration system cannot retain tiny particles from households.
- Since most of the garments washed in the USA contain at least 60% of synthetic materials, microfibers that shed during washing can enter directly to the ocean through sewage.
- It is essential to determine the source of microfibers to adopt sustainable policies that can help prevent this contamination.
- To achieve this goal, first, we quantified fiber loss during washing with and without detergent on textiles with different percentages and types of polymers. Then, we examined the presence of microplastics and specially microfibers in Newtown Creek and Flushing Bay water samples because they are located close to wastewater treatment plants and highly urbanized areas.

METHODS

1. Quantification of Fibers

			
Preparation * Get rid of moisture (50 °C)	Washing * 15 min	Filtering * Vacuum Filtration Apparatus	Drying * 1h * (57.2 °C)

2. Sediment Samples Analysis



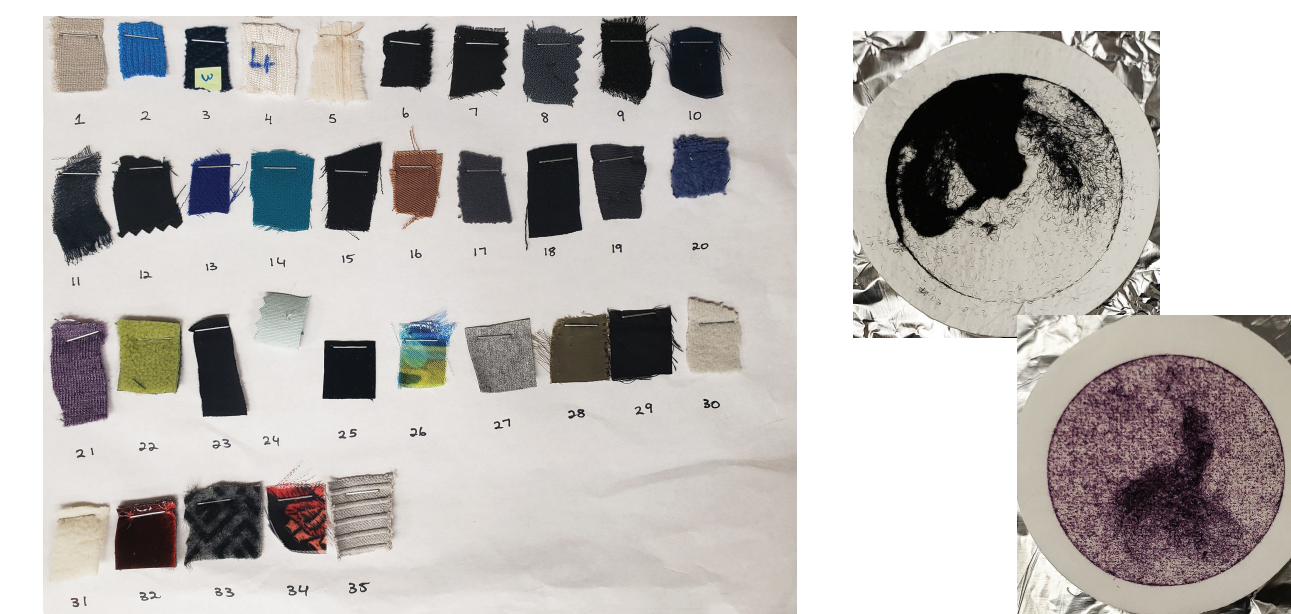
Density separation process.

3. Water Samples Analysis

- Degradation of organic material with NaClO
- Staining process with Nile Red
- Fluorescence identification with UV light

RESULTS

Figure 1. Inventory of textile samples and filters with fibers sample# 21 and # 25



During the drying cycle the percentage of fibers released was 72-95% greater in the process without detergent (Fig. 2), and 55-95% greater in the process with detergent (Fig. 3). In both variations, Tencel shed more fibers respect to its original mass. Nylon - Polyester lost 86% more fibers when detergent was added (Fig. 4).

Figure 3. Comparison between % mass loss during drying and washing (With Detergent)

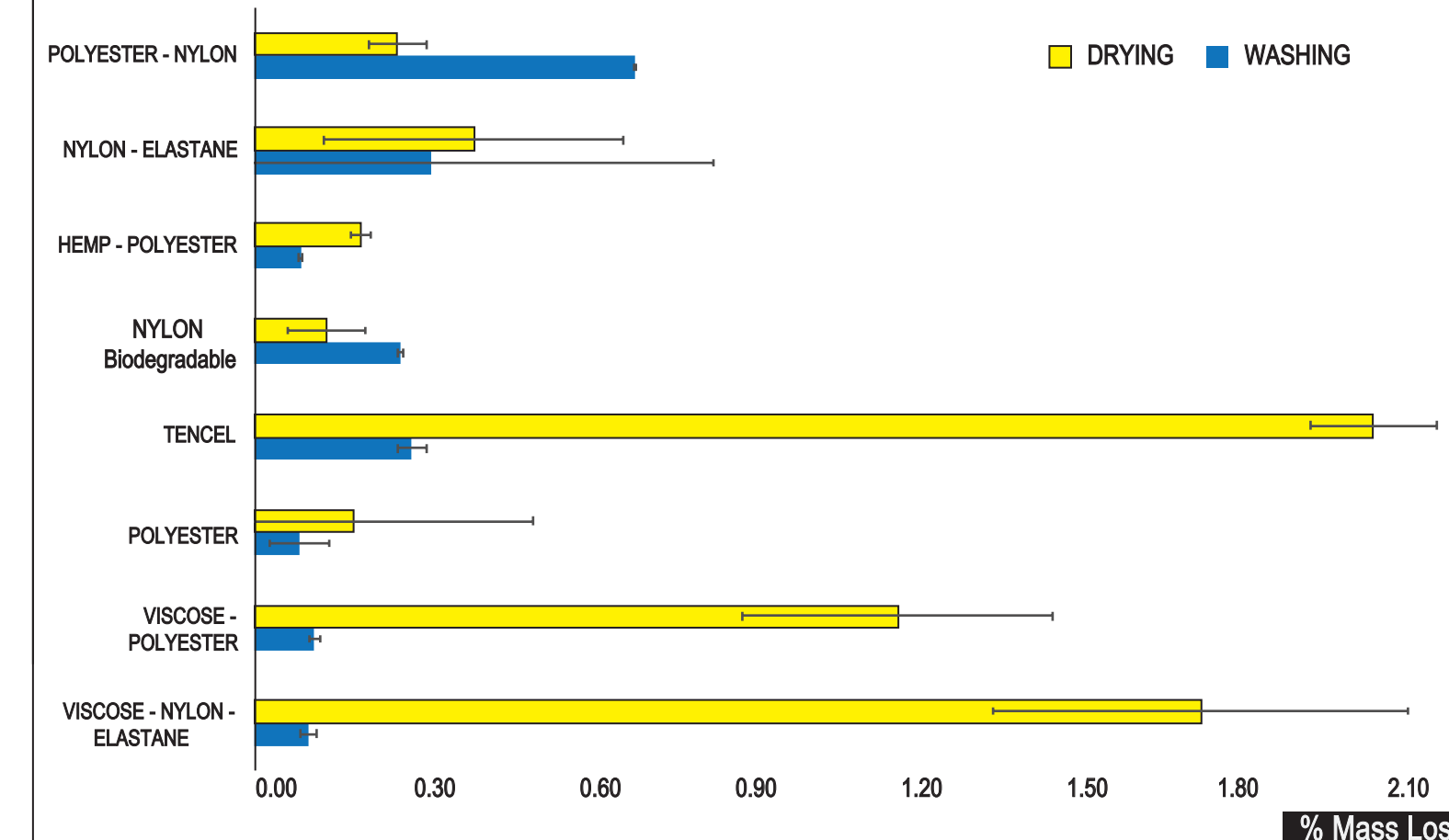


Figure 2. Comparison between % mass loss during drying and washing (Without Detergent)

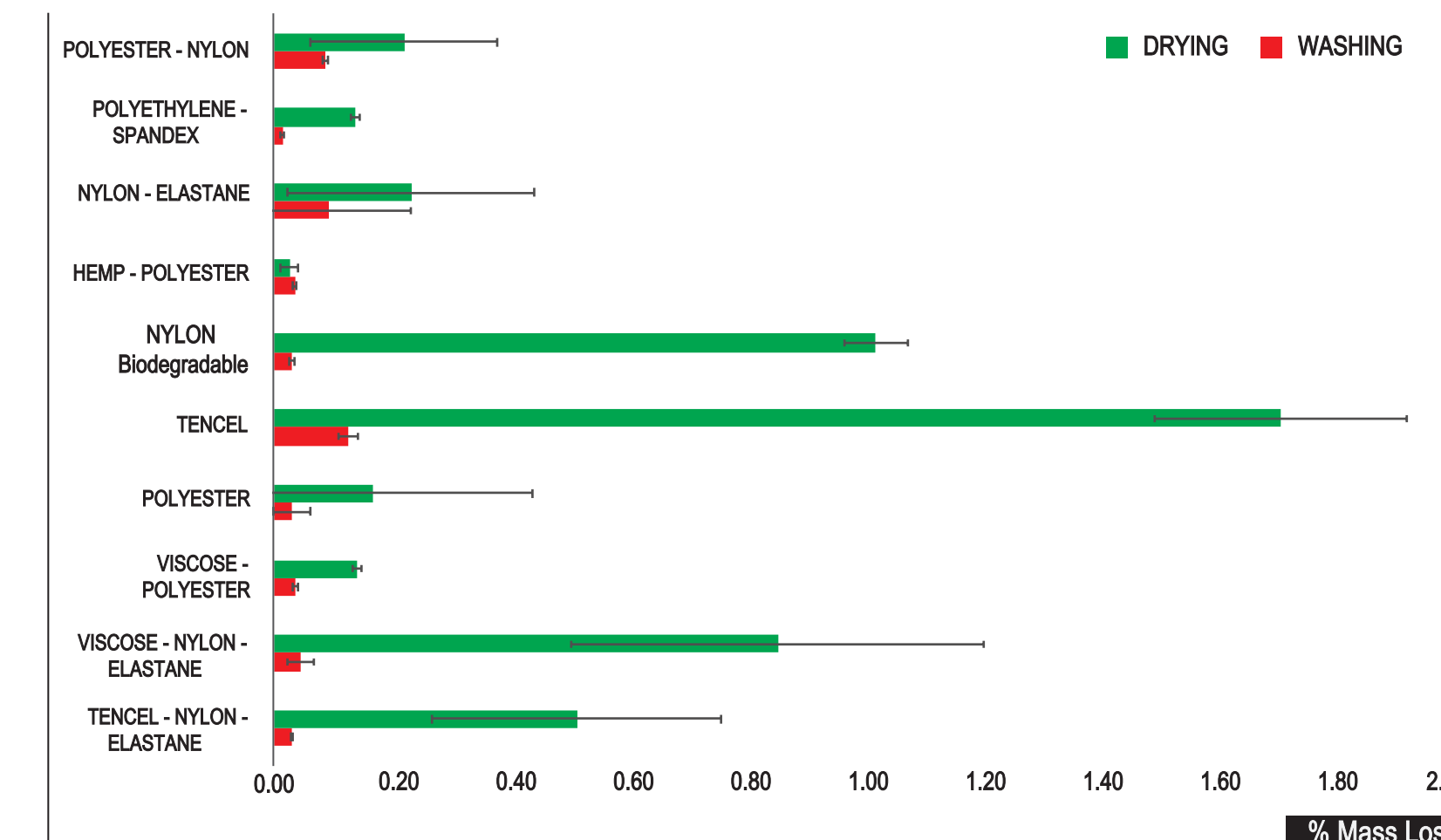


Figure 4. Comparison between % mass loss washing process (With and Without Detergent)

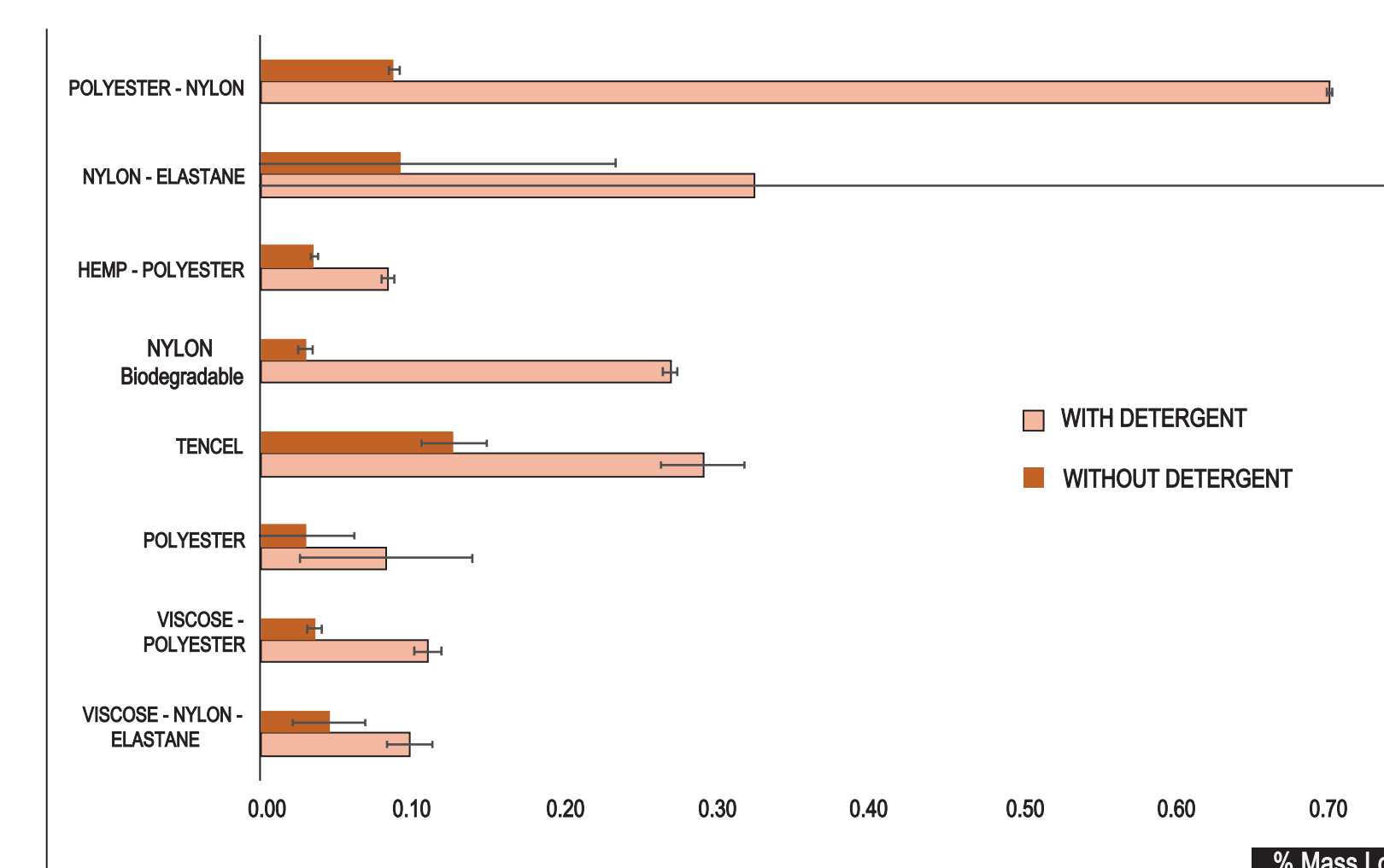


Figure 5. NEWTOWN CREEK ANALYSIS (100X)

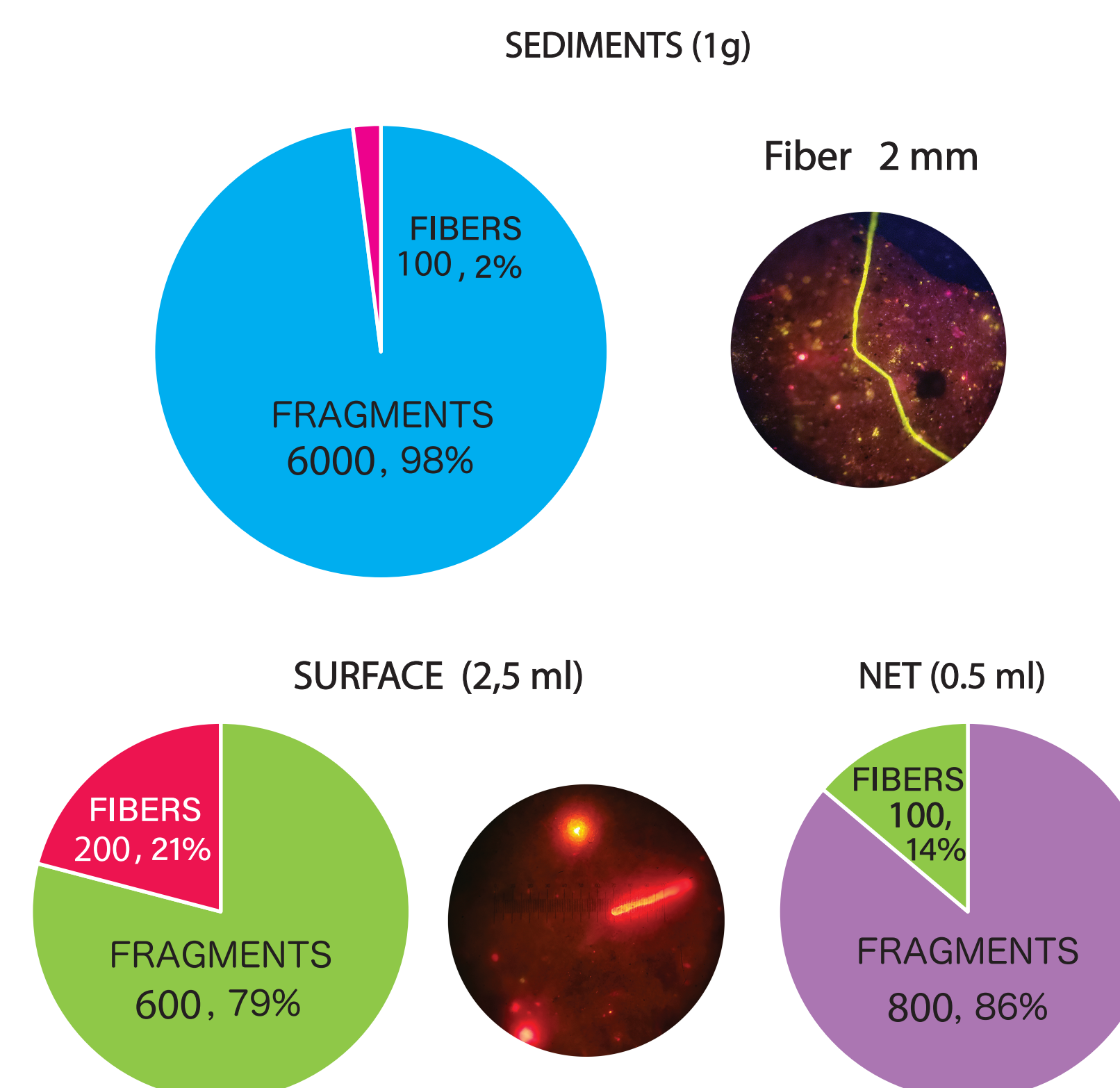
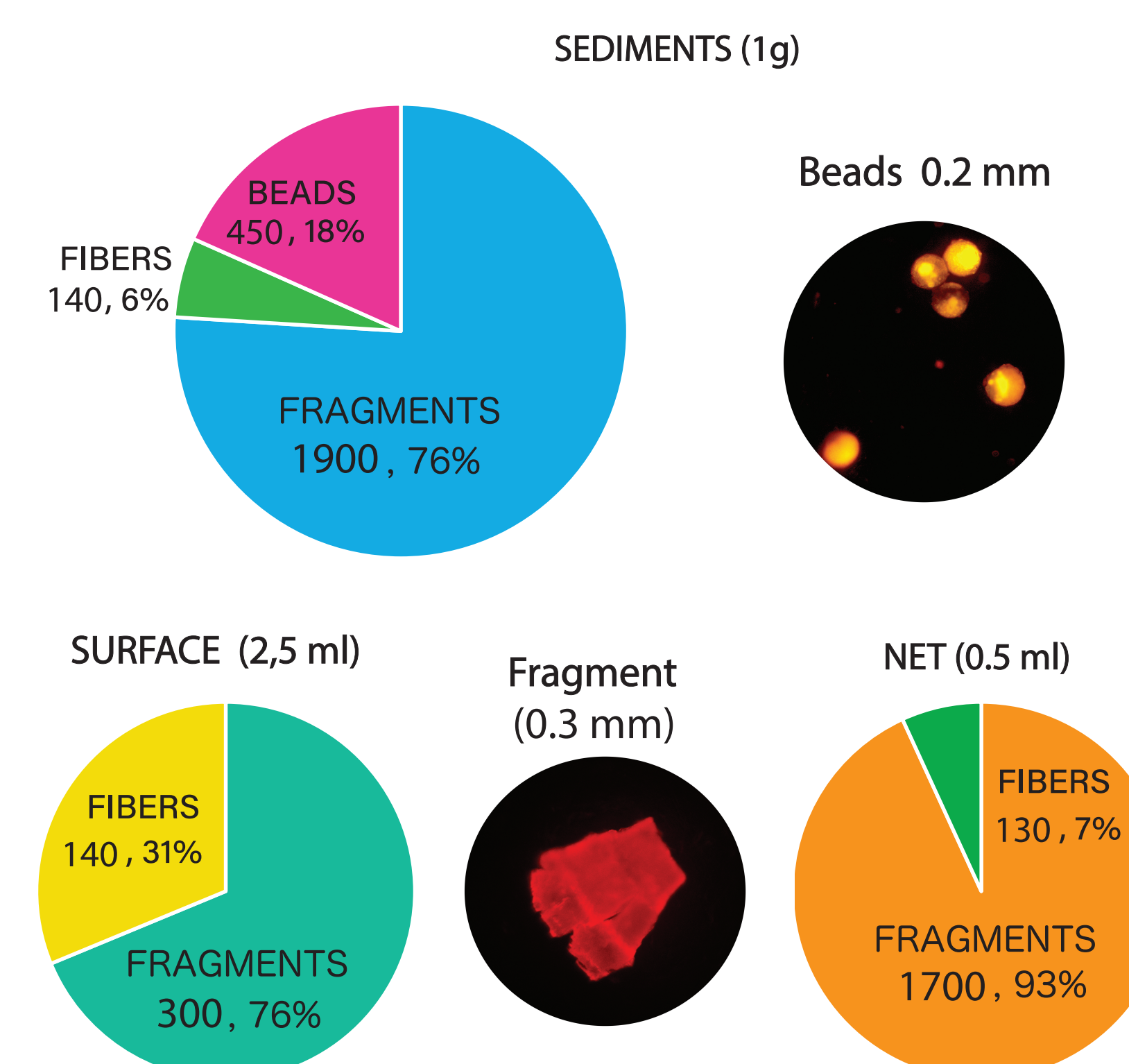


Figure 6. FLUSHING BAY ANALYSIS (100X)



Conclusions and Recommendations

- According to the average amount of fibers released in washing with detergent, the volume of wastewater received by the Newtown Creek and Flushing Bay treatment plants may contain approximately up to 16 million and 21 thousand kg of fibers per year respectively.
- Nylon should be especially avoided. When it is part of the textile components, fiber release during washing increases by up to 33%.
- Nile Red is not efficient to stain all synthetic materials. It is essential to develop new techniques that increase identification efficacy.
- It is required the verification of the composition of fluorescent particles; techniques like FTIR analysis can be adopted.
- A suitable filtration system should be applied in washer machines to prevent high concentrations of synthetic fibers from getting into the ocean.

FUTURE WORK

Figure 7. Comparison between Gold and iD - Poly Dyes NEWTOWN CREEK (0.5 ml 100X)

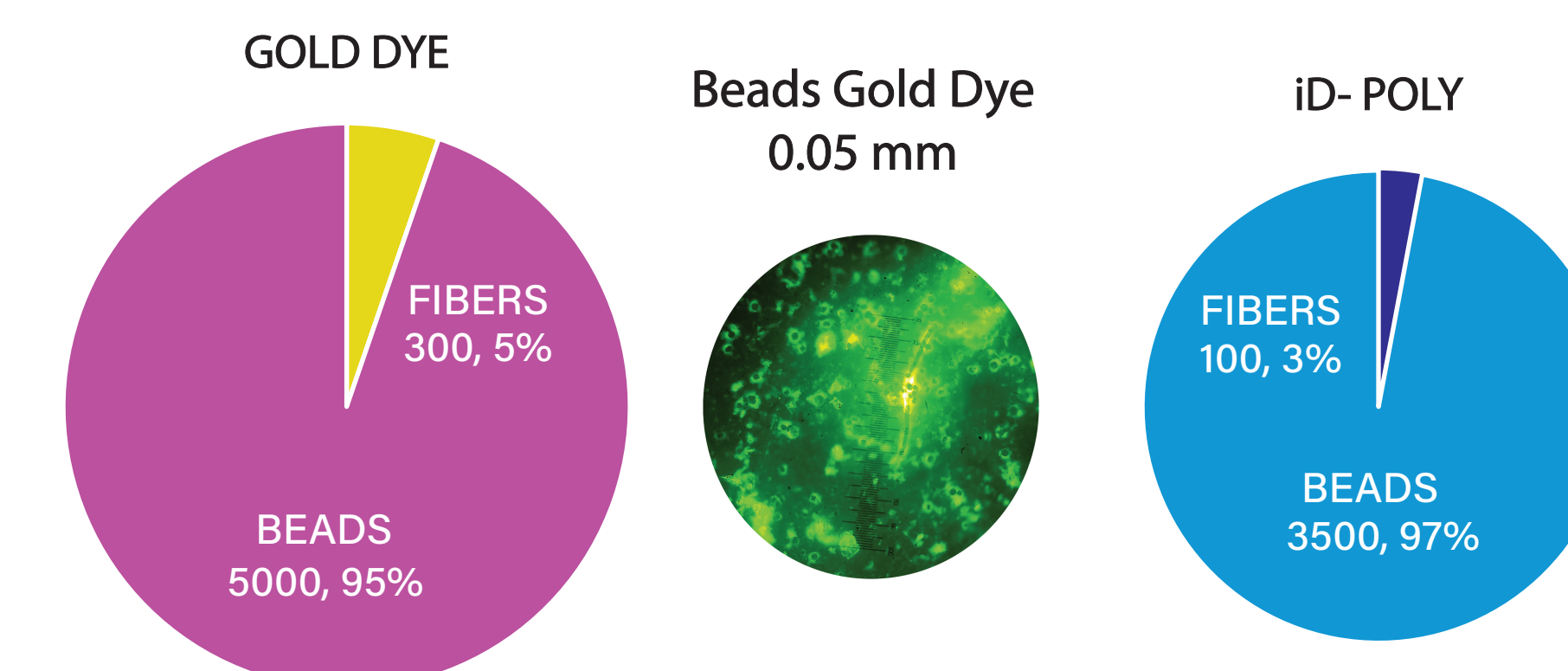


Figure 8. Test Gold Dye on sample # 9 Image 400 X

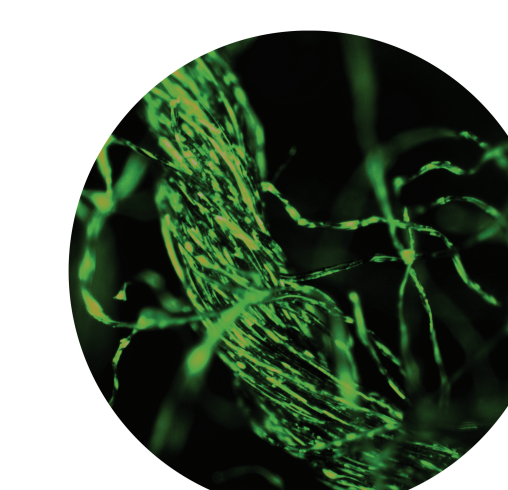
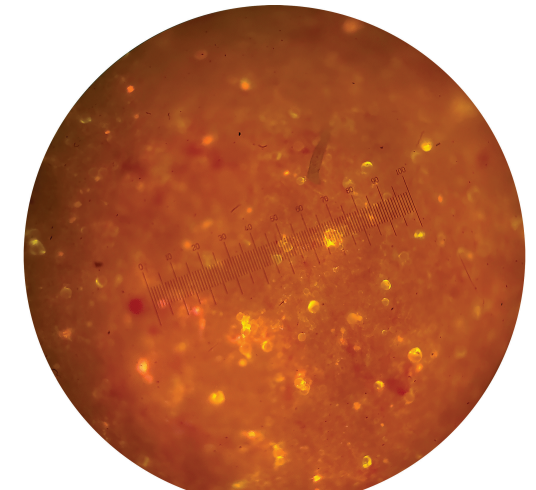


Figure 9. Beads in detergent only Image 100 X Nile Red



References and Acknowledgments

- (Sharma & Chatterjee, 2017) Microplastic pollution, a threat to marine ecosystem and human health. Many thanks to Dr. Joaquim I. Goes and Dr. Beizhan Yan for their mentorship and guidance in protocol development. Special thanks to Kali McKee and Debra L. Magadini for their instruction in laboratory work. To Dr. Helga do Rosario Gomes for her feedback. To Emmerline Ragoonath for her fellowship and support. To the NSF and the Earth Institute for providing funds.

The quantity and sizes of microplastics in sediment samples were larger than in water samples.