Advanced Recycling Issues Solutions Update 2012
Overview

Issues & Challenges that affect Post Consumer carpet recycling

New Technological Innovations that promise new solutions
The foundation of the Post Consumer Carpet Recycling industry is **Nylon Residential Carpet**. Without it, there would virtually be NO Post Consumer recycling Industry. The volume, collection, and processing of this raw material segment is the lifeblood of CARE’s goals.

Today, and for the immediate future, as **Nylon Residential carpet** goes, so goes the health and viability of Post Consumer Recycling.
Early Low Value Products are disappearing
- Key in early stages of P.C. recycling
- Today all development: Purity Development

Higher Value products are Natural progression

As we learn,
- Recycling Evolves
- As we evolve, we develop new processes
- As we develop new processes, new products emerge
- As new products emerge, higher value products are manufactured
- As higher products are manufactured, Recycling flourishes
- As Recycling flourishes, recyclers reap higher economic rewards
Macro Economic Issues

Out of our Control; However:

CRITICAL FOR PRODUCT DEMAND
AND
PRICING POWER
Greatly Affected Recycling volume

- 2008 low point: Resin demand reduced by 75%
  - End Users & Outlets Disappeared
  - Recyclers had no outlets
  - Prices bottomed: See slide later in presentation

- 2010 Recovery Greatly Increased Recycling Demand
  - Volume due to pent up demand accelerated Rapidly:
  - Demand outstripped Supply- Rapid Price expansion: not sustainable
  - Affected entire recycling supply Chain: Equipment, collectors Processors,
  - End Users. Most End users unable to find adequate Nylon supply
2011 Issues surfaced again
- Demand and Prices weakened in 3rd Q. of 2011: Why?
- Exports to China Virtually stopped
- Japan Tsunami – Affected U.S. – Affect lagged by 3 months
  - Auto Industry: Crippled due to lack of parts (much of it Nylon)
- China Slowing & Tsunami Created “perfect Storm” late 2011

Outlook for 2012
- Early 2012 very weak – reflected in Price declines & product Availability
- China stable now, but not as strong as early 2011
- Overall Demand now very robust:
  - Prices increasing
  - Many recyclers sold out
  - Product Shortages
- Demand & Prices expected to be robust balance of year:
  - Demand for P.C. Nylon may outstrip supply in the short term
Economic Disruptions

They are inevitable and will always be a fact of life. A robust and sustainable Post Consumer Carpet Recycling Industry must be sufficiently cost effective in order to be able to weather various Economic Disruptions which create wild swings in market prices.
The development and deployment of Regional Recycling Centers as the hub of dozens of Regional collection centers is Critical component of Cost and Viability. It assures that every market is engaged in collections and Recycling so that CARE’s National goals are met and a robust recycling infrastructure develops.
Regional Recycling Centers

Why They Are Critical

- **Economics: Transportation Costs**
  - Ave. Sq. Yd. Residential Carpet: 1.6 lbs. of Calcium Carbonate
  - On average: 1 lb carpet contains 40% Limestone
  - Transport of “dirt” is expensive
    - Ave. 40K lb load contains 16K lbs dirt: 500 mile trip = 5 cents/Lb. Dirt.

- **Regional Recycling Centers**
  - A Single Regional Recycling Center supports dozens collection points
  - Smaller collection points should be closest to Recycling center
  - Process where the carpet is located.
Regional Recycling Centers

Regional Centers Are Developing

- Northeast Corridor
- Midwest
- Western United States
  - Southern California
  - Northern California
  - Northwest
- Southeast
  - Several Centers – Largest Concentration
- Possible Additional Centers
  - Midwest – Very large area & population
  - Southwest – Texas Area
  - San Francisco Area
  - Northeast – Densest Area of country
The development and deployment of Regional Recycling Centers as the hub of dozens of Regional collection centers is Critical component of Cost and Viability. It assures that every market is served, engaged in collections and Recycling so that CARE’s National goals are met and a robust Economic model can be formed.
How Do we Reach full Recycling Potential

THE TWO MAIN CHALLENGES

- Commercial Carpet
- PET Residential Carpet
Growth of Commercial tiles
- 2010: 50% of Commercial Volume
- 2012: Estimated 55% of Commercial Volume
- 2015: Estimated at 60% of Commercial Volume

2 Types of Tile Chemistries Dominate
- PVC Tile backings
- Extruded Polyethylene tile backings

PVC Tile Recycling
- 2 Manufacturers (Interface & Tandus) recycle largest Volume
- PVC recycling Technology Well Developed

Extruded PE Tile Recycling
- Very limited
- Early beginnings in recycling development
Commercial Carpet Issues

Commercial Carpet is difficult to recycle

- Multiple fibers in single carpet
  - Many broadloom products contain nylon 6 & nylon 66
  - Historically done for styling reasons

- Low Fiber weights – Ave. now is 22 oz./yd.
  - Shearing is almost impossible – Extremely low yields

- Multiple backing components
  - thermosets, thermoplastics, fiberglass, PET, etc

- Most Broadloom Direct glue to floor
  - Multipurpose adhesive cling to back

- Difficult to “De-construct”
  - Calcium/latex ration 2/1.
  - Residential calcium latex ration 5/1.

- No single Recycling system can effectively process all the variations.
- Unique solutions must be found to encompass all variations
Growth of PET Residential Carpet

- 2010: 25% of Carpet Output
- 2012: Estimated 30% of Carpet Output
- 2015: Estimated at 39% of Carpet Output
- 2015 more PET than Nylon 66 (844 MM vs. 544 MM)

PET Solution Mandatory for long term Survival

- Disposal costs will sap most of recycler profits
- High Level Strategic CARE Committee formed
- All technologies being investigated.
- Initial work & development in process
## Long Term Carpet Trends

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<tr>
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<th>2010</th>
<th>2011</th>
<th>2012</th>
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<td>Residential Lbs.</td>
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<td>2170</td>
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<td>Total Nylon % (Of Total)</td>
<td>64%</td>
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<td>60%</td>
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<td>Total Nylon Lbs.</td>
<td>2304</td>
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<td>2178</td>
<td>2183</td>
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<td>2014</td>
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<td>6/66 Ratio</td>
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<td>63/37</td>
<td>65/35</td>
<td>67/33</td>
<td>70/30</td>
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<td>Nylon 6</td>
<td>1382</td>
<td>1406</td>
<td>1416</td>
<td>1463</td>
<td>1416</td>
<td>1470</td>
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<td>Nylon 6.6</td>
<td>922</td>
<td>826</td>
<td>762</td>
<td>720</td>
<td>607</td>
<td>544</td>
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<tr>
<td>Total PET/PTT %</td>
<td>25%</td>
<td>28%</td>
<td>30%</td>
<td>32%</td>
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<td>Total PET/PTT Lbs.</td>
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<td>Polypropylene %</td>
<td>9%</td>
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<td>Others %</td>
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<tr>
<td>Others Lbs.</td>
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Chemical Recycling

Mechanical Recycling

- Within those 2 systems there is complexity and Variety
- Some systems use combination (Dry/Wet) to produce final product
Chemical Recycling

Typical Target is high value Fibers
- Fiber back to Fiber
- Carpet usually aggressively Processed as first step

Chemical Recycling Types
- Depolymerization – Nylon 6 only
  - Shaw Evergreen:
  - Aquafil
  - Nylene of Canada
- Formic Acid Dissolution – Nylon 6 and Nylon 66
  - Modular Carpet Recycling:
  - Multiple units easily deployed
MECHANICAL RECYCLING

- **Targets Fibers & Backings**
  - Dry Only
  - Wet Only
  - Dry/Wet Combinations
  - Wet Only

- **New Fiber Recycling Technologies Target**
  - Engineered Resins
  - Fiber Applications: Carpet fiber back to Carpet fiber

- **New Backing Recycling Technologies Target**
  - Residential P.P. backing – Engineered Resins
  - Commercial PVC Backing – New Tile backings
New Technology Development

Development of technically & Economically viable technologies for the production of Increasing Pure Post Consumer High Value End Product is the critical Key for a Sustainable Carpet Recycling Industry which will achieve CARE’s goals for high Levels of Post Consumer Carpet Recycling. Many new and innovative solutions are taking place.
Dry System
Joint development: Heritage/Genesys
Vertical Carpet Fragmentation
Inertial forces Fragment carpet
Significant Latex/Calcium Reduction during fragmentation
Final R & D Stages
Currently Running on PP Post Consumer Carpet
Contact Ron Sherga: 214-693-7792
New Mechanical systems

TORNADO SYSTEM

- Wet System
- Carpet materials trialed
  - Residential Carpet
  - Commercial Carpet
  - Carpet Tiles
- Pulp Industry Adaptation to Carpet
- Ash removal down to < 1% - Depends on Input material
- Water “tornado” action
- Initial System projected Operation – June 2012
- Contact Paul Ashman: 978-621-9540
New Mechanical systems

SHEAR CARPET CARCASS PROCESSING

- Dry System
- Collects Carcass from Shear Operators
- Tearing System Extracts Carcass Nylon
- Low Nylon fiber recovery
- Operational April 2012
- End Use Not Known
- Located South of Atlanta
- Contact John Knox: ReCom Technologies: 770.330.4811
Shear Developments

Development in Shear Operations

- 2 Shear Operations processing own carcass
- 3 shear Processors ceased operations in 2013
- 2 to 3 new companies starting shear in 2012
- Most Shear processors sell fiber only
- Approximately 12 companies shearing by end of 2012
  - Many have multiple Machines
Long Term Carpet Trends

CRITICAL ISSUE

WHY?

WILL DETERMINE DIRECTION OF RECYCLING TECHNOLOGIES
Thank You

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