Opportunities and Challenges for Biobased Plastics R&D

Patrick Krieger, PLASTICS
We are the full supply chain
Bioplastics Division

The PLASTICS Bioplastics Division works to develop bioplastics as an integral part of the plastics industry by:

- **Educating** consumer, the plastics industry, and the government about bioplastics
- **Advocating** on behalf of the industry to regulators and legislators
- **Collaborating** with organizations and companies to promote bioplastics
Current Members

- Attis Innovations
- BASF Corporation
- BiologIQ, Inc.
- Braskem America
- The Coca-Cola Company
- Danimer Scientific
- Earth Renewable Technologies
- Eastman Chemical Company
- Heritage Bags
- Center for Bioplastics and Biocomposites
- Jarden Plastic Solutions
- JinHui ZhaoLong High Technology Co.
- Leistritz
- NatureWorks LLC
- Novamont North America, Inc.
- PepsiCo
- Plastic Technologies, Inc.
- PolyOne Corporation
- Teknor Apex Company
- Total Corbion PLA bv
Recent Bioplastics Division Activities/Projects

For more information, go to: plasticsindustry.org/bioplastics

September 17-21, 2018
#BioplasticsWeek
USDA BioPreferred® Program

• Increase the purchase and use of biobased products
• Two major parts of the program:
  • Mandatory purchasing requirements for federal agencies
  • Voluntary labeling initiative for biobased products
• ~3,000 products certified and labeled products
A biobased bioplastic is made, wholly or in part, from renewable resources

- Corn
- Sugar Cane
- Wood
- Canola
- Biogenic Methane
- Algae
Degrade through biological action in a defined environment into carbon dioxide or methane, water, and biomass.

*As per ASTM D6400 – “Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities”*
Why Biobased Bioplastics?

- Diversification of feedstocks
- Potential reduction in greenhouse gases
- Consumer and Brand Owners Preferences
- Government Policies
Opportunities

Markets & Trends
Global production capacities of bioplastics

![Bar chart showing global production capacities of bioplastics from 2017 to 2022.](chart)

More information: [www.bio-based.eu/markets](http://www.bio-based.eu/markets) and [www.european-bioplastics.org/market](http://www.european-bioplastics.org/market)
Global production capacities of bioplastics 2017 (by material type)

- Other (bio-based/non-biodegradable): 9.2%
- PET: 26.3%
- PA: 11.9%
- PEF*: 0.0%
- PE: 9.7%
- PP*: 0.0%
- PBAT: 5.0%
- PBS: 4.9%
- PLA: 10.3%
- PHA: 2.4%
- Starch blends: 18.8%
- Other (biodegradable): 1.5%

Total: 2.05 million tonnes

Bio-based/non-biodegradable: 57.1%
Biodegradable: 42.9%

*Bio-based PP and PEF are currently in development and predicted to be available in commercial scale in 2020.

Global production capacities of bioplastics 2016 (by material type)

- PET: 22.8%
- PA: 3.5%
- PEF*: 0.0%
- PE: 4.8%
- PUR: 41.2%
- Other (bio-based/non-biodegradable): 4.6%
- Total: 4.16 million tonnes

Global production capacities of bioplastics 2017 (by material type)

- PET: 26.3%
- PA: 11.9%
- PEF*: 0.0%
- PE: 9.7%
- PP*: 0.0%
- Other (bio-based/non-biodegradable): 9.2%
- Total: 2.05 million tonnes

*PEF is currently in development and predicted to be available in commercial scale in 2020.


Global production capacities of bioplastics 2017 (by material type)

- PET: 26.3%
- PA: 11.9%
- PEF*: 0.0%
- PE: 9.7%
- PP*: 0.0%
- Other (bio-based/non-biodegradable): 9.2%
- Total: 2.05 million tonnes

*Bio-based PP and PEF are currently in development and predicted to be available in commercial scale in 2020.

Global production capacities of bioplastics in 2017 (by market segment)

- Packaging (flexible & rigid): 58%
- Consumer goods: 11%
- Automotive & transport: 7%
- Building & construction: 7%
- Textiles: 6%
- Agriculture & horticulture: 5%
- Electrics & electronics: 4%
- Others: 2%

Total: 2.05 million tonnes

Trends

Polymers, Production, Products
2018 Trends - Polymers

- Furan dicarboxylic methyl ester (FDME) & Polytrimethylene furandicarboxyate (PTF)
- Monoethylene glycol (MEG), Polyethylene terephthalate (PET), & PTF
- Polypropylene (PP)
- Benzene, Toluene, Paraxylene & Xylene
2018 Trends - Production

- Polyhydroxyalkanoates (PHAs)
- 1,3-propanediol (PDO), polytrimethylene terephthalate (PTT), & polyurethanes
- Polylactic Acid (PLA)
- Overall, production is increasing
2018 Trends - Products

- Packaging & Food Service Ware
- Automotive
- Electronics
- Consumer Goods
  - Toys
  - Clothing
  - Footwear
Challenges
Data

- US Market Data Gaps
- No NAICS Codes
Investment

- Federal Grants
  - Encourage review panels to be feedstock agnostic
Access to Sustainable End of Life Options

• Encourage the development of new industrial composters and aerobic digesters
• Allow compostable plastic products to be used in USDA organic program, remove 100% biobased content requirements
Infrastructure/Logistics

• Compared to “fossil” based plastics, biobased bioplastics have a wide array of challenges to feedstock access which need to be accounted for when developing a new feedstock and/or polymer.
The conversion rate for Ethylene gas to Polyethylene is ~97%
Conversion Rates for Biobased Polymers

<table>
<thead>
<tr>
<th>Polymer</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polylactic Acid</td>
<td>1 : ~ 1.6</td>
</tr>
<tr>
<td>Biobased PET</td>
<td>1 : ~ 4</td>
</tr>
<tr>
<td>Biobased PE</td>
<td>1 : ~ 5</td>
</tr>
</tbody>
</table>
150 kT carbohydrates

300 kT lignocellulosic material (bone dry)

600 kT lignocellulosic material (actual biomass)

Operate 365

*Numbers are approximations
Other Logistics Considerations

- Seasonality
- Storage
- Shortages
- Locations
Thank You

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