GC3 & Hyundai

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Materials Development

May 10, 2012
Hyundai · Kia America Technical Center, Inc.
1. Recognizing Global Issues
2. Green Chemistry & Sustainability
3. Business Case
4. Where to focus?
5. Hyundai Activities
1. Global Issues

ECONOMIC GROWTH

RAW MATERIAL EXTRACTION

SUSTAINABLE DESIGN

END OF LIFE

PRODUCT USE

ASSEMBLY

MATERIAL PROCESSING

PART MANUFACTURING

Long Term Chemical Exposure

www.popconnect.org
2. Green Chemistry & Sustainability

- Definitions

Green chemistry (from Wikipedia), also called sustainable chemistry, is a philosophy of chemical research and engineering that encourages the design of products & processes that minimize the use & generation of hazardous substances.

Executive Order 13423 Definition: (2007 Pres. Bush) “Sustainable” - creating and maintaining conditions under which humans and nature can exist in productive harmony that permits fulfilling the social, economic, and other requirements of present and future generations of Americans.
3. Business Case

- **Annual Corporate Reports**

*Contents Typically include…*

- **Sustainability Management:** Corporate Philosophy
- **Economy:** Global Outlooks, Business Performance
- **Safety:** Crash Performance
- **Environment:** Climate Change, Recycling, Hazardous Materials, Air Quality
- **Society:** Employees, Customers, Suppliers, Community
4. Where to Focus?

- Hazardous Material Assessments
- Efficiency Improvements
- Bio Roof, Wind Power, Solar Array
- HEV, PHEV, EV
- Zero Waste
- Material Developments
5. Hyundai Activities

- **Green Chemistry**

  **Chemicals with Action Plans**
  1. Bisphenol A (BPA)
  2. Hexabromocyclododecane (HBCD)
  3. Nonylphenyl & Nonylphenyl Ethoxylates (NP/NPE)
  4. Penta, Octa, Decabromodiphenyl Ethers (PBDE)
  5. Phthalates

  **Timeline:**
  - 2011
  - 2012
  - 2013
  - 2014
  - 2015

  - **2011:** Attend DFE
  - **2012:** IMDS - Korea
  - **2013:** Replace Deca-BDE
  - **2014:** ID HBCD Alternatives & Replace
  - **2015:** Test Alternative Phthalates & Replace

  - **IMDS - Korea**
  - **IMDS - USA**
  - **IMDS – Modify (fewer wildcards)**
  - **BPA Assessment**
  - **NP/NPE Alternative Testing**
5. Hyundai Activities

- Renewable Energy Sources
- Methodologies & Communication

United Soybean Board

Academia

SAE International
Green Technology Committee

Global Chemical Committee
Sales
Corporate
R & D
Manufacturing
## 5. Hyundai / Industry Activities

### 2011 Materials Development - *Interior Recycled Materials*

<table>
<thead>
<tr>
<th>Part</th>
<th>Material</th>
<th>Suppliers</th>
<th>Benefit</th>
</tr>
</thead>
</table>
|                               | 25-100% PCR Yarn                      | Sage, Miko, Aunde, Freudenberg  | - Reduces consumer waste  
- Reduces depletion of natural resources |
|                               | 25-40% PIR Upholstery / Carpet        | Sage, Aunde, Guilford          | - Reduces energy consumption ~20%  
- Reduces waste ~15%  
- Reduces CO₂ Emissions by ~15% |
|                               | 10-15% Soy or Castor Oil Foam         | Lear, JCI, Woodbridge         | - Reduces depletion of natural resources  
- Reduces CO₂ Emissions  
- Reduces dependency on petroleum |
|                               | Liquid Wood (lignin + resin)          | Ford                           | - Almost carbon neutral material  
- Reduces need to landfill wood waste  
- Improves acoustics |
|                               | Recycled Rubber                       | Seoil                          | - Reduces consumer waste |
|                               | PIR Denim / Cotton                    | Levi                           | - Reduces consumer waste  
- Reduces energy consumption  
- Improves sound absorption  
- Reduces water & fertilizer consumption |
|                               | Wood Flour + Polyolefin               | Innovative Plastics & Molding  | - Reduces consumer waste  
- Reduces depletion of natural resources |
## 4. Hyundai / Industry Activities

### 2011 Materials Development - *Interior Recycled Materials (cont’d)*

<table>
<thead>
<tr>
<th>Part</th>
<th>Material</th>
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<th>Benefit</th>
</tr>
</thead>
</table>
|      | Kenaf / Coconut Fibers | Whole Tree, Visteon, Findlay Ind. | ▪ Source of income for low income farmers  
▪ Reduces CO₂ Emissions |
|      | Wheat Straw + PP | A Schullman | ▪ Reduces CO₂ Emissions  
▪ Reduces petroleum consumption |
|      | 30% Corn Based Poly Tetra Terephthalate | DuPont | ▪ 63% Less greenhouse gas  
▪ 30% Less energy  
▪ 21% Less processed water |
|      | 30-80% Co-Polyester | DuPont | ▪ Reduces consumer waste  
▪ Reduces petroleum consumption |
|      | Re-Engineered Leather | Eagle Ottowa | ▪ Reduces consumer waste |
## 5. Hyundai / Industry Activities

### 2011 Materials Development – *Powertrain Recycled Materials*

<table>
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<tr>
<th>Part</th>
<th>Material</th>
<th>Suppliers</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PCR Nylon from Carpet</td>
<td>Elring Klinger, Wellman, Bosch, Entec</td>
<td>Reduces landfill waste, Reduces part cost</td>
</tr>
<tr>
<td></td>
<td>Soy Based PU Foam + Recycled Tire</td>
<td>Recycled Polymer Materials</td>
<td>Reduces landfill waste, Reduces part cost, Reduces dependency on petroleum</td>
</tr>
<tr>
<td></td>
<td>60-100% Castor Oil Based PA</td>
<td>DuPont, Asahi Kasei</td>
<td>Reduces depletion of natural resources, Reduces CO₂ Emissions, Reduces dependency on petroleum</td>
</tr>
<tr>
<td></td>
<td>30-40% PCR HDPE</td>
<td>Corvac</td>
<td>50% Lighter weight alternative, Improved acoustics, Improved durability</td>
</tr>
</tbody>
</table>
## 5. Hyundai / Industry Activities

### Current Research

<table>
<thead>
<tr>
<th>Material</th>
<th>Researchers</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dandelion Rubber</td>
<td>Firestone, Goodyear, Ohio State University</td>
<td>PT Mounts</td>
</tr>
<tr>
<td>Orange Peel</td>
<td>Ford, University of York</td>
<td>Monomer source for plastic resins</td>
</tr>
<tr>
<td>Chitin</td>
<td>University of Australia Melbourne</td>
<td>Odor Repellent Fabrics</td>
</tr>
<tr>
<td>Corn Based Plastics</td>
<td>Ford, GM</td>
<td>Interior Parts</td>
</tr>
<tr>
<td>Natural Fiber Filled Plastics</td>
<td>Ford, GM, Iowa State</td>
<td>Interior Parts</td>
</tr>
<tr>
<td>PLA from Sugar Beets, Sweet Potatoes, Sugar Cane, Indian Grass</td>
<td>Ford, Iowa State</td>
<td>Interior / Exterior Parts</td>
</tr>
<tr>
<td>Fungus Based Foam (replaces Styrofoam)</td>
<td>Evocative</td>
<td>Packaging, Acoustics</td>
</tr>
</tbody>
</table>
5. Hyundai Activities

- Steel’s Sustainability
  - 1 Ton Recycled Steel conserves 4,000 pounds of raw materials
    - 2,500 lbs iron ore
    - 1,400 lbs coal
    - 120 lbs limestone
  - Guaranteed recycled material: old steel used to make new steel
  - EPA Statistic: Processing used steel saves 74% energy used to process new steel