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Microbeads: An Emerging Water Quality Issue

For decades, water quality professionals have faced the challenge of controlling a variety of conventional and nonconventional pollutants (e.g., nutrients and suspended solids; oil and grease) and toxic chemical compounds that can harm aquatic life in lakes, streams, and coastal waters, as well as public health. Microplastics, plastic fragments that measure less than 5 millimeters (mm) in size (0.2 inches), are contaminants of recent and growing concern. Microplastic is ubiquitous and persistent in the environment. It has been reported in marine and coastal waters and many freshwater lakes and rivers worldwide, as well as on beaches and in sediments: a 2014 study estimated that 5.25 trillion plastic particles weighing nearly 270,000 tons are floating on seas globally.

One source of microplastic pollution has received attention: microbeads, which are a subset of the contamination problem (probably less than 10% by volume). A number of companies are voluntarily removing microbeads from their consumer products, and nine states passed laws to ban manufacture and sale of products with microbeads. In December 2015, Congress passed legislation, the Microbead-Free Waters Act (P.L. 114-114), to ban manufacture and distribution of cosmetic products that contain microbeads in the United States.

Background

Most microplastic debris results from the breakdown of items such as plastic bottles and bags, synthetic clothing fibers, and boat paint particles, in addition to personal care products. In the aquatic environment, marine mammals, birds, and fish and shellfish cannot distinguish microplastics from food. Once in the food chain, particles may threaten aquatic life and public health, but risks—particularly for humans—are not well understood. The particles themselves may contain toxins. Additionally, microplastic fragments can act like sponges, adsorbing persistent organic pollutants, such as polychlorinated biphenyls (PCBs), which are harmful to organisms that consume them. Microplastics show minimal biological degradation. Particles may remain in the environment for a long time and travel a long way from the point of origin, continuously releasing toxic substances that may result in long-term harm to biological diversity and ecosystems.

Microbeads are synthetic polymers such as polyethylene or polypropylene plastic. They are used as abrasives and exfoliants in hundreds of consumer and personal care products such as facial scrubs, shampoos and soaps, lip gloss, deodorants, and toothpaste. The particles are tiny—from 5 micrometers (µm) to 1 mm in diameter (the latter is about the size of the period on a printed page; see **Figure 1**). A single product can contain hundreds of thousands of microbeads.

Figure 1. Plastic Microbeads



Source: <http://www.nationofchange.org/2015/10/10/california-passes-nations-strongest-ban-on-plastic-microbeads/>.

In most cases, microbeads are intended to be washed down the drain after use and end up in the municipal sewer system. Because microbeads are so small, most wastewater treatment technology is not capable of filtering or removing them completely from the wastestream. Most microbeads do not biodegrade, as they require high-heat processing to break down, which municipal sewage treatment systems typically are unable to do. As a result, particles pass through the plant and are discharged into nearby waters. A 2015 report by the New York State Attorney General's Office found microbeads in effluent samples from 25 of 34 wastewater treatment plants studied, concluding that microbeads likely are being discharged at the majority of treatment plants operating across New York State. Particles that subsequently enter water supply systems are not removed by drinking water treatment technologies.

A growing body of research reports microplastic contamination throughout the marine food web, ranging from zooplankton and invertebrates to species such as bluefin tuna that are consumed by humans. Recent studies have drawn attention to concentrations of plastic particles in freshwaters, such as the Great Lakes and Lake Champlain, at greater concentrations than in ocean waters. In 2014, the U.S. Geological Survey began a study of microplastics in rivers, sampling 29 Great Lakes tributaries across six states. Other research of Great Lakes waters suggests concentrations of more than one million bits of microplastic per square mile in some parts of the lakes' surfaces. Microbeads occurred in more than 60% of the samples.

Responses

Consumer and advocacy groups began campaigns in 2013 urging that products containing microbeads be redesigned to incorporate less problematic constituents. Some groups maintain lists of products that contain microbeads and urge consumers to seek out alternatives. In response, companies such as Johnson & Johnson, Unilever, and Procter &

Gamble initiated voluntary efforts to eliminate the use of microbeads in their products in favor of alternatives. Consumer groups endorsed the companies' efforts, while also noting that they did not apply to all manufacturers and were not legally enforceable.

Initial legislative responses to the microbeads issue occurred at the state level. Bills were introduced in more than two dozen states. Nine states and several New York counties passed laws to ban manufacture and sale of products that contain microbeads. Illinois was the first state to enact legislation, in 2014; eight others passed bills in 2015 (California, Colorado, Connecticut, Indiana, Maine, Maryland, New Hampshire, and Wisconsin). These state laws differ in various ways, including how terms such as "plastic microbeads" and "biodegradable" are defined, whether biodegradable products are excluded from bans, and what types of products are covered. The state laws established schedules for banning manufacture and sale of consumer products that contain microbeads and prohibiting manufacture and sale of over-the-counter drugs that contain microbeads, but with differing implementation timelines. Advocacy groups, such as the Alliance for the Great Lakes, argued that state law differences could lead to a confusing patchwork of standards across the country, creating problems for interstate commerce, and urged Congress to enact a federal ban on microbeads in cosmetics and personal care products. Industry groups, such as the Personal Care Products Council and the American Chemistry Council, supported a uniform federal approach that avoids different requirements and deadlines across the states and gives manufacturers sufficient time to reformulate their products.

People often use the term "personal care products" to refer to a variety of items commonly found in the health and beauty departments of drug and department stores. The term is not defined in law, however. Under the Federal Food, Drug, and Cosmetics Act (FD&C Act), many products intended to cleanse or beautify are regulated as cosmetics. Examples include skin moisturizers, lipsticks, shampoos, toothpastes, and deodorants. These products are primarily subject to labeling requirements. Other personal care products that are intended to treat or prevent disease—such as antiperspirants and treatments for dandruff or acne—are drugs under the FD&C Act and must receive premarket approval by the Food and Drug Administration (FDA). Some products are both cosmetics and drugs and must meet FD&C Act requirements for both. Examples include beauty products that bear sun-protection factor (SPF) claims or antidandruff shampoos.

Before passage of the Microbead-Free Waters Act of 2015 (P.L. 114-114), no agency regulated plastic microbeads. The Environmental Protection Agency has authority under the Clean Water Act to regulate microbeads that enter wastewater from industrial discharges, but that authority does not extend to directly regulating microbeads in wastewater effluent released from households.

The new federal law amends the FD&C Act to prohibit the manufacture and distribution of rinse-off cosmetics

(including toothpastes) that contain intentionally-added plastic microbeads. The ban takes effect on:

- July 1, 2017, for manufacturing, and July 1, 2018, for distributing; and
- July 1, 2018, for manufacturing a rinse-off cosmetic that is also a nonprescription drug, and July 1, 2019, for distributing a rinse-off cosmetic that is also a nonprescription drug.

The act defines a plastic microbead as "any solid plastic particle that is less than five millimeters in size and is intended to be used to exfoliate or cleanse the human body or any part thereof." It preempts states or localities from establishing restrictions on the manufacture or distribution of rinse-off cosmetics containing plastic microbeads that differ from those in the federal law, including those previously enacted.

The new federal law does not provide an exemption for biodegradable plastics, which some of the recent state laws allowed. Laws passed by Indiana, Colorado, and Maine would allow manufacturers to replace plastic microbeads with biodegradable alternatives. Consumer groups oppose such provisions, arguing that claims of biodegradability have not been scientifically proven and that exemptions put the "burden of proof" on officials, not manufacturers, to prove that a changed product is a non-biodegradable plastic. Other states (e.g., Connecticut, Maryland, and California) prohibited such alternatives or allowed them only after a process to certify biodegradability.

Consumer and advocacy groups are generally supportive of the new U.S. law, although some are concerned that restricting its applicability to products that are "used to exfoliate or cleanse in a rinse-off product" may not address plastic microbeads used in products that are not designed to exfoliate or cleanse, such as skin moisturizers or lipsticks, because rinse-off products are only one of many sources.

In June 2016, Canada took action to align its control of plastic microbeads to the new U.S. restrictions. Following a unanimous resolution passed by the House of Commons, the Canadian government finalized an order under its Environmental Protection Act designating plastic microbeads up to 5 mm in size as a toxic substance. The designation will enable the government to propose risk management measures, either rules or nonregulatory approaches, to manage the environmental risks that microbeads pose. Beyond North America, several European nations have called for an EU-wide ban on microbeads, including the Netherlands, which enacted a ban in 2014. The European Parliament called for single-use plastics that cannot be recycled, such as plastic microbeads, to be phased out of the market or banned outright. In 2015, the United Nations Environment Program recommended a global ban on microplastics in personal care and cosmetic products.

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