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Research Brief

Microplastics: Developing Standards that Inform Policy

Overview

Plastics have become an indispensable and pervasive material in modern society, but their true cost to humanity and the environment is not reflected in their price. Costs include harm to environmental aesthetics, habitat, tourism, marine wildlife and food chains. State and federal legislation has fallen short of fully addressing the problem. Defining a scientifically recognized standard for degradable plastic materials that are safe for human health and the environment will be a critical first step to a solution. Stanford researchers have joined a team of scientists to develop such a standard, *Ecocyclable* (see Box). The aim of this standard is to enable policymakers to distinguish plastic materials' safety based on biodegradability, toxicity and potential for accumulation within food chains.

Harmful plastic accumulates in natural and man-made environments.

Key Points for Policymakers

- **A scientifically-vetted microplastics standard, such as *Ecocyclable*, could alleviate the growing plastic pollution problem by helping policymakers determine whether a material is bio-safe and environmentally benign (see Box);**
- **Microplastics should be required to biodegrade within environments of concern, such as the ocean;** they should also be non-toxic to humans and wildlife; and contain no additives that accumulate in food chains;
- **Standards should be applicable to all environments where microplastics may be present, including natural soils, landfills, wastewater treatment facilities and marine ecosystems;**
- **Standards should include designations that distinguish between environments.** For example, a material could be certified as 'generally *Ecocyclable*' if it is biodegradable, non-toxic and non-bioaccumulative in all environments; and "conditionally *Ecocyclable*" within a specified environment in which it meets these three criteria.
- **Official certification by a designated agency or organization could be compulsory.** State-funded land grant university laboratories or non-profits could serve as the certifying entity, or a legislatively defined standard could be mandated.

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Background

An estimated eight million metric tons of plastic waste enters our oceans annually, with a tenfold increase projected by 2025. These microplastics come from many sources, including manufactured microbeads and the breakdown of larger plastic products. The Microbead-Free Waters Act of 2015 bans the use of small manufactured plastic particles in personal care products such as facewash, toothpaste and bodywash, but overlooks other microplastics.

Microbeads

To understand broader health and environment implications, and to find solutions, California legislators passed the California Safe Drinking Water Act: microplastics (SB-1422) and the Ocean Protection Council: Statewide Microplastics Strategy (SB-1263). Both require the development of scientific testing methodologies and standards. When developing such standards and strategies, it is important to consider multiple scenarios because microplastics contamination occurs in both natural and man-made environments.

Banning a particular compound is usually unsuccessful because plastic compositions can be readily changed. A more effective policy strategy would involve establishing a set of universally accepted and scientifically verifiable standards. These standards would ensure that all plastic materials be uniformly tested and given objective environmental safety ratings.

Ecocyclable Definition*

A material, including its additives, is Ecocyclable in a given environment if it satisfies the following criteria for degradability, bioaccumulation and toxicity:

1. In a 180-day period in a specific environment, representative samples of the material degrade to an extent at least 25% of that observed in an equivalent mass of the reference sample – either cotton fiber or poly-3-hydroxybutyrate (PHB) - and the reference sample has equivalent or greater surface area relative to the material sample; AND within 180 days to 18 months in that environment, samples of the material degrade to at least 90% of that observed in an equivalent mass of the reference sample;

2. The material and associated additives do not bioaccumulate in representative organisms; and

3. The material and/or its additives have toxicity that is not significantly greater than that of a comparable composition of either cotton fiber or PHB under acute and chronic exposures to environmentally relevant concentrations.

*Note: the Ecocyclable standard is a trial model and will require refinement through additional laboratory testing.

McDevitt, J., C. S. Criddle, M. Morse, R. Hale, C. Bott, and C. Rochman. 2017. Addressing the issue of microplastics in the wake of the Microbead-Free Waters Act—a new standard can facilitate improved policy. Environmental Science and Technology 51 (12): 6611–6617.

The *Ecocyclable* framework outlines a standardized set of criteria that can be employed to measure a plastic's degradability, toxicity and bioaccumulation against known bio-safe polymers. Those that fail the test would not receive the *Ecocyclable* or bio-safe designation.

Implementing microplastics standards approved by scientists, using *Ecocyclable* or a similar framework like Greenscreen (*www.greenscreenchemicals.org*), could also lead to wider adoption of safer, already-available plastic alternatives. A standard can provide material designers with clear targets. Legislation can incentivize development and use of *Ecocyclable* materials, creating new markets. This, in turn, can stimulate private-sector innovation and scale up, decrease costs, and ensure market prices of conventional plastics reflect their true costs to the environment and society.

About the Author

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Eight million metric tons of plastic waste enters the oceans annually.