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SORTING THROUGH THE LATEST NAMES, CLAIMS AND PERFORMANCE OF DEGRADABLE ADDITIVES



Basic Definitions

- **Bioplastic:** *plastic that is biodegradable, has biobased content or both.*
- **Biodegradable Plastic:** *a plastic that undergoes biodegradation under specified environmental conditions (a process in which the degradation results from the action of naturally-occurring micro-organisms such as bacteria, fungi, and algae) and within specified degradation time as per accepted industry standards. As of 2013, accepted industry standard specifications include: ASTM D6400, ASTM D6868, ASTM D7081, ISO 17088 and EN 13432.*
- **Degradable Plastic:** *a plastic designed to undergo a significant change in its chemical structure under specific environmental conditions, resulting in a loss of some properties that may be measured by standard test methods appropriate to the plastic and the application in a period of time that determines its classification.*
- **Oxo-Degradation of Plastics:** *degradation identified as resulting from oxidative cleavage of macromolecules. (ISO TC249/WG9)*
- **Oxo-Biodegradation of Plastics:** *degradation identified as resulting from oxidative and cell-mediated phenomena, either simultaneously or successively. (ISO TC249/WG9)*



Introduction to Degradable Additives

- **Degradable Additives** have been around for many years
- **Common Names** - “degradable,” “oxo-degradable,” “oxo-biodegradable,” “oxo-green”, “landfill degradable”)
- **Common Uses** – added at 5% or less into traditional polymer (polyethylene, polypropylene, polystyrene, PET, PVC) to promote degradation and biodegradation.
- **Active Ingredients** - based on chemical catalysts containing transition metal ions such as cobalt, manganese, iron, etc., or organic materials, which may 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.
- **Typical Uses** – Ag mulch films, daily landfill cover, single use consumer products.



Degradable Additive Claims

- Retain all the advantages of the conventional products , with **no impact** on recycling.
- Contains transitional metal ions/salts such as cobalt, iron or magnesium and **no “heavy metals”**
- **Embrittlement**, loss of molecular weight, **oxidation**, **eventual biodegradation** are caused in traditional plastics.
- It is well known that there is a "plastic soup" of waste floating in the Pacific Ocean which now covers an area greater than the size of Texas. If all short-life plastics had been made with d₂w - **this environmental menace would be very much smaller.**
- **Does not leave fragments** of petro-polymers in the soil.
- Does not emit methane or nitrous oxide, even deep in a landfill.
- **Can be composted in-vessel.**

- When the material has reached the fragmentation stage it is no longer a plastic, and is **"biodegradable" in the same way as nature's wastes such as straw and twigs.** The process continues until the material has biodegraded to **nothing more than CO₂, water, and humus.**



Degradable Additive Claims (cont.)

- Oxo-biodegradable plastic will fragment in the upper layers and will save some space, ***but a landfill is not an environment for which degradable plastic of any kind is really relevant.*** Once a piece of plastic waste has been collected and buried in landfill it has already been disposed of responsibly
- Oxo-biodegradable plastics fragment and **partially biodegrade to CO₂ and water in the parts of the landfill where oxygen is present**, but the residues are completely inert deeper in the landfill in the absence of oxygen. They do not emit any significant amounts of methane.



What is Biodegradation?

- capable of being broken down especially into innocuous products by the action of living things (as **microorganisms**). Websters Dictionary
- A **process** by which **microbial organisms** transform or alter (through metabolic or enzymatic action) the structure of chemicals introduced into the environment." - U.S. Environmental Protection Agency, 2009
- the **process** by which organic substances are decomposed by **micro-organisms (mainly aerobic bacteria)** into simpler substances such as **carbon dioxide, water and ammonia**. OECD 1997
- Biodegradation is nature's way of recycling wastes, or breaking down organic matter into nutrients that can be **used by other organisms**. "Degradation" means decay, and the "bio-" prefix means that the decay is carried out by a huge assortment of **bacteria, fungi, insects, worms**, and other organisms that **eat dead material and recycle it into new forms**. Cornell University 2009

A process, dependent on micro-organisms, converting material chemically, into new, simpler forms



How do we measure Biodegradation?

- Testing breakdown of materials (loss of properties, integrity)?
- Can we no longer see the material?
- How do micro-organisms behave? (eating, respiring, living, dying)
- The only sure testing for confirming biodegradation is taking place is to look at the micro-organisms and determine what they are doing.
- Carbon Dioxide is produced from the process of aerobic biodegradation. Methane is produced (with some CO₂) from the process of anaerobic biodegradation. Both are products of metabolizing by the micro-organisms . (eating)
- Measuring CO₂ and methane evolution from the micro-organisms is a proven method to determine how much biodegradation is taking place.
- Measuring fragmentation, loss of properties, or visual condition is not a method for determining if biodegradation is taking place. **These only show that degradation is taking place.**



Specifications Test for Biodegradation of Plastics

Test Specifications	Title	Duration
ASTM D6400	Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities	84 days disintegration; 180 days mineralization
ASTM D6868	Standard Specification for Biodegradable Plastics Used as Coatings on Paper and Other Compostable Substrates	84 days disintegration; 180 days mineralization
ASTM D7081	Standard Specification for Non-Floating Biodegradable Plastics in the Marine Environment	Up to 365 days
EN 13432	Requirements for Packaging Recoverable Through Composting and Biodegradation – Test Scheme and Evaluation Criteria for the Final Acceptance of Packaging	84 days disintegration; 180 days mineralization
ISO 17088	Specifications for Compostable Plastics	84 days disintegration; 180 days mineralization



Other Test Guides/Standards

Test Guides	Title
ASTM D6954	Standard Guide for Exposing and Testing Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation

**Note: Test guides provide a framework or roadmap of steps, criteria, procedures or a general approach but provide no pass/fail guidance on how to qualify results of the tests.

Test Methodologies	Purpose	Data Obtained
ASTM D5338	Aerobic Biodegradation of Plastic Materials Under Controlled Composting Conditions	Degree and Rate of Aerobic Biodegradation
ASTM D5511	Anaerobic Biodegradation of Plastic Materials Under High-Solids Anaerobic Digestion Conditions	Test Duration, % Landfill Biodegradation
ASTM D5988	Soil Biodegradability	Test Duration, % Soil Biodegradation
ASTM D6691	Marine Biodegradation	Test Duration, % Marine Biodegradation
ASTM D6866	Biobased Carbon Content	% Biobased Carbon Content

***Note: Test methodologies provide standardized guidelines on how to conduct testing but provide no pass/fail guidance on how to qualify results of the tests.



Peer Testing of Degradable Additives

- The Biodegradable Products Institute (BPI) has tested bottles and bags containing degradable additives, to confirm claims made about their biodegradability.
- In the case of the bottles that were tested using ASTM D5511, BPI noted that “after 60 days, the bottle achieved an overall biodegradation total of 4.47% or 10% of the positive control. Moreover, the biodegradation process has stopped, as the gas generation curve has plateaued. Per ASTM D5511-11, the results of this test cannot be extrapolated to claim that the bottle will fully biodegrade in the future.
- In the case of the bags that were tested using ASTM D5511, BPI noted that “after 60 days, the bags achieved an overall biodegradation total of 0.16% or less than 1% of the positive control. Additionally, the biodegradation process has stopped, as the gas generation curve plateaued.

Sources: - Biodegradable Products Institute. “BPI Tests Aquamantra “Biodegradable” Bottle. February 2011. 9 August 2012
NSF International. “NSF International Test Report.” [Biodegradable Products Institute](#). January 2011. 9 August 2012
Biodegradable Products Institute. “Additional Testing Data on Aquamantra Bottles.” May 2011 2011. 9 August 2012
Organic Waste Systems. “Final Report – High Solids Anaerobic Digestion Under Thermophilic Conditions of Aquamantra Bottle. March 2011. 9 August 2012.
Biodegradable Products Institute. “Testing Results for Green Genius ‘Biodegradable’ Bags.”. April 2011. 9 August 2012
NSF International. “NSF International Test Report – Green Genius ‘Biodegradable’ Bags.”. March 2011. 9 August 2012



Fragmentation vs. Biodegradation

- **Fragmentation Is Not the Same as Biodegradation**
- Fragmentation of “degradable additives” for plastics is not the result of a biodegradation process but rather the result of a chemical reaction called oxidation.
- The resulting fragments will remain in the environment as there is no peer reviewed testing data to confirm biodegradation
- Fragmentation is not a solution to the waste problem, but rather the conversion of visible contaminants (such as bags, cutlery, packaging) into invisible contaminants (plastic fragments).
- Plastic products can be collected once in the environment, plastic fragments at very small levels are impossible to collect or control.
- Biodegradation of plastics will result in no residues, no fragments and complete assimilation of the polymer.
- Composting offers one of the most active biodegradation environments on the planet, and is highly regulated and controlled. Thus plastics which are compostable must biodegrade rapidly with no residues in order to be considered compostable.

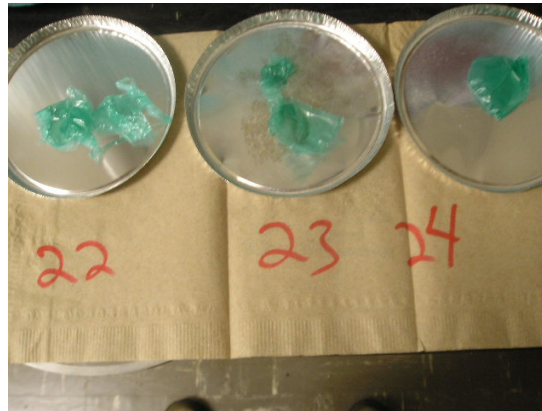


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Pictures



Composting Test, Norterra Organics
2012 – oxo-degradable bag; BASF



Lab Marine Test (Oxo-degradable),
November 7, 2007
Joseph P. Greene, Ph.D.
California State University, Chico



Vacaville In-vessel Food Waste
Compost Pictures (180 days)
November 7, 2007
Joseph P. Greene, Ph.D.
California State University, Chico



FTC Guidance on Degradable Claims

- In October 2012, the U.S. Federal Trade Commission (FTC) issued its revised ***Guides for the Use of Environmental Marketing Claims***, also known as the “**Green Guides**.”
- The Guides’ section on “degradable claims” which the FTC notes is applicable to oxo-degradables, oxo-biodegradables and similar claims states that (a) **marketers may make an unqualified degradable claim only if they can provide that the “entire product or package will completely break down and return to nature within a reasonably short period of time (defined as within one year) after customary disposal**

and (b) **“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.”
- **Claims of degradability are deceptive according to the FTC.**



What about Recycling Claims?

- **But some companies producing degradable additive plastics claim that they are recyclable in today's collection methods.**
- According to Steve Alexander, President of APR, "These **claims of recyclability are unfounded, untested, and possibly misleading** as outlined by the Federal Trade Commission's Green Guide. No third party testing data has confirmed these statements of recyclability. We urge companies claiming recyclability to share such supporting data with the recycling community.
- "The facts are very clear," reports Dave Cornell, the Technical Director of APR. "The **degradable additive concept effectively renders the product using the additive non-recyclable**. Many recycled plastics are used to make durable goods. Failure of these next-use products, such as carpets or piping, could range from distressing to tragic



Conclusions

- Despite new product names, degradable claims are still considered deceptive by the FTC.
- No peer reviewed, 3rd party certified scientific data exist which proves claims of complete biodegradation of degradable additive treated traditional plastics.
- Recycling experts state degradable additives render traditional plastics non-recyclable.
- Well established testing specifications do not exist for degradable additives.
- Peer testing of degradable additives using ASTM standard test methods for plastics show little or no biodegradation occurring.



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