Washing Machine Filters Reduce Microfibre Emissions

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ABSTRACT

Washing clothing is a known pathway for microfibers to reach the environment. Previous research has demonstrated washing machine filters as a potential mitigation strategy. Here, we investigated the effectiveness of washing machine filters at the community level. We installed filters in 97 homes in Parry Sound, Ontario, representing approximately 10% of households connected to the municipal wastewater treatment plant (WWTP). We evaluated treated final effluent and found a significant reduction in microfibers after filter installation. Furthermore, lint samples from filters revealed an average weekly lint capture of 6.4 g, equivalent to 179,200–2,707,200 microfibers. This research shows that microfiber filters on washing machines are effective at scale, and this result can help inform policy decisions to reduce microfiber emissions from laundering textiles. The project was then expanded to 300 households in the Town of Collingwood.

MATERIALS

- 97 households in Parry Sound, Ontario were equipped with an after-market washing machine filter, Filtro160. The Filtrol 160 contains a 100 µm polyester mesh and has a microfiber capture rate of 89% of microfibers shed from laundry into wash water by weight (Filtrol, 2021).

- 300 households in Collingwood and surrounding areas, including Wasaga Beach and Town of the Blue Mountains, on septic and town water
- Water sampling equipment for the Wastewater Treatment Plant final effluent

METHODS

All households were asked to collect and store their lint samples in the freezer. These samples were collected every 3-6 months for analysis and weighing.

Through this study, we conducted three main types of sampling analysis including mass (in grams), microfibre count and wastewater effluent.

Parry Sound

Lint Capture by Mass

- Lint samples were weighed in sample bags, recording the wet weight in the full bag, and subtracting the weight of the empty bag.
- To maintain safe working environments during the COVID-19 pandemic, the third and fourth batch of samples remained sealed in the bags, and the average bag weight was used for subtraction.

Estimating Lint Capture by Count

- 10 randomly selected households were chosen to estimate microfibre counts, of which three 5 mg wet weight sub-samples were taken to determine a representative count per replicate.
- A solution of 10% Alcojet and reverse osmosis (RO) water was used to separate the individual particles within each sub-sample.
- In the first collection of samples, the number of microfibres were counted under the microscope and categorized by particle colour and shape. In the second sample, we also quantified the number of suspected anthropogenic fragments.

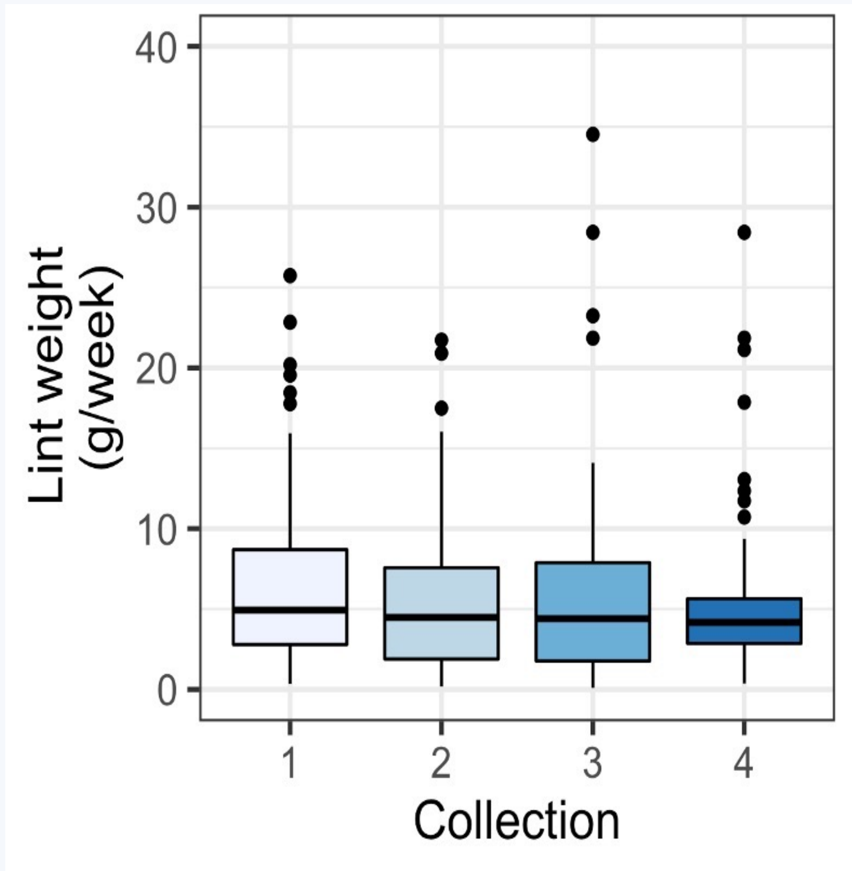
Wastewater Effluent

- Effluent from the Parry Sound WWTP was collected in 4 sample periods before and after filter installations, March and July 2019 (before) and August 2019 and March 2020 (after).
- Sampling was performed at the UV-treatment stage. Three 24-h composite samples (approx. 3.6 L volume) were collected on 3 consecutive days at each sampling event using a pre-programmed ISCO 3710 sampler, set to collect 150 mL per hour.
- In the laboratory, the samples were processed using a stack of stainless-steel sieves. Tyler sieves with mesh size fractions of 1 mm, 500, 355, 125, and 45 µm, were stacked in decreasing mesh size.
- Each sample was extracted by pouring it through the sieve stack, measured using a large graduated cylinder, rinsed into separate clean glass jars using RO water, which were analysed under a Leica M80 stereo microscope.
- Particles were analyzed for measurements and Raman Spectroscopy.

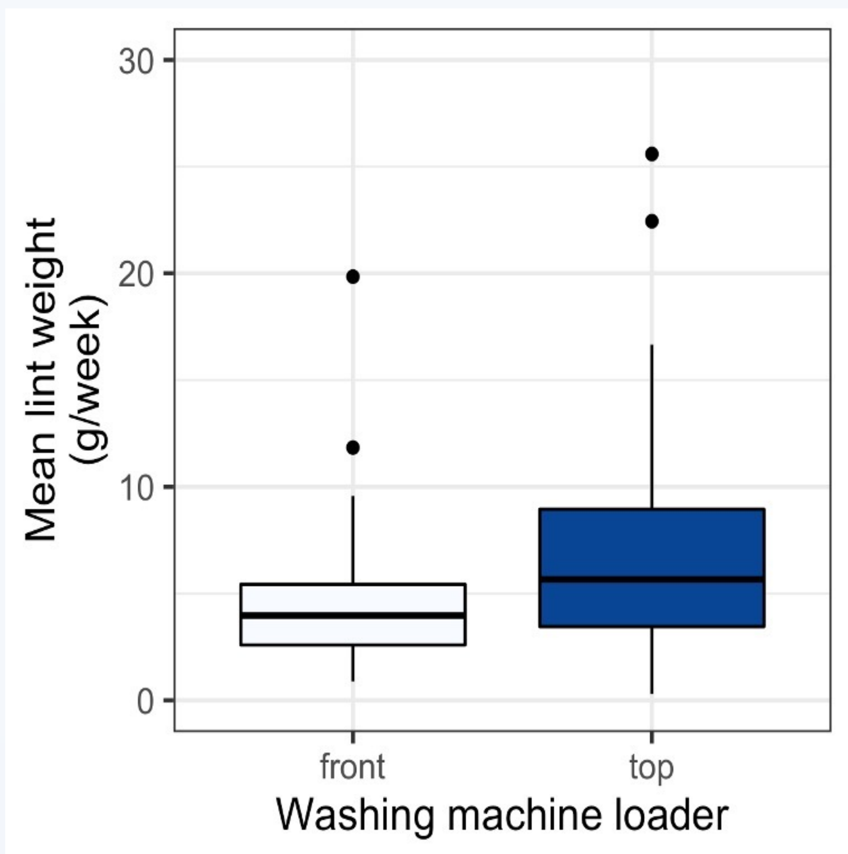
Southern Georgian Bay Coastal Communities

- Lint samples were weighed in grams (g) for analysis to determine the total mass of material diverted. Samples remained sealed in the bags, and the average bag weight was used for subtraction.

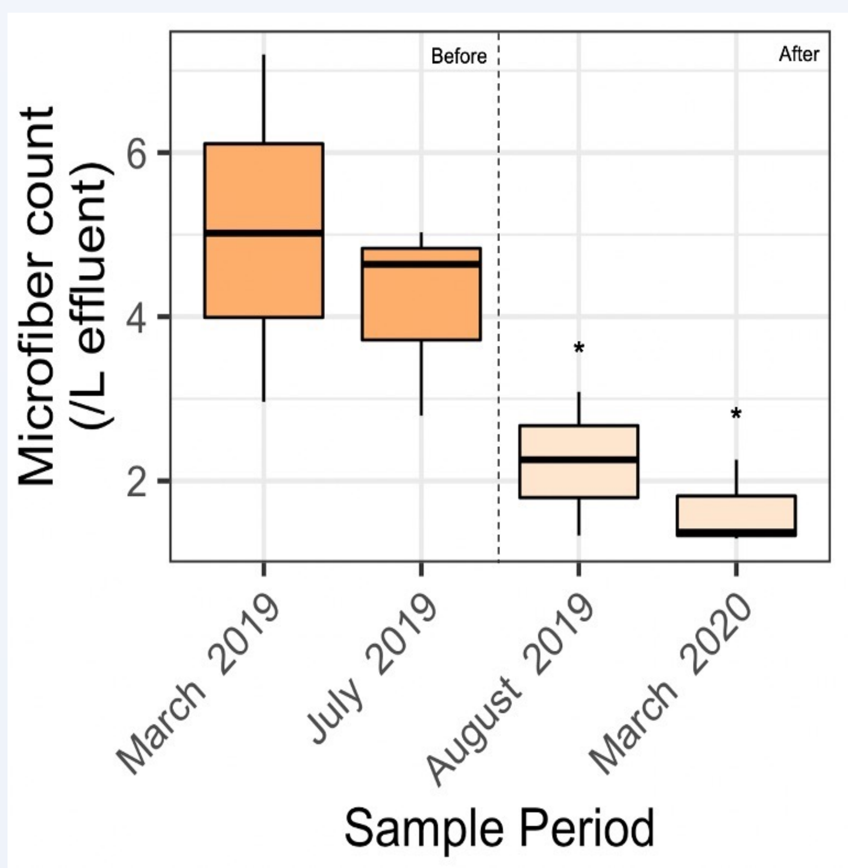
RESULTS



Weight of lint in g/week for lint capture in household filters across four collection periods (n1 = 73, n2 = 51, n3 = 60, and n4 = 62).



Weight of lint in g/week for lint captured in household filters across different washing machine types. A *t*-test test revealed a significant difference between collection periods ($p < 0.05$).



Microfiber count for each sample period before (March & July 2019) and after filter installation (August 2019 & March 2020) at WWTP. A 2-factor ANOVA showed a significant difference before and after filter installation (*$p < 0.01$), and no significant difference amongst seasons ($p = 0.8$) or the filter-season interaction ($p = 0.4$).

CONCLUSION

We demonstrated that microfiber filters are effective at the community and WWTP scale. We installed 97 washing machine filters in people's homes, and our results show a significant decrease in microfibers at the municipal WWTP after installing filters. Analysis of household lint samples also revealed that filters captured microplastics in addition to microfibers. While future investigations are still needed to address other sources of microfibers release to the environment, this work shows that washing machine filters are an effective tool to capture microfibers when applied in people's homes. Washing machine filters may be a key milestone on the path toward reducing microfibers in the environment. The implementation of filters as a solution will also require support by legislation, innovation, and awareness to drive change.

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