Comparative Life Cycle Assessment of Frozen Food Packaging Systems

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Overview

• The goal of this project was to quantify and compare the environmental impacts of two types of packaging used in the frozen entrée industry—Tray-and-Film and Traytite.

• The client for this project was Kurt Naas of A-line Corporation.
Life Cycle Assessment

• Tracing the environmental impacts of a product from “cradle to grave”

• Four steps of an LCA:
  – Goal and scope definition (and redefinition)
  – Inventory analysis
  – Impact assessment
  – Improvement analysis
Defining Impacts

• Raw Materials/Energy Use
  – Water
  – Wood
  – Energy

• Global Warming
  – CO2 and Methane

• Eutrophication
  – NH3

• Acidification
  – SOx and NOx

• Solid Waste
Identifying relevant processes

- Raw materials acquisition
- Materials manufacture
- Production
- Use/reuse/maintenance
- Waste management
Data Collection

• Sources of data and process information
  – Industry experts
  – Existing LCA reports
  – Machine manufacturers
  – EPA websites

• Limitations and assumptions
  – Data is unavailable or inaccessible
  – Process ambiguity
  – Shared or negligible processes

• “Cradle to Gate” assessment
Traytite®
• Solid Bleached Sulfate (SBS) paperboard tray and lid
• Polyethylene terephthalate (PET) coating

Tray-and-film
• SBS outer carton
• PET tray
• PET film
PHASE 1
Raw Materials Acquisition

Wood Harvest

Crude Oil Extraction

Transport

Tray and Film

Traytite

Tray – and - film Carton

Traytite Coating

Film

Tray

Photo Sources:
PHASE 2c
Filling/Packaging Distribution
(Michelina’s)

Form Traytite

Denester

Fill

Seal

Cartoning

Freeze

Transport

To Consumer

Photo Sources:
http://www.aline1.com/products/?productID=61
Results

- The TrayTite required less raw materials than the Tray-and-Film.

- The consumption of water was the largest component of the raw materials for both product.

- The second largest resource used was wood used for the paper board of the TrayTite, and the Tray-and-Film carton.
Energy consumption by process (Traytite):
- Resin Production (per coating): 14%
- Coating Production: 4%
- Pulping (SBS): 3%
- Papermaking (SBS): 3%
- Tree Harvesting (SBS): 2%
- Transportation: 2%
- Traytite Forming: 1%
- TrayTite Sealing: 1%

Energy consumption by process (Tray-and-Film):
- Resin Production (per film): 30%
- Film Production: 3%
- Resin Production (per tray): 2%
- Pulping (SBS): 0%
- Papermaking (SBS): 0%
- Tree Harvesting (SBS): 2%
- Tray Production: 1%
- Denesting: 1%
- Tray Sealing: 0%
- Cartoning: 0%
- Transportation: 51%
The Tray-and-Film emits almost twice as much CO$_2$ Equivalents as the Traytite.

Even though the breakdown of contributions from product, one process from each stands out clearly as the most
- Pulping involved with SBS paperboard production is the largest contributor for both products.

- The production of the plastic for the tray in the Tray-and-Film design is the main reason why this product has higher greenhouse emissions.

**Traytite Global Warming Potential (CO2 Equivalents)**

**Tray and Film Global Warming Potential (CO2 Equivalents)**
**Euthrophication Potential**

- Amount of NH3 (kg)
- Tray and Film: 0.0000012 kg
- Traytite: 0 kg

**Eutrophication Potential for Tray- and-Film**

- Amount of NH3 (kg)
- Tray Production: 0.0000012 kg
- Film Production: 0 kg

**Acidification (g/unit)**

- Traytite: 1.0 g
- Tray & Film: 1.5 g

- SOx: 0.5 g
- NOx: 0.5 g
Conclusions and
Recommendations
Traytite vs. Tray-and-Film

- Resource consumption: Traytite
- Emissions: Traytite
- Recyclability: Tray and Film
- A thorough investigation of the two products, including material and energy inputs and emissions suggests that the Traytite package has a smaller impact on the environment than Tray-and-Film.
## Recommendations

<table>
<thead>
<tr>
<th>Category</th>
<th>Traytite</th>
<th>Tray-and-Film</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Use</td>
<td></td>
<td>Re-design carton, increase use of recycled fiber</td>
<td></td>
</tr>
<tr>
<td>Water Use</td>
<td></td>
<td>Reduced quantity of PET</td>
<td>Increase process efficiency, paper use, gray water</td>
</tr>
<tr>
<td>Recyclability</td>
<td>Alternative Coating</td>
<td>Non-black PET</td>
<td></td>
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<tr>
<td>Solid waste generation</td>
<td></td>
<td>Reengineer resin production</td>
<td>Increase internal recycling</td>
</tr>
<tr>
<td>Water Emissions</td>
<td></td>
<td></td>
<td>Paperboard</td>
</tr>
<tr>
<td>Air Emissions</td>
<td></td>
<td>Reduced paper/fiber use</td>
<td>Combustion of waste at factory</td>
</tr>
</tbody>
</table>
Conclusion

• The major negative environmental consequences (global warming, eutrophication, and acidification), are more substantial for the tray-and-film product than for the traytite product

• However, there is less room for improvement in traytite manufacturing and consumption