

Biodegradable Additives in Plastic Packaging

Frequently Asked Questions

What is biodegradation?

Biodegradation is a natural process in which organic materials are broken down and converted into natural substances such as water, carbon dioxide, minerals, and biomass with the help of microorganisms, such as bacteria and fungi. The process of biodegradation depends on the environmental conditions as well as on the material or application itself. The Federal Trade Commission (FTC), which exists to protect U.S. consumers, defines biodegradability to mean the entire item will completely break down and return to nature (i.e., decompose into elements found in nature) within one year under typical and customary disposal conditions¹.

What use do biodegradation additives serve?

Most common synthetic plastics are very stable and although plastics in the environment may be slowly degraded by both chemical and physical processes, they will last for decades or millennia in the environment. Various biodegradable additives have been designed to enhance or increase the degradation rates of these various plastic materials. The degradable additives are typically incorporated in conventional plastics such as polyethylene, polypropylene, polystyrene, polyethylene terephthalate, and polyvinyl chloride during the converting process from polymer pellets to final products. Addition rates vary by type of degradable additive and planned use but are typically below 5%. Many materials using bio-additives have not been shown to degrade within one year, thus companies offering such materials may not claim their products as biodegradable⁵ unless they also include the conditions and time frame in which biodegradability takes place.

What are these additives?

These additives are based on chemical catalysts containing transition metals such as cobalt, manganese, and iron, or organic materials, such as pro-oxidant chemicals, natural products, enzymes, or microorganisms². The additives influence the mechanism of plastic degradation by changing the chemical and/or physical properties of the plastics to increase the rate of degradation. Instead of being slowly degraded simply by environmental factors, such as sunlight (photo-oxidation) or heat (thermal degradation), the addition of the biodegradable additives typically cause fragmentation as a result of a chemical oxidation of the plastics' polymer chains triggered by ultraviolet irradiation or heat exposure, or outright biodegradation of the organic additive. While there is chemical theory to support a slow biodegradation process, in places such as landfills, the absence of light and oxygen (as well as the presence of moisture or low temperatures) slow the process resulting in a slow or absent chemical process.

What is the typical end of life for materials that incorporate biodegradation additives?

Materials that use bio-degradation additives are commonly destined for the landfill because of their lack of compatibility with recycle³ and compost collection streams.⁴ Further, claims made about the degradation of bio-additives in the landfill unfortunately have been shown to be misleading.⁵ Such findings⁶ have resulted in bans of certain types of bio-degradation additives in parts of Europe⁷ and court cases against some of the world's largest retailers.⁸ The state of California has gone even further than the FTC by prohibiting any claims of biodegradable plastic unless it can be shown to compost per industry accepted testing protocols.⁹ Materials made with bio-degradation additives have not been shown to pass California's required testing, and therefore may not be labeled as biodegradable in that state.

How does compostable differ from biodegradable?

While all compostable products are biodegradable, not all biodegradable products are compostable. The main differences are the types of material chemistry, how they decompose, and the residual elements after decomposition. Compostable products are typically manufactured from natural, organic, plant-based materials that are able to degrade within days to months. Upon degradation, compostable products only leave behind beneficial residual products like biomass, humus and other materials which improve soil. Typically, compostable products need a specific environment to degrade which includes warm temperatures, nutrients, moisture, and oxygen. Testing for compostability is conducted following standard specifications such as AS 4736, ASTM D6400, ASTM D6868, EN 13432, and ISO 17088. Complete biodegradation levels under industrial composting conditions in less than six months must be proven, according to these specifications.

What happens to the additive-treated plastic during the biodegradation process?

The process of biodegradation occurs in three steps:

- Biodeterioration: Mechanical weakening of its structure by environmental factors such as moisture, sunlight (photo-oxidation) or heat (thermal degradation)
- Biofragmentation: Breakdown of materials by microorganisms
- Assimilation: Incorporation of old material into new microorganisms

What issues do biodegradable additives in plastics cause?

The characteristic of biodegradability on its own does not mean the item will break down in a short amount of time, nor that it will result in any soil-enriching biomaterial as in the case of compost.

- By design, biodegradable additives aim to fragment petroleum-based plastics into smaller pieces to enable biodegradation. Because of the lengthy time frames required for degradation, these fragmented microplastics run the risk of leaking into the environment⁹ where they can contaminate soil and water sources.¹⁰
- As biodegradable additive-enhanced plastics are released into the environment, the process also may release greenhouse gases such as methane (anaerobic environment) and carbon dioxide (aerobic environment), various chemicals (which could be potential toxins), and other unexpected substances.
- Biodegradation of packaging in either a marine environment or on land, either aerobically or anaerobically, can potentially increase global warming and/or chemical pollution.
- People are more likely to litter something labeled as biodegradable.¹¹
- The FTC maintains there is no evidence to support the degradable and biodegradable claims made by companies concerning degradable additives.^{13, 14} Additionally, the U.S. National Advertising Division (NAD) of the Council of Better Business Bureaus has recommended advertisers discontinue claims such as “100% oxo-biodegradable or degradable” because such statements incorrectly suggest a plastic will quickly or completely biodegrade with the help of these additives. The NAD and FTC have acted against companies for making false and unsubstantiated claims using the additive technology for “oxo-biodegradables” and using the word “biodegradable” as marketing language.¹⁵

Standards and Certifications

The specification of time needed for the ultimate biodegradation is an essential requirement for any third-party tested and certified biodegradability claim. There are several internationally established and acknowledged standards and certifications that effectively substantiate claims of biodegradation under certain, specific end-of-life conditions.

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The published standards are used to certify materials and products by several other organizations, including the Bureau of Indian Standards (IS 17899 T:2022), DIN CERTCO in Germany, Japan BioPlastics Association, Vinçotte in Belgium, the Bureau de normalisation du Québec, the Australasian Bioplastics Association, or the Biodegradable Products Institute in the U.S. These certification agencies use well-researched and vetted test specifications to establish third-party, peer-reviewed programs to confirm the end-of-life performance of bioplastic materials following the requirements of the standard specifications.

With the ongoing development of new materials, standards and certifications for other end-of-life scenarios have or are in the process of being developed. Frequently, the testing done on degradable additives often refers to ASTM D5338 and D5511, but these standard test methods are not standard specifications, do not take the material to complete biodegradation, and contain no pass or fail criteria established by the industry for rate, time, or amount of biodegradation.

Sealed Air's Response

Sealed Air believes landfills are one of the least desirable end-of-life scenarios for any material. A preferred approach, one with much higher environmental value, is to keep materials in play via recycling or re-use, often referred to as the circular economy.⁷ Using degradation processes to eliminate plastics, which are manufactured from limited resources, completely removes these valuable materials from the circular economy where they could be recycled and reused. A critical challenge facing the packaging industry is demonstrating the circularity of materials that are complex and difficult to recycle. Sealed Air is making global investments in its packaging solutions and to infrastructure to enable recycling, reusability or compostability. As a result, the company is enabling a circular economy for recovering packaging materials that provide value and serve an essential purpose.

References

Ref. No.	Supporting Facts	Sealed Air's Position
1	<p>Section 260.8 of the FTC Green Guides, which all claims in the U.S. must adhere to, states: <i>It is deceptive to make an unqualified degradable claim for items entering the solid waste stream if the items do not completely decompose within one year after customary disposal. Unqualified degradable claims for items that are customarily disposed in landfills, incinerators, and recycling facilities are deceptive because these locations do not present conditions in which complete decomposition will occur within one year.</i></p> <p>[Source: FTC Green Guides]</p>	<p>Sealed Air adheres to the FTC Green Guides for all of its sustainable marketing claims. The FTC's past legal cases and settlements have made it clear that the science is lacking to prove biodegradability.</p>
2	<p>In this position paper, the SPI Bioplastics Division outlines the issues and questions of concern in order to support consumers, retailers, and the plastics industry in identifying unsubstantiated and misleading product claims around degradability and biodegradability of plastics.</p> <p>[Source: SPI: The Plastics Industry Trade Association]</p>	<p>Sealed Air agrees with the SPI: Plastics Industry Association findings.</p>
3	<p>The only widely available way to recycle plastic films in the U.S. is via the retail store drop-off program. Only a subset of films are eligible for the store drop-off program. The How2Recycle label is the best indicator of which materials are eligible. Films that are biodegradable, including those that use bio-additives, are not eligible for recycling in the store drop-off program.</p> <p>[Source: How2Recycle.info]</p>	<p>Many products using bio-additives do so to allow for degradation in a landfill. Regardless of these products degrading or not, Sealed Air believes a better solution is to capture valuable, recyclable materials. Materials that can be reused or recycled keep the molecules in play and can reduce the demand for virgin raw materials. Sealed Air is a member of the Sustainable Packaging Coalition which administers the How2Recycle label program. Several of Sealed Air's products carry the How2Recycle label and are eligible to be collected and recycled at more than 18,000 retail store drop-off locations.</p>

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4	<p>The most common indicator of certified composability is the Biodegradable Products Institute (BPI) certification for industrial composability. The BPI indicator means the material has been tested in an approved third-party laboratory and confirms to ASTM 6400 (compostable plastic) or ASTM 6868 (compostable packaging). Plastic films claiming biodegradability by way of utilizing bio-additives do not carry the BPI certification and therefore are not compatible with industrial compost collection streams.</p> <p>[Source: Biodegradable Products Institute]</p>	<p>Most industrial compostable waste streams will only accept BPI-certified materials for anything outside of food waste. Materials without such certifications will likely end up in a landfill.</p>
5	<p>A common claim of manufacturers using bio-additives in their products is that it helps the materials degrade in a landfill. However, in multiple cases such claims have been shown to be misleading.</p> <p>[Source: Citation 18, Ellen MacArthur Foundation Position Paper]</p>	<p>Because materials made with bio-additives are not accepted in either recycle or compost streams, they're destined for the landfill if not environmental pollution. The environmental conditions in most landfills do not allow for biodegradation to occur, and even if and where they did, because of the lengthy amount of time such additives require, they're more likely to be leaked into the environment as microplastics. Bio-additives do not deliver on the promise of bettering the environment.</p>
6	<p>Researchers at Michigan State University conducted a scientific study of the five most commonly used bio-additives. The study states: <i>"Biodegradation was evaluated in compost, anaerobic digestion, and soil burial environments. None of the five different additives tested significantly increased biodegradation in any of these environments. Thus, no evidence was found that these additives promote and/or enhance biodegradation of PE or PET polymers. So, anaerobic and aerobic biodegradation are not recommended as feasible disposal routes for nonbiodegradable plastics containing any of the five tested biodegradation-promoting additives."</i></p> <p>[Source: National Center for Biotechnology Information]</p>	<p>A common tactic used by those promoting biodegradability claims of plastics made with bio-additives is that published studies don't reflect the environment in which their additives work, or that studies were not done on their specific type of additive. However, in this case five different types of additives were tested across three different types of end-of-life scenarios and no evidence was found that these additives promote and/or enhance biodegradation of PE or PET polymers.</p> <p>A copy of the full study can be provided by request.</p>
Ref. No.	Supporting Facts	Sealed Air's Position
7	<p>Oxo-degradable plastics are one of the eight materials prohibited under the UK Plastics Pact, which pact members were expected to remove from shelves by the end of 2020.</p>	<p>Sealed Air ensures compliance with all local and national regulations and laws.</p>



	<p>The EU's European Commission ruled that member countries had until March 2021 to adopt legislation prohibiting the use of oxo-degradable plastics.</p> <p>[Sources: UK Plastics Pact and European Commission]</p>	
8	<p>Under its Truth in Environmental Advertising laws, California has actively litigated against any companies selling and making unqualified environmental claims. Because the science is lacking to support the biodegradable claims made on products with bio-additives, several of the world's largest retailers have been forced to settle with the state in court. In 2019 Amazon settled for \$1.5MM. In 2017 Walmart settled for \$1.0MM. In 2018 Costco settled for \$500K.</p> <p>[Source: CalRecycle]</p>	<p>Sealed Air ensures compliance with all local and national regulations and laws. Bio-additives such as those used in the products cited in these court cases are on Sealed Air's banned substances list.</p>
9	<p>The only way to legally claim biodegradability on a product in the state of California is to obtain BPI certification for composability, which for plastics means passing ASTM 6400. Any plastic material claiming biodegradability sold in California, which has not passed ASTM 6400, must add a disclaimer such as "California law prohibits the sale of plastic packaging and plastic products that are labeled with the terms 'biodegradable,' 'degradable,' or 'decomposable,' or any form of those terms, or that imply in any way that the item will break down, biodegrade or decompose in a landfill or other environment."</p> <p>[Source: California Legislation]</p>	<p>California's law states that standard ASTM 6400 must be met to claim biodegradability of plastic. This goes further than the FTC in that ASTM 6400 requires "...84 days as reasonable for fragmentation of the product, and 180 days for complete mineralization in a properly managed composting facility." As a global company, Sealed Air ensures compliance with all national and local regulations. The company will not use materials nor make claims that conflict with local California regulations.</p>

Ref. No.	Supporting Facts	Sealed Air's Position
10	<p>Most additives are designed to fragment petroleum-based plastic into small pieces to make it sufficiently available to the microorganisms that perform biodegradation. These fragmented micro pieces remain invisible to the naked eye, yet their effects as micro-litter can be detrimental.</p> <p>[Source: Sustainable Packaging Coalition Position Paper]</p>	<p>Instead of completely degrading plastics naturally in the environment to carbon dioxide and water, the use of such additives has resulted in minimal or partial fragmentation, which negatively impacts recyclability and is a potential source of microplastics in the environment.</p>
11	<p>The Ellen MacArthur Foundation, a global NGO and prominent voice driving collaboration around the circular economy, published a position paper urging companies not to use any flavor of bi-additives in plastics. The paper concludes: <i>“A significant body of evidence indicates that oxo-degradable plastics simply fragment into small pieces, including microplastics, with the entire process of biodegradation into naturally occurring molecules requiring timescales often (far) in excess of those claimed by their manufacturers. The contribution of these plastics to microplastic pollution poses an environmental risk, particularly in the ocean.”</i></p> <p>[Source: Ellen MacArthur Foundation Position Paper]</p>	<p>Sealed Air was one of more than 150 companies that signed the Ellen MacArthur Foundation position paper which concluded “Oxo-degradable plastic packaging is not a solution to plastic pollution and does not fit in a circular economy.”</p>
12	<p>People are more likely to litter something labeled as biodegradable.</p> <p>[Source: Keep America Beautiful 2020 National Litter Study]</p>	<p>Sealed Air discourages all littering. The preferred solution is to design materials for collection and reuse.</p>
13	<p>The FTC Green Guides caution that items destined for landfills, incinerators, or recycling facilities will not degrade within a year, so marketers should not make unqualified degradable claims for these items</p> <p>[Source: FTC Issues Revised Green Guides]</p>	<p>Sealed Air adheres to the FTC Green Guides for all of its sustainable marketing claims. The FTC's past legal cases and settlements have made it clear that the science is lacking to prove biodegradability.</p>
14	<p>If a product is going to a landfill, a company shouldn't say its product is biodegradable unless it also explains how long it will take to degrade and how much it will break down over time.</p> <p>[Source: FTC Consumer Advice]</p>	<p>Sealed Air adheres to the FTC Green Guides for all of its sustainable marketing claims. The FTC's past legal cases and settlements have made it clear that the science is lacking to prove biodegradability.</p>
15	<p>The U.S. National Advertising Division of the of the Council of Better Business Bureaus observed that there was no evidence in the record that consumers understood “oxo-biodegradable” to have a different</p>	<p>Sealed Air adheres to the FTC Green Guides for all of its sustainable marketing claims. The FTC's past legal cases and settlements have made it clear that the science is lacking to prove biodegradability.</p>

Sealed Air®

	<p>meaning, or a different impact on the environment, than products that are “biodegradable.”</p> <p>[Source: BBB National Programs Archive]</p>	
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