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Environmental Impacts of Contact Lens Waste

Senior Honors Project
Abigail Wilhelmi

Introduction

Contact lenses have been used for decades to correct vision. Their materials have evolved to enhance vision as clearly as possible while maintaining the eye health of the user, ultimately resulting in a plastic polymer, silicone hydrogel.

Contact lenses, as well as their packaging and care products, have contributed to increased plastic pollution and may also contribute to microplastic contamination.

Microplastic Contamination

Microplastics are plastic particles under 5 mm by the longest dimension.

Microplastic in water treatment plants may be an important source of microplastics to humans (Figure 1¹).

Harmful contaminants, such as pesticide or bacteria, can adsorb to microplastic and cause adverse effects if ingested.

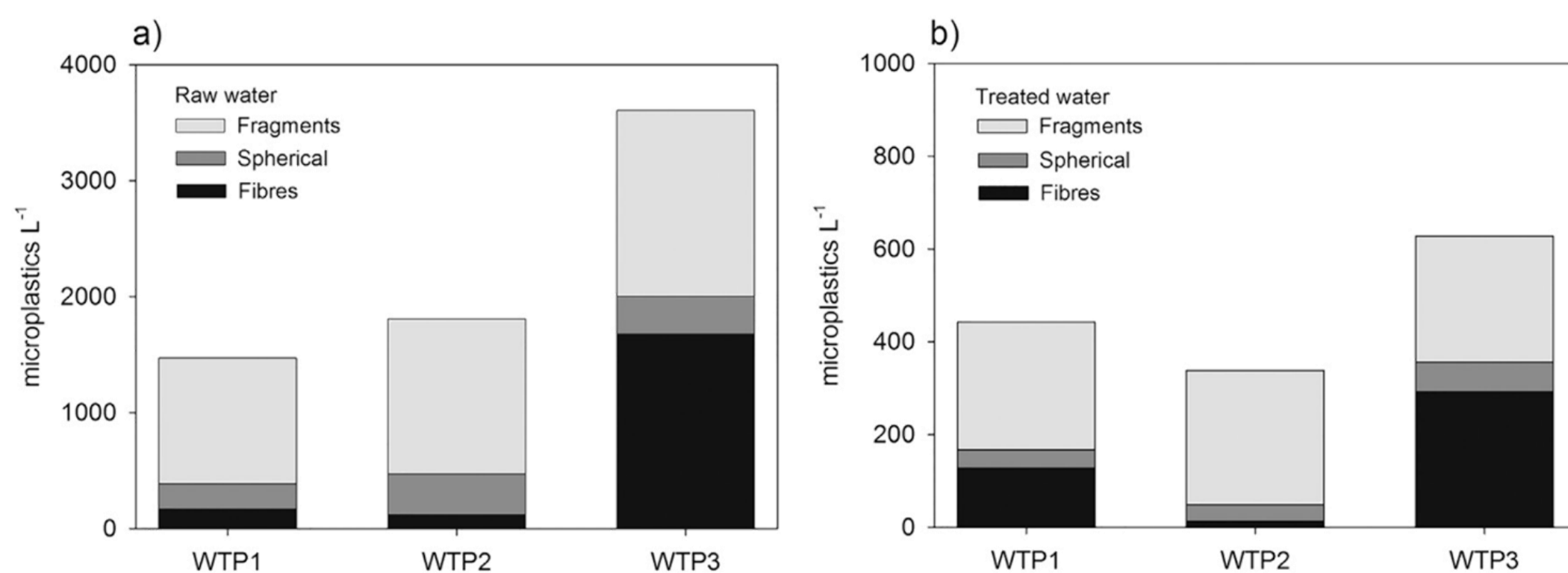


Figure 1¹: A comparison of microplastic shapes and quantities in 3 wastewater treatment plants.

Contact Lens Materials

Contact lens material must be as permeable to oxygen as possible, as there are no blood vessels which oxygenate the cornea. They must also exhibit hydrophilicity to adhere to the eye, but minimally disrupt the tear film.

Past and current contact lens materials:

- 1880s – glass
- 1940s – polymethylmethacrylate (PMMA)
- 1960s – hydroxyethyl methacrylate (HEMA)
- 1990s – silicone derived HEMA

Contact Lens Waste Related Research

There are approximately 150 million people who use contact lenses worldwide. Including plastic care materials, it is estimated this results in over 132 million kilograms, or 291 million pounds, of contact lens related plastic waste annually.

A 2020 survey found 21% of contact lens wearers still flush or wash their lenses down the drain, putting them directly into the water system. Analysis of contact lenses taken from wastewater treatment plants showed little chemical degradation, but notable physical degradation.²

Studies on the overall use of plastic for contact lenses showed conventional systems using the most plastic and monthly replacement systems using the least (Figure 2³).

Analysis of recyclability shows that 100% of daily disposable contact lenses and materials can be recycled if household recycling is combined with a specialist recycling program (Figure 3⁴).

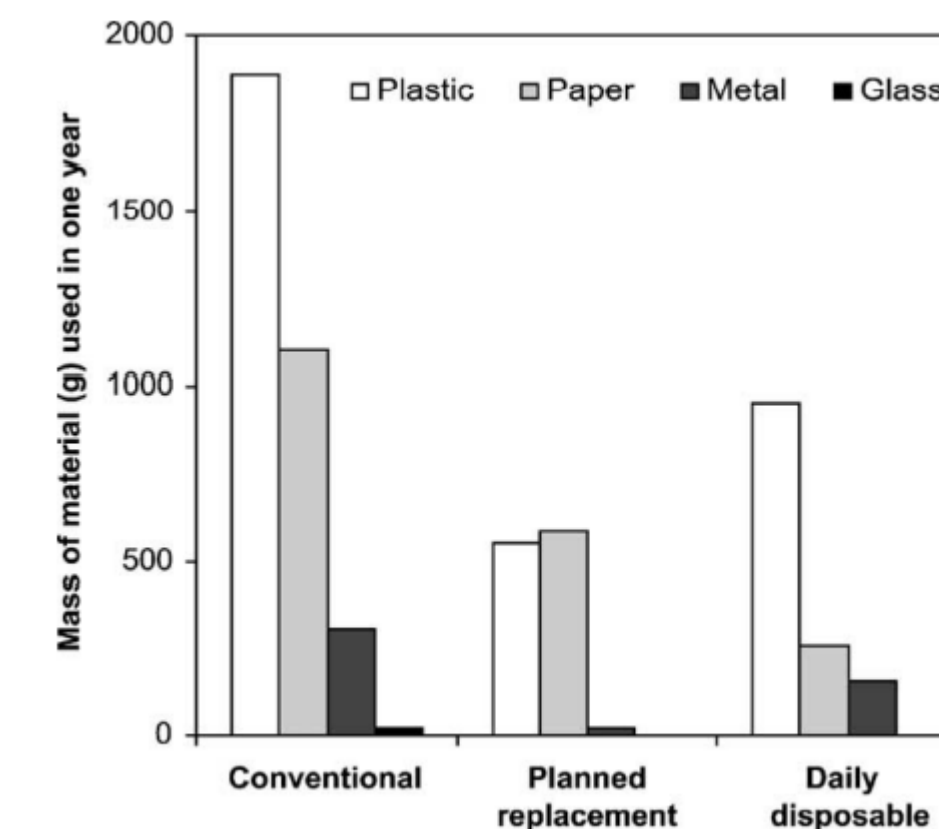


Figure 2³: Varying contact lens modalities are compared for amounts of disposed materials used.

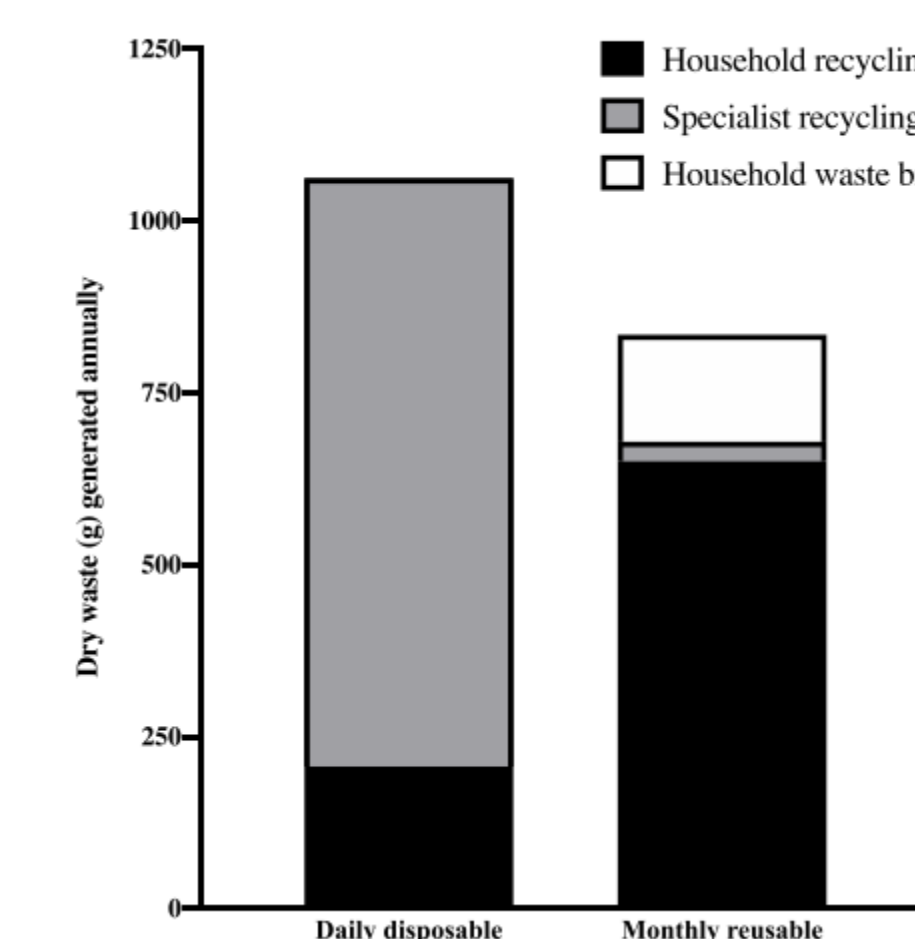


Figure 3⁴: A comparison of the recyclability of daily disposable and monthly reusable contact lens and related plastic material.

Current Solutions



Figure 4: Over 200 used contact lenses and plastic blister packs to be recycled through Bausch & Lomb's One by One Recycling Program.

Bausch & Lomb One-by-One Recycling Program with Terracycle has recycled more than 162,000 pounds of CL waste since launching in 2016.⁵

Acuvue recycling in the UK, also with Terracycle.⁶

CooperVision partnered with Plastic Bank to produce the first net plastic neutral contact lens, funding the reuse of plastic waste equivalent to the plastic in a box of contact lenses.⁷

Conclusions

Silicone hydrogel has become the primary contact lens material because of its ability to maintain eye health while providing clear vision for the user. There is currently no naturally occurring material that would provide all the necessary properties of a contact lens.

Contact lens waste may be contributing to microplastic contamination of water systems.

The International Union for Conservation of Nature states recycling and reuse of materials as the most effective actions available to reduce the environmental impacts of plastic.

Informing contact lens users of their disposal options and the consequences of flushing contact lens waste down the drain is essential.

Acknowledgements

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