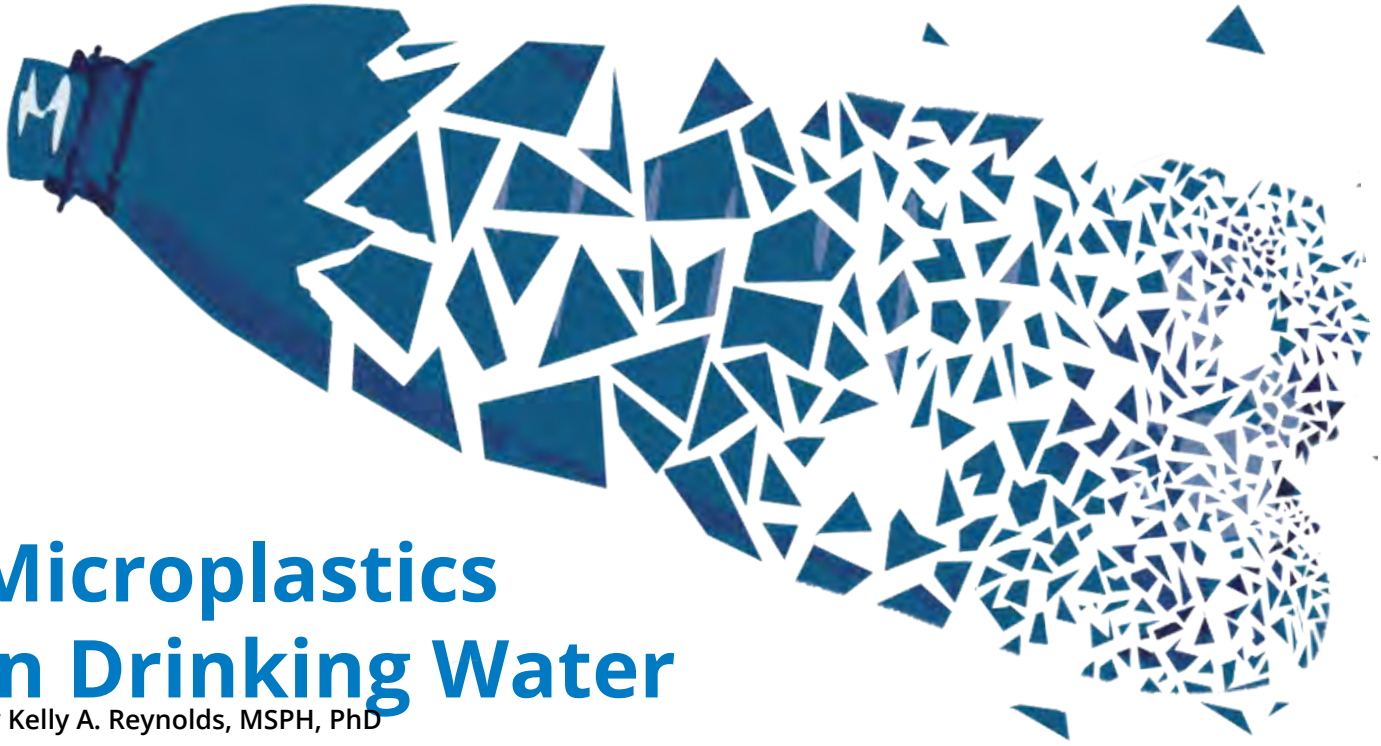

Microplastics in Drinking Water

By Kelly A. Reynolds, MSPH, PhD

The prevalence of microplastics in drinking water is an emerging issue and the topic of recent media headlines and research priorities. One media outlet reported that globally, humans ingest an average of five grams of microplastics each week—the equivalent of a credit card.[1] Given that the impacts of these contaminants on human health are unknown, more research is needed to assess exposure potentials, toxicological risks and mitigation strategies.

What Are Microplastics?

The first synthetic plastic was produced in 1907 but production boomed after 1950 to over 380 million tons annually today. Cumulative production approaches nearly eight billion tons of plastic—more than a ton for every person currently alive (https://ourworldindata.org/plastic-pollution). Poor management of plastic waste has led to a global crisis with broad ecological consequences. According to the United Nations Environment Programme (UNEP), by 2050 there will be more plastic in the sea than fish (https://www.unenvironment.org/interactive/beat-plastic-pollution/).

Plastics dumped into the environment break down into smaller byproducts that may unknowingly be consumed by animals and people. These microplastics are tiny plastic contaminants measuring less than five millimeters in size. Invisible contaminants have been found in water and wastewater ranging in size from five to 20 microns, where they can escape conventional treatment works.

A wide variety of man-made materials contribute to microplastic contamination in the environment. While industrial wastes and pollution are recognized environmental sources, personal care products like toothpastes and body washes (with microbeads), artificial fibers from clothes or the breakdown of larger plastic materials into fragments and fibers are also common contributors. Effluent from a single washing machine may contain hundreds of thousands of synthetic plastic fibers shed from polyester, nylon or acrylic materials.

Drinking Water Contamination

Microplastics are ubiquitous in the environment and have been detected in water, air and food. Common food items (such as fish and salt) and drinks (such as water and beer) routinely test positive.[2] Water may be the largest source of human ingestion of microplastics, followed by shellfish (Cox). A growing number of studies have found microplastics in a variety of drinking-water sources, including rivers, lakes, tap water and bottled water.[3]

Orb Media, a non-profit investigative journalism group based in Washington DC, in collaboration with a researcher from the University of Minnesota School of Public Health, found more than 80 percent of tap water samples, collected across five continents, were positive for microplastic contamination. The US had one of the highest frequencies, with 94 percent of tap water samples testing positive.[4]

Bottled water was also tested and found to be positive at a similar frequency. A sample size of 250 bottles of water comprised of 11 major brands across nine countries was found 93-percent positive for some level of microplastic contamination. Plastic bottles can inherently contribute to the particle load by leaching microplastics into drinking water products.[5] Americans are estimated to consume up to 121,000 microplastic particles per year from drinking water. That number may increase by tens of thousands for those who use bottled-water sources as opposed to tap water (http://Orbmedia.org/stories/plus-plastic/).

In a comparison of plastic, paper and glass water containers, one study found that reusable plastic containers contributed on average 118 ± 88 microplastic particles/L to the water content, compared to 14 ± 14 particles/L in single-use plastic bottles. Still, microplastic content in water stored in paper cartons and glass bottles was 11 ± 8 particles/L and 50 ± 52 particles/L, suggesting contamination prior to packaging or from other sources. Most of the particles in water from the reusable plastic bottles consisted of polyester (primary polyethylene terephthalate PET [84 percent]) and polypropylene (PP, 7 percent), common compounds in water bottles caps, respectively. Polyethylene is also found in beverage cartons coated with foils and lubricants.

Health Concerns

Data on health risks associated with microplastic exposures are very limited. Plastics are not considered highly toxic materials; however, the high rate and frequency of exposures has many scientists concerned. According to a study by the European Food Safety Authority on microplastics in seafood, 90 percent of the non-digestable particles likely pass through the gut.[6] Others may deposit in the intestines or spread to the blood, kidneys, liver, pancreas and other vital organs. Some researchers suggest particles can initiate inflammation and immune response in the body but the long term or overall health impact is currently a mystery.[3] Another indirect concern is that chemicals in the environment can adsorb to plastics and may be released after consumption. Suspected carcinogenic chemicals such as PCBs (polychlorinated biphenyls) and PAHs (polycyclic aromatic hydrocarbons) are used during plastic manufacturing and may contribute to hazard risks.

Minimizing Exposures

Once plastics are in the environment and break down into microplastic particles, preventing exposure is very difficult. Therefore, reducing plastic production and use is the first line of defense for minimizing environmental contamination. In 2015, the United States banned the production and sale of microbeads commonly used in beauty products. Consumers can drive the momentum toward minimizing plastic packaging and using more paper cartons or glass containers. The next best practice is broader implementation of effective containment.

This small size of microplastics makes them more difficult (but not impossible) to treat. Conventional drinking-water treatment may remove as much as 90 percent from drinking water but high levels may still remain. For example, monitoring for microplastics before and after municipal drinking-water treatment revealed an abundance of particles ranging from 1473 ± 34 to 3605 ± 497 particles L−1 in raw water and from 338 ± 76 to 628 ± 28 particles L−1 in treated water across three different utilities.[7] All samples tested positive for some level of microplastics; 95 percent of the particles were below 10 microns and as small as one micron.

Conclusion

There are no regulatory standards mandating removal of microplastics from our food or water supplies. Thus, individual consumers are responsible for their removal at the point of use. POU filters may be used but ensuring the right method is in place is critical. For example, granular activated carbon filters typically remove particles larger than five microns. Carbon block filters may be rated down to 0.5-micron nominal pore size. Maximum efficacy for microplastic removal may be found with ultrafiltration and reverse osmosis technologies capable of filtering particles as small as 0.001 microns. Only time and continued research will tell whether or not microplastic contaminants are a significant risk to human and animal health. Consumers, however, tend to be opposed to any foreign substances in water, particularly when investing in POU-treated or bottled-water supplies.

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SETTING THE STAGE: GROUNDWATER GUARDIAN IN YOUR COMMUNITY

Kick off Groundwater Week 2019 by discovering how your work connects you with your community and its groundwater. The Groundwater Foundation invites you to an afternoon and evening of activities at Springs Preserve just outside of Las Vegas on Monday, December 2 that will set the stage for a great week. From 1:30 – 5:30 p.m., the afternoon activities and sessions will provide you with the tools and resources to recharge groundwater protection and education in your community and be recognized as a Groundwater Guardian, including:

- **Peer-to-peer networking and connections**
- **Sessions featuring innovative approaches to community-based groundwater protection and education**
- **A tour of Springs Preserve to discover how groundwater helped establish the City of Las Vegas**

The afternoon sessions will be followed by the Cheers to Groundwater Reception from 5:30 – 7:00 p.m., which will feature:

- **A fun and interactive groundwater festival**
- **Groundwater-infused cocktails**
- **Groundwater-grown appetizers**

Shuttle buses will run between the Westgate and Springs Preserve from 12:15 – 7:30 p.m.

For more information and to register, visit www.groundwater.org/settingthestage.