Microplastics in Biosolids

WEAO Fact Sheet

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What are Microplastics?

Microplastics are very small particles of plastic, which are typically made of polymers derived from petrochemicals (i.e., coal, oil, and natural gas). They can persist in the environment from several hundreds to thousands of years. Plastics do not biodegrade but instead break up into smaller and smaller pieces over time when exposed to environmental factors such as wind, sunlight, different temperatures, and shear forces. Based on their size, plastics can be classified as macroplastics (>25 mm), mesoplastics (5-25 mm), and microplastics (<5 mm). Microplastics come in various shapes (i.e., fragments, beads, fibres, and films) and polymeric compositions, which ultimately determine their transport and fate in the environment.

Microplastic Sources

There are several sources of microplastics to the environment [1,2]. Plastic waste litter can be carried to the environment through surface water runoff, wind dispersal, soil erosion and then break up into microplastics. Laundering of clothing that contains synthetic materials (i.e., acrylic, fleece, and polyester) contributes microfiber plastics to wastewater systems. Another contributor of microplastics can be some hygiene and beauty products such as exfoliants, toothpaste, sunscreens, and moisturizers. Degradation of tires and paint used for road markings and house exteriors account for 10% of microplastic pollution entering the environment through air deposition [1]. Other sources include accidental industrial releases, combined sewer overflows, stormwater discharges, and microplastics that may be associated with the agriculture and fishing industry as well as recreational activities.

Microplastics in Wastewater and Biosolids

Wastewater treatment plants do not generate microplastics; they simply provide a transport pathway. Microplastics are generally resistant to biological and chemical treatment processes, and wastewater treatment plants today cannot significantly degrade microplastics. Conventional wastewater treatment plants are, however, effective in removing 80-95% of microplastics from wastewater through physical treatment processes, and with additional polishing steps and end-of-pipe technologies (i.e., rapid sand filters, microfiltration), 99% removal can be achieved [1,3]. Heavier microplastics are captured mainly in the preliminary (i.e., screens, grit removal) and primary treatment processes (i.e., primary sedimentation, scum removal). The release of microplastics in wastewater effluents may just form <0.1% of microplastics introduced to surface waters in urban areas [4].

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While materials from preliminary treatment processes are typically disposed of in landfills, sludge from primary sedimentation is typically further treated to produce sewage biosolids. This can reintroduce microplastics into the environment when applied to land or otherwise beneficially used. Research has shown that microplastics concentrations increase in soils after each biosolids application [5]. To date, there are no feasible treatment processes that can separate or remove microplastics from sewage sludge and biosolids. Some of the smaller and lighter microplastics, including microfibers, escape wastewater treatment and remain in wastewater effluents. The quantity of microplastics that are discharged from wastewater treatment plants in treated effluents or biosolids is relatively small compared to other sources of microplastics that enter aquatic and terrestrial ecosystems [6].

Environmental and Health Impacts

Microplastics' environmental and health effects are highly dependent on their concentration, size, shape, and chemistry [1,2]. At current microplastic concentrations in the environment, no clear environmental or health impacts have been observed [7]. However, a relationship between high levels of microplastics and adverse environmental impacts has been reported. The long-term effects of microplastics at environmental concentrations are still unknown [8,9,10]. Although humans are exposed to microplastics through various sources in their daily lives, mostly through food, there are currently no significant reported impacts on human health [10].

Knowledge Gaps

Microplastics are a relatively new research area and there are many knowledge gaps. There are still no standardized methods for sampling, quantification, and characterization of microplastics, and there are very limited data on their concentrations in Canadian water, wastewater, biosolids, and soil environments. Further, more research is needed to understand the short- and long-term ecotoxicological and health effects of microplastics.

How can we control plastic and microplastic pollution?

Source control is the only effective and sustainable solution to control plastic waste. Plastic recycling has not been a highly impactful method for controlling plastic pollution because production of plastics from raw materials is cheaper, and thus more favourable to industry, than recycling plastics. As a result, a very small percentage of plastic waste is recycled worldwide. There is an urgent need for a comprehensive regulatory framework that controls all sources of plastic waste to the environment. Several countries have started taking steps in this direction and restricted or banned the intentional use of microplastics in cosmetics and personal hygiene products as well as single-use plastics in packaging. Canada has prohibited the manufacture and import of all toiletries that contain plastic microbeads as of July 1, 2018, with a selective prohibition of the sale of such toiletries effective July 1, 2019 [11]. Furthermore, Canada has introduced Single-use Plastics Prohibition Regulations published on June 22, 2022 which prohibit the manufacture, import, and sale of six categories of single-use plastics that threaten the environment [12].

Conclusions

Plastic waste is ubiquitous in the environment; it is in air, water, and soil. Wastewater treatment plants do not generate microplastics and simply provide a pathway to their release. Biosolids applied on agricultural lands in Ontario enhance soil health, recycle nutrients, sequester carbon, reduce fertilizer use and strengthen farm economies. In Ontario, biosolids are applied to agricultural land as non-agricultural source materials (NASM) following strict rules and regulations under the Nutrient Management Act, prepared by the Ministry of Environment, Conservation and Parks as well as the Ministry of Agriculture, Food and Rural Affairs, or as a commercial fertilizer under the Federal Fertilizer Act of the Canadian Food Inspection Agency and its regulation.

The wastewater sector is committed to understanding more about microplastics and supporting further research. The wastewater community is committed to working with manufacturers and users of plastics along with federal and provincial regulators to reduce plastic production, increase plastic reuse, and develop technologies to capture and remove plastic waste. The wastewater sector supports the development of appropriate additional legislation and regulation to achieve this.

References

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