Importance of Industry Driven Research

December 7th, 2011
Bioeconomy Research Highlights Day & Expo
Craig Crawford, President & CEO
Overview

• Background
  – Automotive Roadmap
  – Bioproduct Targets
  – Examples of Research Commercialization

• Ontario BioAuto Council
  – Membership
  – Approach
  – Strategies for Enhancing Customer Value
  – Examples Applied Research

• Why Is Industry Driven Research Important
Biopolymer Roadmap - Auto Sector

Possible Polymers Derived from Plants

Plants → starch → cellulose → glucose xylose → lactic acid → ethanol → EO → EG → isosorbide → 1,3-PDO → 1,4-BDO → succinic acid

Plants → hemi-cellulose → lignin → ligno phenol → fatty acid → methyl ester → glycerin → sebacic acid

Plants → oil → PHA → PLA → PE → PP → PET → PEIT → PTT → PBT → PBS → PA → PUR
Toyota’s Bio-material Targets

Expectations for Technical Innovations

Toyota’s Vision

Establishment of technology for 20wt% usage of Eco-Plastics & recycled plastics by 2015

Polymers for Automotive Parts

Primary Target: Interior Parts
Commercialization of Soy-Based Foam

- Applications: seat cushion, seat back
- Soy content: 12% polyol replacement
- Implemented: August, 2007
- Soy foam usage: 2.2 Million pounds per year
- Extensive media coverage and interest
Diffusion Across Vehicle Platforms

- Ford Mustang
- Ford Expedition
- Lincoln Navigator
- Ford Escape
- Mercury Mariner
- Mazda Tribute
- Ford Fusion
- Mercury Milan
- Lincoln MKZ
- Ford Crown Victoria
- Mercury Grand Marquis
- Ford Focus
- Lincoln MKS
- Ford Taurus
- Ford Flex
- Lincoln MKT
- Ford Edge
- Lincoln MKX
- Ford Explorer
- Ford Fiesta
- Ford F-150
- Ford F-250/350
- Ford Ranger
# Current Bio-Polyamide (PA) Producers

<table>
<thead>
<tr>
<th>Company</th>
<th>Country</th>
<th>Brand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkema</td>
<td>France</td>
<td>Rilsan PA11 and PA12</td>
</tr>
<tr>
<td>BASF</td>
<td>Germany</td>
<td>Ultramid S Balance</td>
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<tr>
<td>DSM</td>
<td>Netherlands</td>
<td>EcoPaxx</td>
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<tr>
<td>DuPont</td>
<td>USA</td>
<td>Zytel RS</td>
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<tr>
<td>EMS-Grivory</td>
<td>Switzerland</td>
<td>Grilamid</td>
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<tr>
<td>Evonik</td>
<td>Germany</td>
<td>Vestamid Terra</td>
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<tr>
<td>Rhodia</td>
<td>France</td>
<td>Technyl eXten</td>
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Potential PA Applications

- Coolant circuit car engine
Ontario BioAuto Council

Board of Directors:

- Chrysler Canada (J. Mann)
- Automobile Parts Manufacturers Association
- Magna Interiors and Exteriors
- Woodbridge Group
- Canadian General Tower
- Husky Injection Molding
- AUTO21 Network Centres of Excellence
- Ontario Centres of Excellence
- Sustainable Chemistry Alliance
- Tembec / Greenfield Ethanol
- Ontario Agri-Food Technologies
- PSA Composites
- Woodrill Ltd.

Members (examples):

- Toyota Tsusho Canada
- DuPont Canada
- Cargill (US)
- Dow Automotive (US)
- DSM (Netherlands)
- BASF (Germany)
- Braskem (Brazil)
- Innventia (Sweden)
- Merquinsa North America
- Bayer Material Science
- Valle Foam
- Carpenter Company
- CCC Plastics
- National Research Council
- FP Innovations
- Exova (formerly Bodycote)
- University of Waterloo, WatCAR
- University of Toronto, Centre for Biocomposites and Biomaterials Processing
- Enterprise Saskatchewan
- Alberta Innovates – Bio Solutions
- Linnaeus Plant Sciences
- BioteCanada
- Deloitte
Approach

- Focus on new product development
  - Source of new jobs and wealth creation

- Enhanced customer value - use biomass and emerging technologies (biotechnology, green chemistry & engineering, material science, advanced manufacturing) to:
  - Control raw material costs
  - Improve product and processing performance
  - Enhance social and environmental responsibility (brand strength)

- Open innovation systems - establish global partnerships and supply chains
  - Companies
  - Clusters
  - Universities
  - Government labs, research institutes, networks
Strategies for Enhancing Customer Value

• Cost control/predictability/availability
  – Lower cost biochemicals/resins (e.g. succinic acid, isobutanol, soy-based polyols, etc)
  – Inexpensive plastic fillers (e.g. wood, wheat straw, oat hulls)
  – New plastic processing equipment (e.g. more rapid prototyping, faster processing times, greater parts integration, reduction in processing steps, etc)

• Performance (light weight, enhanced durability, etc)
  – High performance composites (using advanced micro-fibre, nano crystalline cellulose, carbon fibre technologies)
  – New 3-D structures (e.g. composite sandwiched structures)

• Environmental and social responsibility
  – New biochemical platforms and additive packages with reduced toxicity and GHG emissions
  – Closed loop material systems (enhanced recycling, energy recovery)
Target Automotive Parts for Bio-Transformation - Today

- Seat Cushions (5%)
- Structural Foam (20%)
- Carpet Backing (20%)
- Elastomers (10%)
- Coverstock Foam (5%)
- Acoustical Products (10%)

- Sunshade (20%)
- Under the Hood (15%)
- Headrest (25%)
- Headliner (20%)
- Armrest (25%)

- Energy Management (18%)
**Magna Loadfloor Construction**

- Layered sandwich composite process
- Material
  - Soy polyol to replace up to 50% of fossil fuel based polyol
- Material Suppliers
  - Dow
  - Bayer
- Process
  - Fabricate a glass/honeycomb/glass sandwich
  - Spray urethane (contains the Soy Polyol) on both sides
  - Place in tool, close press and cure
  - Removed finished composite part

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**Ontario BioAuto Council**
Coated Fabric Applications

- Door Inserts
- Map Pockets
- Headrests
- Seating – A, B, C Surfaces
- Armrests
Importance of Advanced Manufacturing

We need to integrate biopolymers, natural fibers, and bio-based additives with advances in manufacturing technology. Example: Magna Global Composites Centre.
Importance of Market Development

ELAPSED TIME FROM COMMERCIAL PLANT TO ANNUAL SALES OF 300 MILLION lb

Years

Plastics source: McKinsey

<table>
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<tr>
<th>Commodity</th>
<th>PLA</th>
<th>PVC</th>
<th>PS</th>
<th>LDPE</th>
<th>PUR</th>
<th>HDPE</th>
<th>PP</th>
<th>PET</th>
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<td>19</td>
<td>24</td>
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<tr>
<td>2004 NA sales volume (billion lb)</td>
<td>15.8</td>
<td>6.0</td>
<td>7.8</td>
<td>4.4</td>
<td>17.7</td>
<td>17.8</td>
<td>7.6</td>
<td>1.3</td>
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Industry-Driven Multi-Sector Research

Need to form industry-driven, multi-sector, centres of excellence to develop technology platforms that will facilitate more rapid aggregation of market demand. Example: ArboraNano Network (nanocellulose crystals)
Summary & Conclusions

- Strong interest by the automotive sector in using bio-based materials, IF they can demonstrate customer value:
  - Reduced material costs
  - Enhanced product performance (e.g. light weighting)
  - Real, verifiable, benefits for human health and the environment.

- Ontario, through the Ontario BioAuto Council, has commercialized a number of applications in the automotive and consumer products sector that demonstrate some of these benefits

- Advances in biotechnology, green chemistry, and material science need to be integrated with innovations in advanced manufacturing

- Industry-driven, multi-sector partnerships are needed to help coordinate public and private research research efforts and drive market demand.
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