SPE ACCE
Light-weighting Automotive Parts with
Price-Performance-Process Competitive
Bio-Composites – A Novel Approach
Novi, Michigan
September 11, 2015
Light-weighting – Imperative for meeting CAFE standards

Examples of some key initiatives in the industry:

- **Car Body materials** – Aluminum, Carbon Fibre Composites, etc.: Capital intensive, major process changes, expensive, fraught with challenges / supply chain, price stability, etc.

- **Engine related fuel efficiencies for favourable power/weight ratios** – New technologies, fuel research, high capital dollars, ROI timeframe

- **Car interior and exterior component parts and sub-assemblies**: New materials, price-performance-process competitive substitutes:
  
  *Low-risk Accelerated Adaption possible - low-hanging fruit using bio-materials for light-weighting auto parts*
Competitive Green Technologies: Focus on large scale production of bio-composites and bio-plastics – Leamington, ON

- Use variety of Ag biomass to make bio-composites – de-risk supply chain
- Satisfy need for reduced dependence on fossil polymers without a performance or process or cost penalty
- De-risk bio-composites and bio-plastic development initiative of our customers – technology research and development at University of Guelph’s Bio-products Discovery and Development Center.
- Work with leading customers around the world – mutual respect of each stakeholders’ knowledge and technology
Why do Bio-Composites offer an opportunity for light-weighting?

- Ag biomass (specific gravity 1.27 gm/cc) is about 50% lighter than other traditional fillers – like mineral fillers like calcium carbonate (and chopped short glass fibre (2.45 – 2.8 gm/cc)
- With the appropriate surface treatment and chemistry (compatibilizers, impact modifiers), exact same mechanical performance can be achieved
- E.g. 20% TFPP can be substituted with a 32% biomass based PP bio-composite that is 8% lighter with the performance-matching properties and processability and shrinkage
- When substituting say 30% TFPP in a given application, an even greater weight saving can be obtained – 15% - 18%.
- Even hybrid composites – combining biomass and traditional fillers – can result in light-weighting
- All of the above price competitive with non-organic-filler-petro-polymer that is being substituted
Example of properties of substitute for 20%TFPP with over 30% new carbon, lighter weight bio-composite: CGTech-BCR-Auto 30™ Series 4 – black (using patent pending bio-carbon – no carbon black)

<table>
<thead>
<tr>
<th>Property</th>
<th>20%TFPP</th>
<th>BCR-Auto 30™</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFI</td>
<td>10-12</td>
<td>12</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>32 MPa</td>
<td>34 MPa</td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>2.5 GPa</td>
<td>2.3 GPa</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>43 Mpa</td>
<td>47 Mpa</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>2.5 GPa</td>
<td>2.6 GPa</td>
</tr>
<tr>
<td>Impact – Notched Izod</td>
<td>23 J/m @ 23 C</td>
<td>37 J/m</td>
</tr>
<tr>
<td>Impact – Un-notched Izod</td>
<td>275 J/m @ 23 C</td>
<td>427 J/m</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.1 gm/cc</td>
<td>1.028 gm/cc</td>
</tr>
<tr>
<td>Odor Number</td>
<td>Rating 3 max</td>
<td>Rating 2.5</td>
</tr>
<tr>
<td>Flammability</td>
<td>100 mm/mn max</td>
<td>42 mm/mn</td>
</tr>
</tbody>
</table>
PRICE-PERFORMANCE- PROCESS COMPETITIVE

- Performance is matched, including aging resistance
- Process compatible as witnessed by molder:
  - Lower temperature -425 deg F / 220 deg C - versus 500 deg F / 260 deg C – energy saving
  - Back pressure – 10% - no change
  - Cycle time – slightly lower for bio-materials.
- Price – competitive with market price of fossil polymer filled system being substituted - 20%TFPP in this case - as confirmed by OEM and molder.

AND,

- WEIGHT SAVING
Some examples of bio-fillers used as reinforcements in commercial applications

- Miscanthus
- Switchgrass
- Coffee Chaff
- Bio-Carbon
BIOBLAKR® and Bio-Carbon

- An invention that substitutes hitherto used 100% petrochemical based carbon black with a 99% new carbon (C14 test ASTM D6866)
- USDA Bio-Preferred Certified
- BIOBLAKR® masterbatch in several different polymer matrices based on application
- Light-weighting applications – Bio-carbon is 30% lighter than carbon black (1.27 vs 1.81 gm/cc)
- Price – performance – process competitive
USDA Certification for Bio-carbon:


USDA CERTIFIED BIOBASED PRODUCT
PRODUCT 99%
Our values and how we work with our customers

- Customers are our collaborators who work together with us to find price-performance-process competitive solutions
- Mutual respect for each others’ IP – knowledge and technology – across the value chain: University, compounder, moulder, end-customer.
Some examples of substitution of fossil polymer based moulded parts with bio-composites (new carbon content):

**Customer Centric collaboration**

- Bio-composite PE: Municipal waste collection bins – Orbis Corp (moulder)
- **VW de Mexico** – HVAC duct – 20% TFPP substitution - biocarbon
- **Ford USA** – 20% - 30% Talc and glass filled PP and Nylon interior parts – miscanthus / biocarbon
- **FCA / CPK IP** – engine cover – miscanthus / biocarbon
- **GM / Protoplast** - Oil collection tray – Corvette - BIOBLAKR®
- Most recently, world’s first compostable single serve coffee pod to substitute Keurig single serve polymer pod (that was going to landfill): Moulder – Fourmark; **Club Coffee** – pod maker and **Loblaws** (Canada’s largest grocery store) – Retail customer
Conclusion

- Tremendous opportunity for light-weighting using bio-composites in existing molds
- Scalable globally - Ag biomass characterized based on global availability and formatting processes – economic co-product Ag streams / purpose grown low maintenance perennial grasses.
- Even bigger opportunity if new molds designed – thinner wall section – using bio-composites
- BIOBLAKR® - 99% new carbon based black master-batch - light-weighting with new carbon content!
Competitive Green Technologies
Small enough to innovate – big enough to be relied upon™

Thank you

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