"NatureWorks and Closed Venue Success" (Noting Things Change Thanks To Innovation)
August 22, 2012

Doug Kunnemann
Business Segment Director
NatureWorks LLC
doug_kunnemann@natureworksllc.com
Agenda

• “Bioplastics” and “plastics”
  – a broader perspective
• Ingeo™ by NatureWorks LLC
  – Background and Applications
• Closed Venue Success
• End of Life “opportunities”
  – Recycle
  – Compost
    • Other Approaches and Issue Management
• Issues and Next Steps
**What are bioplastics?**

Some are of bio-based / agricultural origin

Replace Existing Nonrenewable Plastics (Coca Cola’s 20% biobased PET, bioethanol based polyethylene, etc)

Some are “biodegradable”

Synthetic polyesters designed to degrade In appropriate environments (BASF, Mitsubishi)

“Bioplastics”
Some are of bio-based / agricultural origin.

What are bioplastics?

Some are “biodegradable”

“Degradation” must be defined & certified – e.g. (ASTM)

- Compostable - D6400
- Marine Degradable – D7801
- Soil Degradable - D5988

Must be certifiable as biobased

- ASTM D6866
Biodegradable Plastics and Bio-Additives

• Some Quotes To Note!

  – “Biodegradable plastic is an incomplete definition. Additional specification is needed - the Environment (industrial compost, marine water, anaerobic digester, home compost, landfill) and the Timeframe.”
    (Joseph P. Green – Ph.D. CA State Chico)

  – “Consumers would love an oxo-biodegradable bottle, but right now, the technologies out there would do more harm than good. So to deliver something that would be more detrimental to the environment … It would be wrong and it would be green washing.”
    (Denise Lefebvre, VP Global Packaging Food and Beverage – PepsiCo)
<table>
<thead>
<tr>
<th>“Where it Comes From”</th>
<th>“Where it Goes”</th>
<th>End of Life</th>
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<tbody>
<tr>
<td>“Beginning of Life”</td>
<td></td>
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<tr>
<td>Hi Biobased Content</td>
<td>Neither Biodegradable nor Compostable</td>
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|                       | •Nylon (Polyamide) 11  
                       | •Bio-PE            | •Ingeo  
                       |                       | •Mirel PHA’s  
                       |                       | •Thermoplastic starches |
| Some BioBased Content | •Bio PTT, bio PET  
                       | •PA 6,10  
                       | •Conventional Plastic / Bioplastic Blends | •Aliphatic – Aromatic copolyester (AAC) & Starch Blends  
                       |                       |                       | •AAC/Ingeo Blends |
| Fossil Based          | •Conventional Plastics  
                       | •PE, PP, PS, PET, ABS, PC, PVC | •AAC’s  
                       |                       | •PBS |
## Bioplastics by Life-cycle

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Who We Are…

• NatureWorks LLC established in 1997

• Wholly owned by Cargill

• World’s first and largest bio-plastics manufacturing facility
  – 140,000 metric ton name plate capacity
  – 2nd production line operational in ‘09

• Resulting NatureWorks based innovations can be found around the globe under the Ingeo™ brand name
Our Customers

Plastics & fibers from plants, not oil

Where It Comes From . . .

Carbon dioxide and water

Plants

sugar (dextrose)

manufacturing

ingeo™
Comparing Environmental Footprint: Greenhouse Gas Emissions

<table>
<thead>
<tr>
<th>Material</th>
<th>Ingeo Target</th>
<th>Ingeo 2009 CIT</th>
<th>Ingeo 2005</th>
<th>PVC (Suspension)</th>
<th>Polypropylene</th>
<th>LD Polyethylene</th>
<th>PET (Amorphous)</th>
<th>PET (SSP)</th>
<th>Polystyrene (HIPS/GPPS Avg)</th>
<th>Polycarbonate</th>
<th>Nylon 6</th>
<th>Nylon 66</th>
</tr>
</thead>
<tbody>
<tr>
<td>From cradle to polymer factory gate [kg CO₂ eq. / kg polymer]</td>
<td>0.3</td>
<td>1.3</td>
<td>2.0</td>
<td>1.9</td>
<td>1.9</td>
<td>2.1</td>
<td>3.2</td>
<td>3.4</td>
<td>3.4</td>
<td>7.6</td>
<td>7.9</td>
<td>9.1</td>
</tr>
</tbody>
</table>

Continuous improvement process
Ingeo 2005 ➔ Ingeo 2009 ➔ Ingeo target

- Fossil based polymers: PlasticsEurope; [www.lca.plasticseurope.org](http://www.lca.plasticseurope.org)
- GWP_{100} factors according to IPCC (CO₂=1, CH₄=23 N₂O=296)
Marietta, GA just welcomed a new Whole Foods store (East Cobb)

What I like about any store is innovation!
I’m excited to see Whole Foods is:
- Thinking end of life (recycle and compost)
- Allowing “Ingenious Innovative yogurt containers” in their stores. (Made from plants – not oil!)
“It’s a win-win-win-win-win. It’s price-neutral, a big win on carbon, and a much stronger package. It’s not perfection, but it is a giant leap.”

Gary Hirshberg, Chairman, President, & “CE-Yo”
Danone and WWF launch sustainable Ingeo™ Activia Yogurt Cup in Germany

Improves packaging carbon footprint by 25% and use 43% less fossil resources
NatureWorks LLC Role With Major U.S. Converters Who Use Ingeo™

Resin (Ingeo™)

Converters
- Pactiv
- International Paper
- Fabri-Kal
- Berry Plastics
- Georgia Pacific
- Solo
- MeadWestvaco

Distributors

Foodservice Companies
Ingeo™ Food Serviceware Suppliers

Why Ingeo™?

We make our biopolymer from annually renewable resources, plants...

...creating an alternative to traditional plastics made from oil...

...and giving you the performance plastics your business needs with the environmental conscience your customers expect.

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Innovative Approaches To EOL* – Starbucks!


  Paper cups are also a challenge for recycling….Starbucks has been working with recyclers and paper mills running tests that have determined that its paper hot cups can be successfully recycled in paper mills. In 2011 the company is beginning to run a pilot to close the loop.

Alternatives to PE coated paper cups exist.

We and others recognize/support Starbucks efforts in food/compostable packaging waste diversion (Focus on Food Service market)

Suppliers, converters and composters hope compostable cups will be included in future Retail based *End of Life assessments!

The Compostable Cup. Starbucks new PLA hot cup, exclusively for foodservice.
Ingeo - Recyclability and Compostability

- Ingeo is unique in that it can be
  - Mechanically recycled into rPLA
  - Chemically recycled (hydrolysis) back into lactic acid

### Feedstocks

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Food Scraps</td>
<td>12.7%</td>
</tr>
<tr>
<td>Yard trimmings</td>
<td>13.2%</td>
</tr>
<tr>
<td>Paper</td>
<td>31.0%</td>
</tr>
<tr>
<td>Metals</td>
<td>8.4%</td>
</tr>
<tr>
<td>Glass</td>
<td>4.9%</td>
</tr>
<tr>
<td>Wood</td>
<td>6.6%</td>
</tr>
<tr>
<td>Rubber, leather &amp; textiles</td>
<td>7.6%</td>
</tr>
<tr>
<td>Plastics</td>
<td>12.0%</td>
</tr>
<tr>
<td>Other</td>
<td>3.5%</td>
</tr>
</tbody>
</table>

### End Markets

- Curbside, MRF
- Post Industrial
- Closed Loop
- Feedstock Recovery
  - Lactic acid
  - r-PLA

Total US MSW Generation (by material), 2008
250 Million tons (before recycling)

Source: Municipal Solid Waste in the US: 2008 Facts & Figures

www.biocor.org
1-888-9BIOCOR
Ingeo - Recyclability and Compostability

- **Compostability**
  - End of life for plastic (fossil fuel based) packaging contaminated with food is the landfill (i.e. associated LCA impacts - costs, energy and water)
  - Ingeo based certified (BPI and ASTM) compostable packaging is an “enabler”:
    - Enables food and packaging waste to be collected as “one” stream and diverted from landfill (reduces hauling, tipping and landfill costs)
    - States actively engaged:
      - WA (Seattle), CA (San Francisco), and OR (Portland)
      - GA (Atlanta and GreenCo)

- Nationwide networking with retailers
  - Quest Recycling – Plano, TX

- Industrial composters have shared - “I secure more compostable waste by accepting both food and compostable packaging wastes”
Oregon’s ONLY Major Pro Sports Team

Portland Trail Blazers & the Rose Quarter Achieve LEED Gold Certification

- Energy Use
  - Wind Energy
  - High Efficiency Lights
- Mass Transit--30% percent of visitors ride bikes, bus or trains
- Water Conservation
- Recycling and Composting

What’s most interesting here – they pursued this on their own without regulations or bans as drivers!
StalkMarket Provides Ingeo™ Based Cups, Plates, Bowls & Cutlery for Food/Beverage Service in the Rose Garden

Composting with StalkMarket based food serviceware

– Saves Money
– Good for the Environment
– Builds Community
Portland Trail Blazer/Rose Garden Results
(Green Sporting Alliance Summit – Portland, OR. – August 1-3, 2011)

The financial return on this investment has been realized in the form of reduced operational costs of landfill tipping fees and solid waste hauling.

Pre-sorted recyclable and compostable materials cost significantly less per ton than trash destined for the landfill.

Recycling stations increased guest participation in carrying debris out of the seating bowl and sorting it properly reducing cleaning labor costs.

Key Outcomes:
- 80% landfill diversion rate in 2010
- Removed petroleum base plastics from the supply chain
- Avoided greenhouse gas emissions by diverting food waste decomposition in the landfill
Ingeo based “compostability” efforts target food serviceware applications!
Composting “Compostables” Is Not Without Issue!

• Issues associated with food serviceware include:
  – Identification
  – Certification(s)
    • Will articles (promoted as compostable) compost (BPI, ASTM, etc.)?
    • USDA Organic Compost Certification (NOP/OMRI)
  – Composting operating processes and parameters
    • Windrow vs Gore vs. …..
      – Requests to reassess timing (disintegration) of existing testing standards being pursued
  – Education (from the “converter to consumer”)
  – Associated costs
    • Compostables (themselves)
    • At the composting site
Issue Management – Next Steps

• Identification
  – Cedar Grove Packaging (The Brown Stripe)
  – Other initiatives
    • USCC Compostable Plastics Task Force
    • USDA Biopreferred (bio-content only!)
      Need to understand both intent/outcome of any program!

• Certifications
  – BPI Certification and ASTM 6400D, D7801 and D5988
    • ASTM discussions on disintegration continue!
  – USDA Organic Certified Compost (OMRI/NOP)
    • A BPI led team now assessing this issue (bio-based packaging labeled as “synthetic”)
    • USCC Compostable Plastics Task Force
Summary

• Bioplastics represent an option for many existing and new applications (focus on carbon footprint)
  – Questions remain regarding biodegradable plastics and biodegradable additives

• NatureWorks LLC and other biopolymer based companies offer renewable, recyclable and/or compostable options
  – Ingeo offers multiple end of life options
  – Working with other associations that target Zero Waste solutions
    – USCC, SPC, FPI, SPI, Elemental Impact and others
    – We (NatureWorks LLC) look forward to joining GRC in 2012!

• Closed venues provide immediate opportunities to implements recycling/compostable initiatives
  – Doesn’t require bans or regulations to create change here!
  – As noted
    • Reduced operating costs (landfill tipping fees/solid waste hauling)
    • Diversion of food and packaging wastes from landfill
New Opportunity To Position Biopolymer Uses:
USDA BioPreferred Label Program

Existing

USDA

DOE

New

USDA ORGANIC

USDA CERTIFIED BIOMASS PRODUCT
PRODUCT 57%

USDA CERTIFIED BIOMASS PRODUCT
PACKAGE 32%