**Motivation**

- The EPA estimates 6.5% of all materials going into landfills are clothing and textile products [1].
- Clothing recycling today has an equivalent impact of removing 1 million cars from the nation’s roads [2].

**Project Definition**

- Convert post-consumer apparel products into a cost effective textile product or material.
- Create a new recycling program for Sector 212.
- Company Needs:
  - Product Created from Sector 212 Waste
  - Cost Effective Process
  - Environmentally Friendly
  - Technology for Production
  - Industry Competitors
  - Global Market
  - Product Viability
- Perform market analysis to find the best manufacturing option

**Goal:**
To be able to incorporate Sector 212 into the trending recycling industry and help the company benefit by increasing their profit as well as creating an example for other industries.

**Sponsorship/Acknowledgements**

Project sponsored by Sector 212
Senior Design Faculty Mentors: Dr. Russell Gorga & Dr. Jesse Jur
regorga@ncsu.edu & jsjur@ncsu.edu
Students Contact Information: lecox@ncsu.edu, jhage@ncsu.edu, jknippe@ncsu.edu

**References**


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**Production Process**

**Mechanical Recycling Process**

- **Cutting:** Process of cutting the post-consumer clothing into small sections.
- **Tearing:** Process of shredding the material from the previous process into fiber form.
- **Opening:** The shredded material is further opened and pulled apart to remove trash content.
- **Mixing:** The regenerated fibers are mixed with raw materials for a desired ratio of total materials.
- **Airlay:** A web of fibers is formed depending on the density.
- **Bonding:** The web of fibers are then thermobonded to create the final product.

**Conclusions**

- Recycling post-consumer clothing into nonwovens can be profitable.
- Virgin fiber will be required in the raw material for a successful product.
- Machinery design will be dependent off of raw materials chosen.

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**Cost Analysis Tool**

<table>
<thead>
<tr>
<th>Initial Cost</th>
<th>Machines</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting/Shredding Machines</td>
<td>$2,121,600.00</td>
<td></td>
</tr>
<tr>
<td>Nonwoven Airlay Machines</td>
<td>$1,727,200.00</td>
<td></td>
</tr>
<tr>
<td>Bonding Machines</td>
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</tr>
<tr>
<td>Air Compressor</td>
<td>$6,228.80</td>
<td></td>
</tr>
<tr>
<td>Gas Lines</td>
<td>$7,480.00</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>$0.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$5,508,108.80</strong></td>
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</table>

**Key Inputs**

- **Shifts:** 3
- **Length of Shift (hours):** 8
- **Days worked per year:** 260
- **Production Rate (kg/hour):** 997.90
- **Post-consumer Material (Price per kg):** $0.00
- **Virgin Material (Price per kg):** $0.44

**Production Rate Payback Period**

<table>
<thead>
<tr>
<th>Conservative</th>
<th>Over 60 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid Range</td>
<td>43 months</td>
</tr>
<tr>
<td>Optimistic</td>
<td>35 months</td>
</tr>
<tr>
<td>Practical Best</td>
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**Opportunities**

- **Nonwoven Machinery Manufacturer:**
  - Laroche is a leading manufacturer of textile recycling machinery. We had the opportunity to go to France to view and learn about the machinery.

**Moving Forward**

- **Novafiber:**
  - Recycling branch added to Sector 212. Clothes that are considered waste materials will be converted into nonwoven products.

**Potential Clients:**

- **Olympia bedding & Ekla Home**

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