BioPlastics Role in Wrapping

Worldwide bioplastic consumption is expected to double in five years. Packaging and food service represents 70% of the application, so we need to understand what it means for packaging.

From 2003 to 2007 bio-based plastics worldwide saw growth rates average 38% and in Europe the growth rate was even higher. This rate is expected to continue through 2013 ,so that production is expected to be around 2.3 MM tons annually in 2013. To put this in context though, Anton Steeman says, "*Even by 2020, the European production of bio-based plastics is projected not to exceed 2 kg per capita, while petrochemical plastics may amount to 166 kg per capita (the current values are 0.27 and 103 kg per capita respectively).*" This means that demand for bio-plastics will continue to grow exponentially worldwide under the right circumstances because there is so much opportunity.

First, What are bioplastics?

By Bioplastics, we mean bio-based plastics made from biological sources, usually plants. The bio-based plastic concept is often thought to include bio-degradability with renewable sourcing, but that is not necessarily true. Bio-based plastics exhibit degradation under varying circumstances. Some are home compostable. Some require commercial composting, which is not commonly available in North America. Some are not degradable any better than petroleum-based plastics.

Where do bio-plastics come from?

First, a little history

Polymers are the building blocks of plastics. The first artificial polymer was invented in the 1860's. One of the most common Cellophane is still in use today. Cellophane is derived from wood polymers.

Large-scale artificial polymer production began in the 1950's from crude oil by-products.

Today, we are searching for alternative artificial polymers to petroleum-based sources by looking into biological/ renewable sources. Common sources of bio-plastics today are corn, sugar, cellulose. But polymers are all around us in woods, leaves, fruits, seeds and animal products.

To quote Anton Steeman again, "*There are three principal ways to produce bio-based plastics, i.e.*

1. *to make use of natural polymers which may be modified but remain intact to a large extent (e.g. starch plastics);*
2. *to produce bio-based monomers by fermentation or conventional chemistry (e.g. C1 chemistry) and to polymerize these monomers in a second step (e.g. polylactic acid);*
3. *to produce bio-based polymers directly in micro-organisms or in genetically modified crops."*

Steeman goes on to note that the first is the primary way in use today and that the thirds is not yet used in any meaningful way.

Common Bio-based plastics

- Starch is a naturally occurring polymer and has been rediscovered as a source of plastics today. Examples include PLA PolyLactic Acid, derived from lactic acid that is sourced from fermentable sugar (including corn).

PLA has come a long ways in terms of heat resistance. This has broadened its applications beyond refrigerated packaged items and into films for wrapping or bagging. Noise is its current issue in bagging. Nature Works is the most notable manufacturer of PLA in the USA but others exist.

- Using existing techniques, vegetable-based ethanol can be used to make ethylene that can be converted to polyethylene, polyvinyl chloride and other plastics.

- Wood based plastics are also commercially available. The most common one is cellophane but more environmentally and use friendly versions of cellulose film exist today. Nature Flex from Innovia is a common example of one that is home compostable.

Bio-Plastic Markets

The market for Bio-Plastics can be divided into

- old products sourced from bio-based feedstock (ie bio-based polyethylene, PVC, etc.)
- new products from bio-based feedstock. Among these starch polymers are the most widely used and contribute about two thirds of world-wide bio-plastic consumption.

Issues with Bio-Plastics

Cost
The key challenge with bio-based plastics is production technology and related costs. Provided they are cost effective, they can be quick and simple substitutes for existing plastics.

Market Acceptance
As we have seen with PLA bags, market acceptance is predicated on the direct substitute having the same qualities. Noise became a surprise factor in PLA bags. These issues can evolve and change rapidly.

Material Performance
Intriguingly density is an issue for most bio-bases materials. Bio-based plastics are in general much denser than their equivalent petro-based cousin. This means that they weigh more relative to their capacity or coverage. Movement to thinner walls or lighter gauge may resolve this but that can require equipment changes.

Disposability
End of life for most plastics today is thermal recovery (waste to energy plants), mechanical recycling or landfill. Bio-plastics offer similar options plus composting, either commercially or at home. This creates a growing need for infrastructure for commercial composting, which is how most bio-based plastics get recycled.

There a need for public awareness of what plastic is being used, so they can dispose of it properly. Mixing bio-based and petro-based plastics contaminates the recycling stream and destroys the benefit.

Organic recycling works where the plastic in question is susceptible to aerobic biodegradation within a given time frame. Use of “oxy” biodegradable additives is of questionable value, since they do not meet current international standards.

Energy Cost to Create
One question being raised about current production methods of bio-plastics is how much petroleum goes into the production in the form of energy and chemical fertilizer on the basic source (ie. corn or sugar for PLA). This is a moving target as methods and sources change, and perhaps an better question for doing in a Life Cycle Analysis. (See below.)

Feedstock or Foodstock
This philosophical question is about using food stock (corn or sugar for example) as a feedstock for plastics in a world that has food shortages.

CO2 Emissions

Use of bio-plastic has been demonstrated to reduce CO2 emissions. Actual performance depends on the type of bio-plastic used and the circumstances of use.

Ways to Measure Impact

Total Cost assessment looks at the total cost of a process. These costs include capital costs, operating costs and material costs. Operating costs include material, downtime, labor, etc.

One of the ways to determine the impact of the environmental costs and possible issues is to conduct a Life Cycle Analysis and examine the costs that occur before material arrives in your plant as well as what happens after it leaves.

From Wikipedia: *"The term 'life cycle' refers to the notion that a fair, holistic assessment requires the assessment of raw material production, manufacture, distribution, use and disposal including all intervening transportation steps necessary or caused by the product's existence. The sum of all those steps – or phases – is the life cycle of the product. The concept also can be used to optimize the environmental performance of a single product or to optimize the environmental performance of a company."*

"*ISO 14000 standards are designed to assist companies in reducing their negative impact on the environment. Organizations are responsible for setting their own targets and performance measures, with the standard serving to assist them in meeting objectives and goals and the subsequent monitoring and measurement of these. This means that two organizations that have completely different measures and standards of environmental performance, can both comply with ISO 14001 requirements."*

"The goal of LCA is to compare the full range of environmental and social damages assignable to products and services, to be able to choose the least burdensome one."

For more information ,see http://www.packagemachinery.com/pages/about-us/sustainability-and-overwrapping/

The purpose of LCA is to make sure that all costs are accounted for. One reason to do this is good corporate citizenship. A second reason is that sometimes costs that are shifted (such as environmental costs) end up coming back to the manufacturer with consequences.

Learn More

http://www.stanford.edu/class/cee214/Readings/ISOLCA.pdf

http://en.wikipedia.org/wiki/ISO_14000

http://www.greenblue.org/

http://www.sustainablepackaging.org/