Opportunities and Challenges for Biobased Plastics

Green Chemistry In Minnesota

Dr. Jim Lunt
Jim Lunt & Associates LLC and Green Harvest Technologies

Projected Biomaterials Trend

- European Bioplastics estimates that annual global production of bioplastics will increase six-fold to 1.5 million tonnes by 2011, up from 262,000 tonnes in 2007.
- By 2011 demand for biobased durable products is expected to account for almost 40% of the global bioplastics total, compared with 12% today.
- This will still only be 0.7% of the approximate 230 million tonnes of plastics in use today.
- So! – there is plenty of room to grow.

What Is Fueling The Growth of Bioplastics?

- Petroleum supplies are dwindling while demand for oil-based goods is rising. Oil prices continuing to increase.
- Oil supplies will run short within the next 20 to 100 years. People generally agree, but debate "when."
- Governments and consumers are demanding action to reduce dependence on oil.
- Increasing concerns over global warming, environmental pollution, toxic affects of some residual monomers and additives are driving legislation and consumer "backlash" against conventional plastics.

Solution? -A Return to Sustainable Practices

We must reduce our overall footprint in terms of how much of the earth's resources we use and how much damage we leave behind.

To achieve this footprint reduction involves:

1. Reduction in our Carbon Footprint
   Carbon Footprint is the amount of non-renewable energy we consume to make the products we use.

2. Reduction in our Ecological Footprint
   Ecological footprint is the permanent changes we create in our environment, such as pollution of water, air and land and the resultant social imbalances.

The Evolving Biobased Plastics Landscape

Feedstocks

Agricultural building blocks

Polysaccharides

- Starch/Sugars
- **Lignocellulosics**
  - -wood
  - -straws, stover etc.
- **Others**
  - - Pectins
  - - Chitosan
  - - Gums

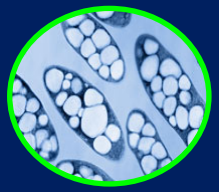
Fats/proteins

- **Animals**
  - - Oils
  - - Casein
  - - Whey
  - - Gelatin
- **Vegetable**
  - -oils
  - - Zein
  - - **soybean protein**
  - - Gluten

Direct Fermentation

Polyhydroxy alkanoates PHA's

PHB **PHBV**



Polymers

Bio-technological Origin

- **PLA**
- **Nylon 11**
- **Polyethylene**
- **Aliphatic Polycarbonate**

Petroleum/ Natural based

- **Starch blends**
- **Nylon 6,10**
- **Nylon 6,12**
- **PTT**
- **PBS**

Next Generation of Bioplastic Building Blocks

Monomers from sugar

- Succinic acid
- 3-hydroxy propionic acid
- Aspartic acid
- Levulinic acid
- Sorbitol

Monomers/Intermediates from Vegetable Oils

- Glycerol
- Soy based polyols

Biobased Polymers Challenges

Three Major Issues Under Debate

- Genetic modification of crops to provide more disease resistance and improved yields and hence lower costs.
- Eutrophication of water supplies and soil due to over use of fertilizers and pesticides.
- Over reliance on food crops.
  - We must move to lignocellulosic biomass as rapidly as possible.

Opportunities for Minnesota

- Create a biobased materials/sustainability cluster.
- Provide leadership in producing renewable-based polymers from alternative feedstocks.
- Drive adoption of biobased products through retail leaders, e.g. Target.

Cluster example -Green Harvest

Green Harvest is a Social Mission Company

- Social Mission: Products that are good for people and the planet
- Founding Member of B-Corp
- Deliberate strategic involvement with nonprofit community (equity, revenue, board of advisors)
- Commitment to Sustainability
- Credibility with NPOs, Green Brands

GHT Network

Eager customers because of GHT's relationship with Stakeholders

Thank You