Addressing the issue of microplastics in the wake of the Microbead-Free Waters Act—a new standard can facilitate improved policy.

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Ecocyclable 1.0

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 said environment, representative samples (between 100 mg and 25 g, depending on the particular test) of the material degrade to an extent at least 25% of that observed in an equivalent mass of the reference sample, wherein said reference sample has equivalent (or greater) surface area relative to the material sample, and is comprised of either cotton fiber or poly-3-hydroxybutyrate; AND

Within a period of between 180 days and 18 months in said environment, representative samples (between 100 mg and 25 g, depending on the particular test) of the material degrade to an extent at least 90% of that observed in an equivalent mass of the reference sample, wherein said reference sample has equivalent (or greater) surface area relative to the material sample, and is comprised of either cotton fiber or poly-3-hydroxybutyrate;

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 (as determined by rigorous statistical testing, $\alpha=0.05$) greater than that of a comparable composition (size and shape) of either cotton fiber or poly-3-hydroxybutyrate under acute and chronic exposures to environmentally relevant concentrations.

The three representative environments are (i) aerobic soil environment; (ii) anaerobic methanogenic environment (as found in modern landfills and anaerobic wastewater treatments), and (iii) aquatic environment.

Alternately, a shorter period is acceptable if a standardized test for degradation takes less than six months to reach completion.

As determined by standardized tests for biodegradation from ISO, ASTM, EPA, OECD, EN or other organizations, provided the test is listed as acceptable below. Additional tests may be added subsequently. For aerobic aqueous or soil environments, approved tests include versions of ASTM D5988 and ISO 17566. For anaerobic methanogenic environments, approved tests include ASTM D5526 and ASTM D5511. For aquatic environments, testing in marine environments is required, and approved tests include ASTM D7081 and ASTM D6691. If the material is processed using standard thermoplastic processing methods such as injection molding, blow molding, thermoforming, transfer molding, reaction injection molding, and compression molding, then the appropriate reference sample shall be purified poly-3-hydroxybutyrate (not cotton fiber). For all other materials, including materials processed via extrusion, the reference sample may be either poly-3-hydroxybutyrate or cotton fiber.

Bleached, scoured, undyed cotton fiber having an average molecular weight of 1,000,000 or less.
Purified poly-3-hydroxybutyrate having an average molecular weight of 1,000,000 or less.

As determined by standardized tests for bioaccumulation from ISO, ASTM, EPA, OECD, EN or other organizations, provided the test is listed as acceptable below. Additional tests may be added subsequently. Test organisms must be relevant to the representative environment. For aerobic soil environments, approved tests include EPA Test Method 100.3: *Lumbriculus variegatus* Bioaccumulation Test for Sediments. For aquatic environments, approved tests include OECD Test No. 305: Bioaccumulation in Fish: Aqueous and Dietary Exposure.

As determined by standardized tests for toxicity of sample and reference materials from ISO, ASTM, EPA, OECD, EN or other organizations. In cases where debris from physical material will be small (e.g., fibers and microbeads), sizes of the materials used in the test should be relevant to the size that will be found in the environment of interest and studies should be dietary. For materials that will be larger than what can be consumed by the test organism, tests should be based off the toxicity of their leachate (via solvent and water extracts). Toxicity tests of materials and leachate should use standard toxicity organisms that are relevant to the environment of interest (e.g., earthworms (*Eisenia fetida*), water fleas (*Daphnia magna*) or fish (*Pimephales promelas*) in acute tests measuring survival and chronic tests measuring development and reproduction.