Microplastics

What are microplastics?

Microplastics are solid polymeric materials smaller than 5 millimeters, or about a quarter of the width of a penny. There are multiple definitions, but the general consensus on their lower size limit is 1 nanometer in size. Microplastics most often result from the degradation of larger plastics in the environment or the shedding of fibers from textiles, but they also originate as purposefully designed microplastics such as microbeads in makeup or nurdles, which are plastic pellets used to manufacture plastic goods. Microplastics are diverse in their shape, color, and chemical composition, which has made it difficult to formally define and measure them.

Plastics (and microplastics) are everywhere in our environment.

As a society, we surround ourselves with plastics: we eat and drink from plastic containers, cook food with plastic utensils, clothe ourselves in synthetic fabrics made from plastic fibers, furnish our living and work areas with carpeting and furniture made from synthetic materials, cover our fields with plastic tarps, and apply synthetic paints to our roadways and boats. Even our air contains plastics: synthetic fibers found in indoor air are the primary source of microplastics that we consume or inhale. A 2019 study estimated that humans consume and inhale 74,000 to 121,000 microplastic particles annually, which is approximately twice the amount of plastic particles compared to when only food and drink are considered.[1] The study also determined that those who drink bottled water consumed twice the amount of plastic particles as those who drink tap water.

Where do microplastics come from?

Sources and pathways for microplastics entering the environment are as diverse as our use of those very same plastics. Wastewater facilities are just one of many pathways for microplastics to travel from their source to the environment. However, multiple studies have shown the overall contribution of microplastics from wastewater facilities are comparatively low. Recent studies concluded that discharge of treated wastewater from a municipal treatment plant plays a minor role in terms of microplastic emission to the aquatic environment, and that other sources such as stormwater runoff and atmospheric deposition likely are more important sources.[2]

What we know about health effects for humans and the environment.

Though microplastics are ubiquitous, reliable data on the effects on human health are limited and inconclusive. Recent studies have demonstrated the presence of microplastics in items we eat and drink every day, including drinking water and many common food items, and subsequently, they have been found in human stool and body tissues. However, in 2019 the World Health Organization released a seminal report that concluded that there was little evidence to indicate a human health concern from microplastics in drinking water, while acknowledging that more research was needed. Some early ecological research has indicated that there may be impacts of microplastics on aquatic life, but these experimental laboratory studies often used levels of microplastics that are not found in nature, and a nearly equal number of studies did not demonstrate such impacts. Without additional data, it is difficult to draw any firm conclusions about the health effects of microplastics on humans and the environment. High-quality, well-defined studies using repeated measurements and realistic exposure experiments are needed to address these inconsistencies.

[1] Human Consumption of Microplastics. Environmental Science & Technology (2019)

[2] Understanding Microplastic Levels, Pathways, and Transport in the San Francisco Bay Region (2019). San Francisco Estuary Institute.

What are the comparative loadings of microplastics in wastewater effluent?

Relative to the everyday pathways, wastewater effluent and biosolids are not the most significant contributor to human exposure to microplastics. Wastewater treatment plants are pathways of microplastics and microfibers which enter from industrial, commercial, and residential waste streams, and the majority of microplastics are removed from effluent through primary and secondary wastewater treatment. Though there has been much focus in California on wastewater effluent as a significant pathway of microplastics to the environment, actual amounts found in wastewater are very low compared to other sources. As one example, a 2019 study found that stormwater contained

over 300 times the amount of microplastics that ended up in waterways when compared to wastewater effluent.[3]

Microplastics in biosolids are comparatively low as well.

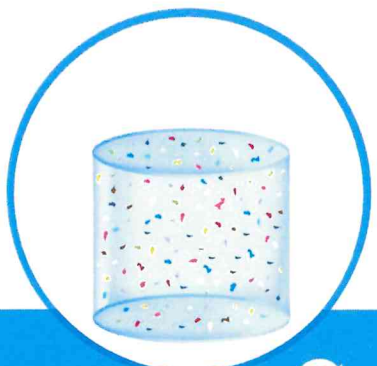
While the majority of microplastics are removed during primary and secondary wastewater treatment, they do not simply disappear. Rather, they are removed from the wastewater stream and can be present in biosolids, leading to some concern that biosolids may be a pathway of microplastics entering the environment. However, in recent studies, biosolids were found to contribute low amounts of microplastics relative to other pathways such as agricultural use of plastics (like plastic mulch and tarps). Moreover, less than 0.5% of California agricultural land receives biosolids.[4] Similarly, a 2017 Danish study actually found higher concentrations of microplastic in soils where biosolids had not been added as fertilizer, indicating that biosolids are just one of many sources of microplastic emission to agricultural soils. [5] Despite any microplastics content, the land application of biosolids remains a beneficial way to recycle organic matter and nutrients, to improve the physical, chemical, and biological properties of soils, and to re-establish vegetation and restoration of degraded ecosystems.

Standardized measurement methods for microplastics are still evolving.

As we begin to better understand the diversity and characteristics of microplastics, the methods we use to find, detect and classify microplastics are also evolving. It is fundamentally important that researchers agree on a definition of this class of contaminants, as well as the methods to measure and count them, before thresholds and management actions are developed. Scientific reviews have highlighted that differences between protocols and contamination can lead to under- and over-estimation of microplastics in different samples. Beyond differences in collection and analytical approaches, there has been a lack of standardization in study design, field sampling, sample preparation, and sample analysis resulting in data that is difficult to interpret, challenging to use, and impossible to reproduce in subsequent studies. Therefore, it is incredibly important that methods be standardized across different samples and techniques, to ensure the appropriate focus of efforts on monitoring and solutions.

Reducing microplastics in the environment: focusing on source reduction and control.

Source reduction is the most important step that we can take as a society to reduce microplastics entering both the environment and our treatment plants. Actions to manage microplastics should be focused on limiting the use of plastic products that contribute the most pollution to the environment, including plastic bags, plastic bottles and caps, straws, food wrappers, and other single-use plastic items, while also incentivizing the use of alternatives to plastics. Reduction of microplastics should focus on sources of the most prevalent microplastics to the environment, including things like tire particles, plastic production, and textile capture. The most efficient and meaningful way for our society to reduce microplastics in the environment is to reduce and eliminate the production and use of plastics at its origins, rather than costly diversions or cleanup efforts after plastics have been released to the air and the environment.



[3] Understanding Microplastic Levels, Pathways, and Transport in the San Francisco Bay Region (2019). San Francisco Estuary Institute.

[4] Transport and fate of microplastic particles in wastewater treatment plants. Water research, 91, 174-182 (2016); A simple method for the extraction and identification of light density microplastics from soil. Science of the Total Environment (2018).

[5] Microplastic in Danish wastewater: Sources, occurrences, and fate (2017). Denmark Environmental Protection Agency.

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