CAS INSIGHTS™

R&D TRENDS: PRIORITIZING THE MICROPLASTICS PROBLEM

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Overview

Pollution caused by microscopic plastic particles (microplastics) has garnered attention in recent years owing to the surprising locations in which they have been identified, from arctic ice to human blood.

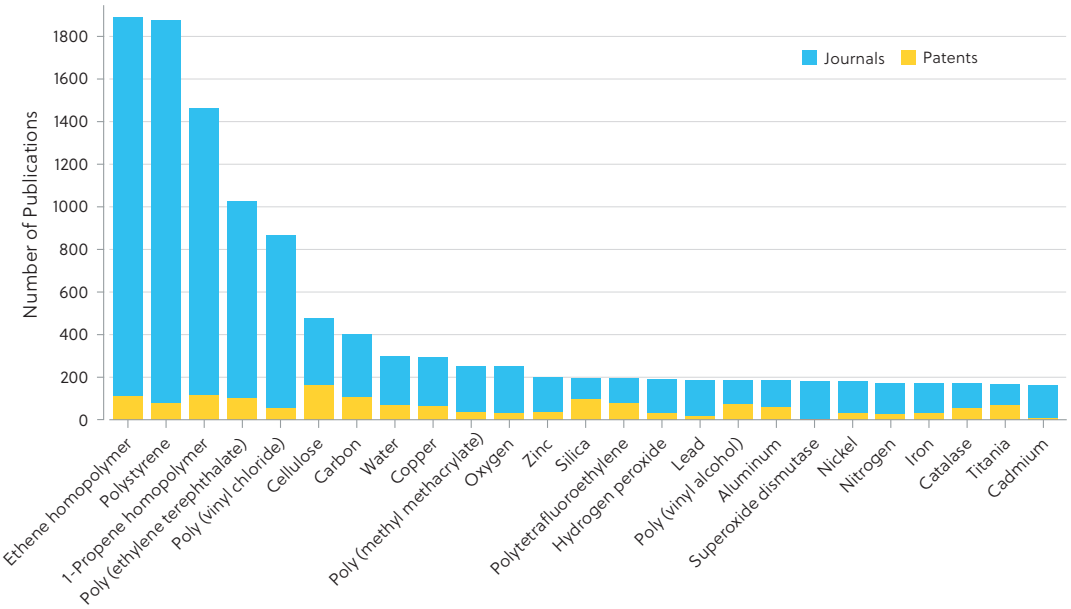
Background: The reach of microplastics is extensive. These plastic pieces and their associated chemicals and additives are harming human health and the environment.

Opportunities: An array of novel methods has been designed to remove microplastics from the environment or prevent their entry completely. However, research undertaken by CAS indicates a lack of innovation in microplastics research.

Key challenges: More research must be done to characterize the effects of microplastics on health, as well as optimize analytical methods for nanoplastic detection. While the problem of microplastics is evident, funding is insufficient. Increased financial support and incentives, along with a reduced use of plastics, are critical steps toward a plastic-free future.

Top registered substances in microplastic publications

Polymers used in plastic manufacturing are, by no surprise, the most prolific materials discussed in microplastics publications. The top five substances being ethene homopolymer (polyethylene), polystyrene, 1-propene homopolymer (polypropylene), polyethylene terephthalate (PET), and polyvinyl chloride (PVC).



The impact of microplastics on human health and natural ecosystems

Single-use plastics and textiles are some of the main contributors to microplastic pollution. Microplastics can be taken in by organisms via ingestion, inhalation, or skin exposure. They have the potential to carry toxic compounds (e.g., phthalates unreacted monomers, flame retardants, persistent organic pollutants, pharmaceutical agents, or metals) and may act in concert with the compounds to cause more harm.

Single and multicellular organisms*	Mice	Humans
• Reduced feeding and photosynthesis • Intestinal damage and inflammation • Changes in oxidative stress and stress-related genes • Reduced reproduction • Changes in intestinal bacteria • Inhibition of acetylcholinesterase	• Estrogenic effects • Thyroid disruption • Hepatoxicity • Oxidative stress • Gastrointestinal distress	• Disruption of fibrin deposition and activity • Reduced immune defence • Potential for increased cancer risk • Gastrointestinal distress • Positive correlation to inflammatory bowel disease

*Evidence from studies of algae, sponges, water fleas, daphnids, nematodes, sea urchins, oysters, clams, invertebrates (crabs, the crustacean *Hyatella azteca*, snails, lugworms, and fish zebrafish (*Danio rerio*), European perch, Japanese medaka (*Oryzias latipes*), goby (*Pomaschistus microps*), and European sea bass (*Dicentrarchus labrax*).

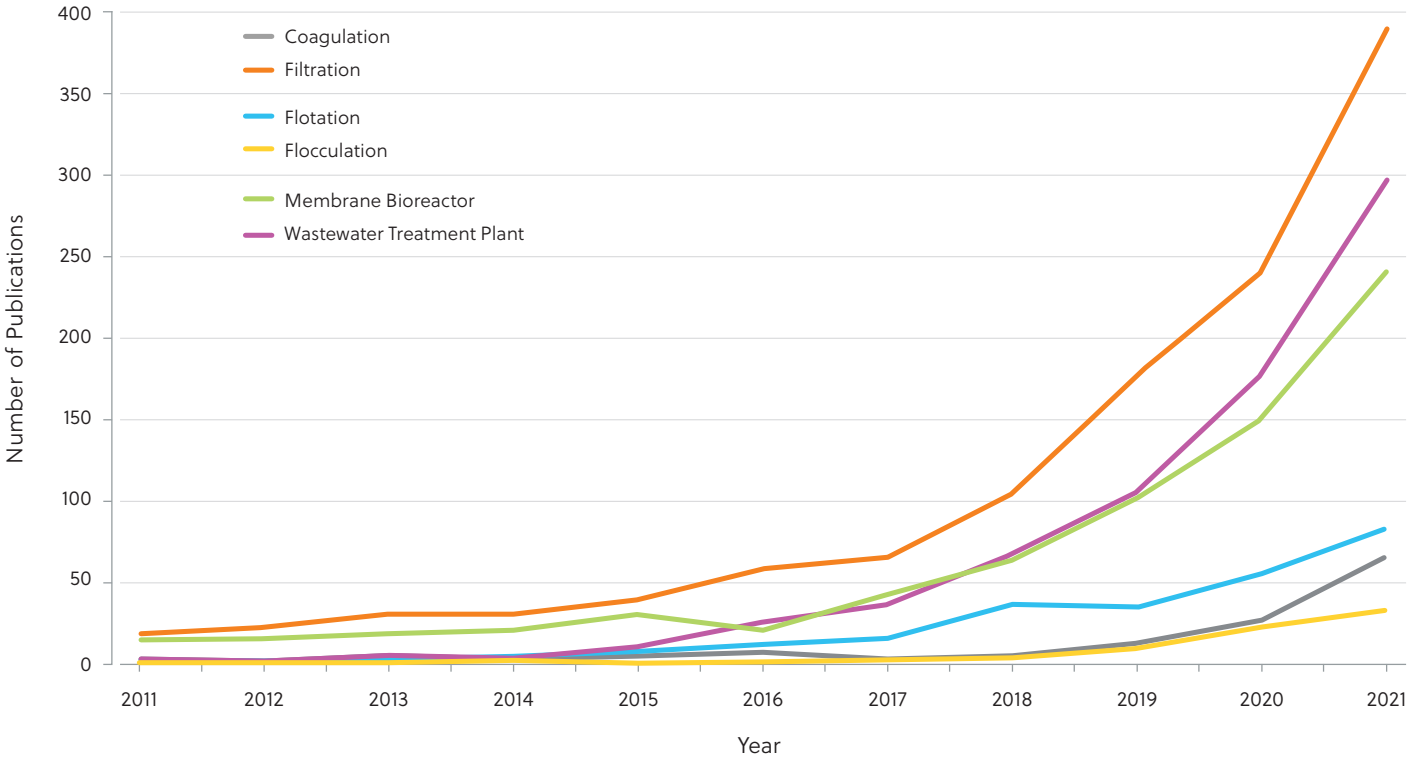
Working toward a plastic-free environment

Concerted efforts from academia and industry have resulted in groundbreaking ideas for tackling microplastics.

Removal			Prevention		
Ship systems	**Interceptors**	**Mussels**	**Wastewater treatment plants**	**Laundry accessories**	**Clothes manufacturing**
Use of ship systems to collect or filter microplastic particles from the water.	Use of plastic waste collecting systems called 'interceptors', which can float on the surface of oceans and rivers and collect plastic debris.	Exploiting mussels, which ingest and excrete microplastics in the form of pellets for easy collection.	Use of ship systems to collect or filter microplastic particles from the water.	Prevent release of microfibers into waste systems.	Revising manufacturing processes to minimize friction and improve the mechanical integrity of garments.

Eliminating microplastics

The number of publications relating to microplastics removal for particular keywords grew sharply after 2017, emphasizing the growing awareness of the problem. Membrane bioreactors were featured in several studies, suggesting the popularity of this newer, more efficient removal method.



Looking ahead

Addressing plastic pollution is a global priority, and there is a clear need for governments to focus on more precise regulation. As experts shed more light on the damage caused by these invisible particles, cross-sector collaboration and investment are vital to instill change and future-proof our society.

Learn more at cas.org/insights

More comprehensive information and references can be found at: cas.org/microplastics-report

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