

Compostable Plastics

Introduction

The market for plastic bags, bottles, and food service ware that are degradable, biodegradable or compostable is growing rapidly. The use of compostable plastics to replace traditional plastics can have many potential positive environmental impacts, for example reducing dependence on fossil energy, reducing GHG emissions, reducing persistent waste in the environment, and fostering the development of sustainable and biodegradable products. However, these products may present challenges for policy makers and end users in regard to their end-of-life management. CIWMB is concerned, for example, that the use of compostable plastic products may impact conventional plastics recycling operations. Questions also have been raised about bioaccumulation, but the CIWMB is not aware at this point of any information or research that demonstrates whether or not bioaccumulation of any toxic substances occurs from compostable plastics. The bioplastic industry is working to provide research that assesses whether or not chemicals from compostable plastic products accumulate and transfer through the food chain as a result of land application of compost that has these products as feedstock. The purpose of this fact sheet is to provide information on issues policy makers should consider regarding the use of compostable plastic products.

Definitions and Statute

The American Society for Testing and Materials (ASTM) defines “degradable plastic” as “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”. If the degradation results from the action of naturally-occurring microorganisms such as fungi, bacteria, and algae, the plastic is called “biodegradable.” If the degradation results from the action of natural daylight, the plastic is called “photodegradable.” If the degradation results from oxidation, the plastic is called “oxodegradable.”

ASTM also defines “compostable plastic” as “a plastic that undergoes biological degradation during composting to yield carbon dioxide, water, inorganic compounds and biomass at a rate consistent with other known compostable materials and leaves no visually distinguishable or toxic residues”. Thus compostable plastics are a subset of biodegradable plastics. Compostable plastics are typically made of a variety of raw materials, including corn, potato and wheat starches. See Table 1 for a summary of definitions, applicable ASTM standard specifications, and test methods.

Two bills enacted in 2008 resolve concerns about misleading labeling, clarify definitions, and establish civil penalties related to compostable plastic bags and food and beverage containers beginning January 1, 2009. Assembly Bill 1972 (Chapter 436, Statutes of 2008) amended PRC sections 42357 and 42359.6 to prohibit the sale of plastic bags and food or beverage containers sold and distributed in California that are labeled as “compostable” or “marine degradable” unless they meet the requirements of the appropriate ASTM standard specification (ASTM D-6400 and D-7081 for plastic bags, and ASTM D-6400, D-7081 and D-6868 for food or beverage containers). It also prohibits the sale or distribution of plastic bags and food or beverage containers in California that are labeled “biodegradable”, “degradable” or “decomposable.” Assembly Bill 2071 (Chapter 570, Statutes of 2008) imposes civil liabilities on suppliers or manufacturers who label plastic bags or plastic food or beverage containers without meeting the specified standards for the term used on the label.

If compostable plastic products are used, they should be independently documented as meeting the ASTM D-6400 or ASTM D-6868 compostable plastic specification. One way to demonstrate this is to be certified by the Biodegradable Products Institute (BPI). BPI, an association of government, industry and academia stakeholders, promotes the use and recycling of biodegradable polymeric materials. For

additional information on ASTM standards, see www.astm.org. For additional information on BPI certification, visit www.bpiworld.org/BPI-Public.

Will Compostable Plastics Affect Your Current Waste Management System?

When compostable plastics are used, decision-makers should consider the entire local or regional waste diversion and disposal system and those that use it. While compostable plastics may offer desirable environmental benefits, decision-makers should also consider potentially negative effects as well. For example, compostable plastic products may enhance food scrap and green waste diversion under well-controlled conditions. However, compostable plastics also have the potential to contaminate an existing plastic recycling program if they are not properly identified and collected and composted or recycled, thus reducing some traditional plastic recycling opportunities. Separating compostable plastics from conventional plastics is possible using near infrared (NIR) detection technology; however, this technology is not widely available in California and may be costly to put into operation. Where NIR detection is in use it will need to be adapted for an additional sort, which may be more or less complicated depending on the configuration of existing sort lines.

Further, while compostable plastic products being certified as compostable (e.g., polyhydroxylalkanoates or PHA) will biodegrade in a compost environment, some (e.g., polylactic acid or PLA) may not break down if released to the land or marine environment, similar to petroleum-based plastics.¹ Compostable plastics should be used in conjunction with a collection and processing program that can ensure their diversion to a compost operation to reduce the risk of their entering the recycling stream or being released into the environment as litter. Any composting program accepting compostable plastic bags, containers or other products should verify that they are labeled as certified compostable and have met ASTM D-6400 or D-6868 requirements.

Why Are Compostable Plastic Products Used?

Key reasons for using compostable plastic products include:

- **Increased Food Scrap Diversion** – Compostable plastic bags could play an important role in the collection of food scrap resulting in increased diversion. In addition, compostable food service ware could be used in restaurant and institutional settings, making co-collection of food scraps and compostable service ware in compostable bags an acceptable option for composting facilities. Food scrap diversion incorporating compostable plastics should be carefully planned and operated to limit the potential for these materials to cross-contaminate other plastic recycling programs.
- **Increased Green Waste Diversion** - Compostable yard waste bags could be used in association with curbside pickup of yard trimmings to divert another significant part of the waste stream to composting facilities.
- **Reduced GHG emissions** – Production of biodegradable plastics may emit fewer greenhouse gases based on their entire life cycle as compared to conventional plastics.
- **Reduced Reliance on Fossil Fuel** - Many raw materials used in the production of compostable plastics are from renewable resources, not from petroleum resources.

¹ "Performance Evaluation of Environmentally Degradable Plastic Packaging and Disposable Food Service Ware", June 2007, California State University, Chico Research Foundation: 38.

What Are The Challenges of Using Compostable Plastic Products?

- ***Compostable plastic products may pose a contamination problem to the recycling stream for non-compostable plastic containers and bags.***

Containers – Compostable containers are visually similar (although usually labeled with the word “compostable”) to conventional plastic containers and, if not adequately sorted, might lead to contamination of plastics being recycled, making them less marketable. Sorting technology (e.g., NIR detection) has been demonstrated to separate compostable containers from conventional plastic containers. It is best to use these products only in institutional food service or possibly large venues where they can be manually source-separated on site for diversion to composting facilities, or once the NIR sorting technology is available and implemented.

Carryout Bags – Similarly, compostable carryout bags should only be used in combination with collection programs that ensure their separation from the non-compostable plastic bag recycling stream. Current plastic bag recycling at California grocery stores does not provide this guarantee. California stores that offer plastic bags are required to provide a drop-off collection service for their customers (PRC 42251). However, the state laws do not require stores to provide separate collection for compostable and non-compostable bags, even if local governments enact ordinances that require stores to provide compostable bags. Such local ordinances would also have to specify separate collection systems. In order to address concerns about potential cross-contamination, the CIWMB by regulation has excluded stores that provide only compostable carryout bags from the requirement to provide plastic bag collection containers for their customers.

- ***Like petro-based plastics, compostable plastics may also end up in landfills or be littered in the ocean and open lands. Some compostable plastics will degrade in these environments (e.g., PHA), while others may not degrade (e.g., PLA).***

Landfills - Landfills are designed to prevent air and water from entering the covered waste. This can retard the degradation of some compostable plastics such as PLA, although some degradation will still occur even in the absence of oxygen. Other biodegradable plastics, such as PHA, will degrade in the landfill even under anaerobic conditions. Although biodegradable plastics have varying degrees of degradation in a landfill, the highest and best use of these materials is to recycle or compost them.

Marine Environment- Although some compostable plastics are expected to fully biodegrade in the ocean, some may not (such as PLA). For compostable plastics that do not degrade in the marine environment, it is currently unknown whether or not those compostable plastics would exhibit negative impacts in a marine environment similar to those associated with conventional plastics such as ingestion by marine invertebrates and the potential to adsorb, transport, and release toxic chemicals to the food chain.

- ***It is unknown whether chemicals from compostable plastics can bioaccumulate in the terrestrial food chain.***

At this point, the CIWMB has not seen any information or research that demonstrates whether or not bioaccumulation of components of compostable plastics occurs, either in the marine environment or on land. Questions have been asked about whether the land application of compost made from compostable plastics can lead to bioaccumulation of component chemicals in the terrestrial food chain. The CIWMB is not aware of conclusive studies on this issue. Although comprehensive toxicity assessments exist on finished compost with and without compostable plastics as a component, specific studies that directly evaluate the accumulation of substances from compostable plastics into the food chain have not been conducted.

Ongoing Research

Several compostable plastic manufacturing companies have recently financed studies to evaluate the toxicity of their products. At least one company was able to identify, measure, and evaluate the toxicity of degradation end products and intermediates. All of these studies concluded that after composting no residues were left that could negatively affect plant growth and germination, earthworms or freshwater organisms. The compostable plastic manufacturing industry is continuing to review existing data to evaluate what the impacts are, if any, of their products on the food chain. For more information about the ongoing research and current studies regarding toxicity of compostable plastic products, please go to the Biodegradable Products Institute website at www.bpiworld.org.

Where can I find more information about the performance of compostable plastics?

To facilitate purchasing decisions and help increase consumer awareness about degradable plastics, the CIWMB contracted with California State University Chico, Research Foundation for a study to evaluate the performance of degradable plastic packaging and disposable food service ware in composting and simulated marine environments. This research resulted in two reports: "Evaluation of the Performance of Rigid Plastic Packaging Containers, Bags, and Food Service Packaging in Full-Scale Commercial Composting" and "Performance Evaluation of Environmentally Degradable Plastic Packaging and Disposable Food Service Ware." These reports can be downloaded from www.ciwmb.ca.gov/Publications/ or ordered by calling the Publications Clearinghouse at (916) 341-6306.

The Compostable Plastics Fact Sheet will be updated periodically as the CIWMB is made aware of new information, scientific advancements, and changes in the marketplace for compostable plastics.

Table 1: Summary of Degradable Plastic Types and Applicable Tests

PLASTIC CHARACTERISTIC	DEFINITION	*COMMON POLYMER TYPES	ASTM STANDARD SPECIFICATIONS	CAN A PRODUCT BE LABELED AS HAVING THIS CHARACTERISTIC? (AB 1972, EFF 1/1/09)	ASTM TEST METHODS	BPI CERTIFICATION
• Biodegradable	Plastic designed to degrade as a result of the action of naturally occurring microorganisms, such as fungi, algae, and bacteria		None	NO	D-6943	No
○ Compostable	Plastic that undergoes biological degradation during composting to yield carbon dioxide, water, inorganic compounds & biomass at a rate consistent with other known compostable materials and leaves no visually distinguishable or toxic residues	PHA, PLA, Starch-based	D 6400-04 D 6868-03 (biopolymer coatings, i.e. on paper & wood)	Yes	D 5338-98 D 6002-96 D 6340	Yes
○ In Marine Environment		PHA	D 7081-05	Yes	D 6691-01 D 6692-01	Yes
○ In Soil		PHA, Starch-based		N/A	D 5988	No
• Photodegradable	Plastic that degrades as a result of the action of natural daylight	Petroleum-based		No		No
• Oxodegradable	plastic that degrades as a result of oxidation	Petroleum-based		No	D 6954	No

Note: This table lists the major ASTM standards and test methods related to biodegradable plastics but is NOT a complete list of the ASTM standards and test methods for degradable plastics.

*Additional polymers not listed here may also be compostable if they meet requirements of ASTM D-6400-04.