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Selecting Cortec Bioplastics

Introduction

Bioplastic products are now being used every day in many markets that likely had not heard of the technology even a few years ago. Whether it is reusable coffee mugs, food packaging, automotive interiors, carpet fibers, plastic shopping bags or flexible packaging films and pouches, there has never been more interest in or potential for bioplastics.

With that opportunity a wave of misunderstanding has developed. These misconceptions may be well intentioned, or perpetuated by many of the marketers of the products in lieu of data supporting claims. We want to clear up much of that as it relates to our products and technologies.

Cortec believes that when you understand the *actual* benefits offered by our bioplastics you will realize that they are designed to save you time, money and costs.

Life Cycle Analysis: Concept and Practical application

Life Cycle Analysis[1,2,3,4] (LCA) has become an increasingly popular tool for comparing environmental benefits of alternative products. LCA tracks all the inputs (materials, energy) and "outputs" (land-filled waste, green house gases, water pollution, fertilizer, compost, recycle streams, etc.) associated with production, transportation, use, and disposal of a product. It allows an "apples to apples" comparison of alternate options, and allows one to cut through misleading claims about environmental benefits. However, LCA analysis is often expensive, and calculations must be tailored to each specific product and market (including the full supply chain and end of life probabilities) to get reliable comparisons. It is often not possible to get all the required LCA input data, so assumptions must be made; which may skew the analysis results. Thus, for many situations, a simpler approach is satisfactory for making good material selections. One such approach is described in this paper below, using the example of current Cortec bioplastic products.

Pairing Goals with Attributes to Create Measurable Benefits

Question: ***"Are Bioplastics better?"***
Answer: ***It depends on what you measure.***

Those that investigate bioplastics are typically looking to improve one or more attributes of their product. These product attributes generally fall into the following four categories:

1. **Renewable Content**
2. **Disposal Benefit in Specific Environment**
3. **Marketability(consumer perception)**
4. **Functional Property**

When investigating the feasibility of bioplastics, many assumptions are made about each of the above attributes. For example, many incorrectly believe that biodegradability (#2) is based on renewable content (#1) or that there are universal disposal benefits (#2).

Cortec recommends that potential users of bioplastics look at all of these above four attributes prior to selecting a film. A good match between the attributes and the product goals can lead to the desired marketing and environmental benefits. A poor match can lead to a "green-washed" product with no real benefits (environmental or marketing).

Examples:

User A *is a well-intentioned environmentalist and is troubled by the plastics dependence and the use of fossil fuels (natural gas for polyethylene) that are required to make them . In response, the environmentalist buys certified compostable bags, marketed claiming starch and vegetable oil content, to replace his shopping bags and trash bags.*

Problem: User A is seeking a benefit that does not exist with the product selected by confusing attributes #1 and #2. Compostable bags are often still 70-100% from traditional petrochemical sources and often need to be thicker (especially larger sizes) than even a polyethylene bag. Additionally, unless sent to a composting facility (or in some cases a similar "active aerobic" environment), even compostable bags are not designed to breakdown. Result: User A is likely paying 5-10 times the price for no measurable benefit. This type of situation is very common and often (but not always), the better solution for User A is to focus on attribute # 1 (renewable content), or even better to go back to the mantra of "Reduce, Reuse and Recycle"—all of which can accomplish in a measurable way the goal of petrochemical-based plastic reduction.

User B *is the organics coordinator for a community that has a compost processor. The processor is licensed by the community to process food, yard and other organic material—a concept that the city views as a more sustainable process as opposed to land-filling waste. In order to run cost effectively, the compost site is run like any other factory—cost, speed and quality—at each step of the production process. Their raw material is organic "waste" and their finished product is high value compost that is sold in retail stores and directly to the local community, golf courses, construction and even the DOT. User B is interested in BPI-certified compostable bags because they are more convenient for homeowners and haulers and do not need to be removed before, during or after the compost process. The bags simply biodegrade right along with the organics waste. When bags are used, participation increases, costs go down and speed improves for their "compost factory."*

Result: User B relies on BPI certification to ensure that the bags that are purchased meet the specification for commercial composting—they will biodegrade safely and fast enough to not impact their processing and sale or compost. User B is also able to measure participation rate, diversion rate, contamination rate (haulers can see into bags thereby rejecting curbside what would otherwise contaminate), cost and time of processing. This total cost approach is used to evaluate further improvements and compare to the cost of compostable bags, using no bags, using paper bags and other options.

Note: User B is ONLY concerned with attribute #2 - the biodegradability in a composting environment as detailed in ASTM D 6400. Although User B may *prefer* a bag that is renewably derived, if renewably derived bags affect functionality (curblife, clarity, strength, shelf life) or cost—that parameter will lose out to #2.

Selecting a Bioplastic

There is no such thing as a perfect plastic as can be shown in the above section. Without defining goals using the above four attributes of bioplastics, it is impossible to realize or measure a benefit. Without a measurable benefit, there cannot be a cost-benefit analysis or comparison. Without that comparison, it is impossible to know if a selection was appropriate.

The next section details benefits and metrics that are often associated with the key attributes identified above.

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ATTRIBUTES, BENEFITS & METRICS FOR SELECTING BIOPLASTICS

Attribute	Beneficial when	Measured by
Renewable Content /Bio-based content	User wants to reduce the petro-chemical derived raw materials used in their product or process. Often the goal is reduced reliance on foreign oil, helping farmers, diversifying raw materials to ensure long-term availability/stability, or reduced net green house gas (GHG) emissions.	Percent of new carbon to old carbon per ASTM D6866[5,6,7] Note: Life Cycle Analysis (LCA) goes several steps further and is more appropriate when options are being compared for total resource consumption.
Commercially Compostable	User wants a plastic to contain or comingle with other compostable material but does not want to remove the plastic prior to, during or after the processing.	ASTM D 6400 EN 13432
Home Compostable	User wants a plastic to contain or comingle with other compostable material to be put in a home compost bin, but does not want to remove the plastic prior to, during or after the processing. Most home compost bins do not typically achieve the high sustained temperatures of commercial compost operations, which are necessary for the breakdown of many bioplastics in a reasonable time frame (weeks to months).	Vincotte OK Home Compost Certification[8]
Anaerobically Digestible (AD)	User wants a plastic to contain or comingle with other anaerobically digestible material but does not want to remove the plastic prior to, during or after the processing. Anaerobic digestion is a growing technology that many view as superior to composting, as energy is recovered from the waste in the form of methane (natural gas).	ASTM D5511
Marine Biodegradable	Users want a plastic that goes away rapidly in marine conditions, usually a result of unintentional or uncontrollable litter/disposal. Most often users will want the film to be disposed of elsewhere, but in the event it cannot or is not disposed of properly, it would not accumulate in the marine environment.	ASTM D7081
Biodegradable (Other Environment)	Users want biodegradation in a specific environment not covered by one of the above methods or specifications. Examples have included agricultural films (weed suppression), down hole drilling environments, burial in soil/sand (military), exposures to specific chemicals, sachets/pouches used as dosing mechanisms, even parachutes for rats that are designed to get caught in trees.	With nearly all of these, it is imperative to test in a real world trial as no ASTM specification exists for the conditions present.[9] Care must also be taken to not rely on the trial results for more than the environment that existed in the trial.
Marketability	Users want a marketable product or a product for marketing purposes. Examples include "tradeshow" bags for universities, associations or companies; retail packaging; food packaging, ancillary packaging for eco-products (sleeve for compostable cups, etc.); overall green image ("we're doing something"). Care needs to be taken here as it is can be illogical, irresponsible or even illegal to market some environmental properties that may be impossible to realize. In the US, environmental claims are subject to FTC (Fed. Trade Commission) guidelines[10,11] and specific state and local regulations. Other countries will have their own regulations.	In nearly all cases, customers seeking "marketability" should be encouraged to identify a specific measurable benefit. For example, if a retail bag is unlikely to be composted, even if "certified compostable"—they should consider using a renewably derived plastic where the message is true and measurable even if the disposal method is unknown.
Functional Property	Users want a property such as clarity, temperature stability, strength, flexibility, hand/touch/texture, printability.	Each of these properties is measured individually usually by ASTM methods.[12]

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CORTEC BIOPLASTIC PRODUCT FAMILIES BY ATTRIBUTE

In the tables below, Cortec bioplast products are compared to one another according to the above attributes. It is readily seen that each has distinct advantages with respect to different product uses and disposal options. Note that all current Cortec bioplastic offerings are certified compostable.

Product	Renewable Content %	Disposal Benefit				Marketable Environmental Attribute	Key Functional Advantage
		Compost*	Anaerobic	Marine	Other		
Eco Film®	0	Certified	No	No	Some	Disposal	Flexibility
Eco Works® 5-70	5-70	Certified	No	No	Some	Disposal, Renewable	Strength, clarity
EcoOcean™	80+	Certified, Home	Certified	Certified	Many	Disposal, Renewable	Toughness
Eco Works® AD	80+	Certified, Home	Certified	Certified	Many	Disposal, Renewable	Toughness
Eco-Corr®	0-50	Certified	No	No	No	Disposal, Renewable (some)	Corrosion Inhib.
Eco-Corr® ESD	0-50	Certified	No	No	No	Disposal, Renewable (some)	Corrosion Inhib., ESD
Eco Wrap®	0	Certified	No	No	No	Disposal	Flex, Cling

*Compost ---- Certified = certified as commercially compostable, Home = suitable for use in home composting

Product	Description
Eco Film	The primary and often only measurable eco-benefit of Eco Film is when disposed of properly. Eco Film is primarily designed as stock bags for organic waste diversion programs—collecting and processing of organics by a commercial compost facility. It has been successfully trialed for agricultural use, home composting, offshore drilling and variety of other environments. It is the strongest, most resilient film and easiest to customize. It has high flexibility at any ambient temperature.
Eco Works 5-70	Eco Works 5-70 build off of Eco Film by adding in renewable content at a total percentage of 5-50% for most usable formulations for bags. Rigidity increases directly with renewable content. Up to 70% is possible for sheeting and shrouds and some custom films. Strength also increases with renewable content, but this is usually accompanied by a decrease in toughness (tear/puncture resistance). Eco Works 5-70 is usable when customers want to market renewable content or to have measurable benefit even if not disposed of properly. These are also the lowest cost products in the Cortec bioplastic portfolio. Common items are sheeting, bags, tradeshow bags. Selected Eco works films can be made with high clarity and high surface gloss.
EcoOcean and Eco Works AD	EcoOcean and Eco Works AD have the highest renewable content for flexible films and the widest range of disposal benefit. EcoOcean and Eco Works AD are "inherently biodegradable" meaning the polymer wants to break down naturally in a vast range of environments without the same need for temperature and hydrolysis that other compostable films require. However—to ensure proper claims and use, it is absolutely critical to understand that with both films, they should still be disposed of in a controlled environment—ranging from composting, anaerobic digesters, backyard composting, soil/land burial. Although the film is marine biodegradable, that attribute is not the intended disposal method, but is instead a "back up" for cases where film ends up unintentionally in waterways. These products have good toughness (puncture and tear resistance). Eco Ocean is marketed and available in sizes, thicknesses and forms typically required for coastal and offshore applications. Eco Works AD is available in sizes, thickness and forms typically required for Anaerobic Digesters and collection of materials for composting.
Eco-Corr	Eco-Corr builds off of Eco Film and Eco Works 5-50 and adds corrosion inhibitor.
Eco-Corr ESD	Eco-Corr ESD builds off of Eco-Corr and adds anti-static properties.
Eco Wrap	Eco Wrap is a high strength cling/stretch film. It is critical that Eco Wrap be used in situations where the disposal can be controlled for aerobic biodegradation or composting. It is available as custom-produced standard sizes.

References

[1] See International Organization for Standardization (ISO) LCA related standards (ISO 14040-14043).

[2] Patel, Martin;Crank, Manuel; Dornburg, Veronika "Overview of results from LCA studies and insights into new research projects", ICS-UNIDO International Conference, June 10-12 2004, Trieste Italy

[3] Detzel, Andreas; Wellenreuther, Frank; Kunze, Sybille "LCA of waste bags on behalf of European Waste Bag Producers" Report June 2009 Institut für Energie- und Umweltforschung (IFEU) Heidelberg; available at: http://www.icpeenvis.nic.in/LCA%20of%20waste%20bags.pdf

[4] Patel, Martin "Life cycle Assessment of synthetic and biological polyesters" International Symposium on Biological Polyesters, 22-26 September 2002, Münster, Germany

[5] 7 CFR 2902.7 – US federal regulations for determining bio-based content

[6] Vincotte OK-20 Biobased content of products
http://www.okcompost.be/data/pdf-document/program-ok-20e-a-ok-biobased.pdf

[7] USDA BioPreferred Program - Homepage
http://www.biopreferred.gov

[8] Vincotte program OK-2 Home compostabilty of products
http://www.okcompost.be/data/pdf-document/Program-OK-02e-c-OK-Compost-HOME.pdf

[9] BPI compilation of Frequently Used ASTM Plastics Standards which address environmental degradation
http://www.bpiworld.org/Resources/Documents/Frequently%20Used%20ASTM%20Plastics%20Standards.pdf

[10] Lieberstein, Marc; Benjamin, Barry M. "Advertising and the Environment: The New FTC Green Guides" NYSBA Bright Ideas Winter 2010 Vol. 19 No. 3
http://www.nysba.org/AM/Template.cfm?Section=Intellectual_Property_Law_Section_Newsletter_Bright_Ideas_&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=35281

[11] "GUIDES FOR THE USE OF ENVIRONMENTAL MARKETING CLIAMS" The Application of Section 5 of the Federal Trade Commission Act to Environmental Advertising and Marketing Practices, Federal Trade Commission, July 1992
http://www.ftc.gov/bcp/grnrule/guides92.htm

[12]

Tensile Strength at Break	ASTM D882-02
Elongation at Break	ASTM D882-02
Yield Strength	ASTM D882-02
Dart Drop Impact Resistance	ASTM D1709-04, Test Method A
Tear Strength	ASTM D1922-06a
Shrinkage	ASTM D2732
Melting Temperature	ASTM D 3418
MVTR (water vapor permeability)	ASTM E 96(E)