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
  - CO_2 and Methane
- Eutrophication
  - NH_3
- 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

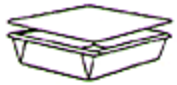
Raw Materials Acquisition

Tray and Film

Traytite

Traytite Coating

Traytite



Film

Tray –and-film Carton

Tray

Wood Harvest

Crude Oil Extraction

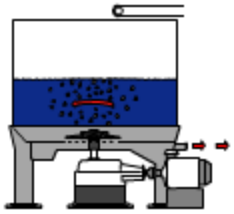
Transport

Transport

Photo Sources:
Dummit, 2008, http://sprinterusa.com/images/tray2.gif, http://www.baypack.com/cartoners/images/carton_side.gif, http://media.canada.com/cfe7ac49-e090-4323-a853-83766709cd57/shelloilsands_cw_073007.jpg, , http://www.germes-online.com/direct/dbimage/50282392/PET_Plain_Film_For_Thermal_Lamination.jpghttp://www.webstaurantstore.com/images/1262027_lg.jpg, http://wwwtest.enbridge-us.com/uploadedImages/Enbridge_Energy/About_Us/Our_Businesses/Natural_Gas_Segment/Trucking_Services/Dufour-truck.gif

PHASE 2a

Materials Manufacture



Wood

Petroleum Intermediates

Paperboard plant (International Paper)

PET resin plant (DuPont)

Pulping

Papermaking

PET Resin Production

Precursor Amorphous PET (APET)

Transport

Traytite Carton Paperboard

Traytite PET coating

PET Extrusion

Tray-and-film Carton Paperbaord

APET for PET tray

Transport

Transport

To Paper Conversion Plant

To Paper PET Packaging Plant

APET for PET film (in DuPont)

Photo Sources:
Dummit 2008

PHASE 2b

Product Fabrication

Traytite, Tray-and-film Carton

Paper Conversion Plant (Graphic Packaging International)

Printing/Cutting

Tray-and-film Carton

Folder/gluing

Traytite

Transport

APET

PET Packaging Plant (Associated Packaging Technologies)

Dryer

PET Extrusion

Pre-heating

Thermoforming

Trim Press

PET Tray

Transport

APET

PET Plant (DuPont)

Dryer

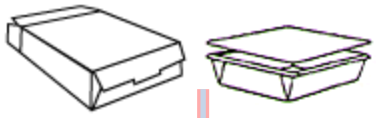
PET Extrusion

PET Film

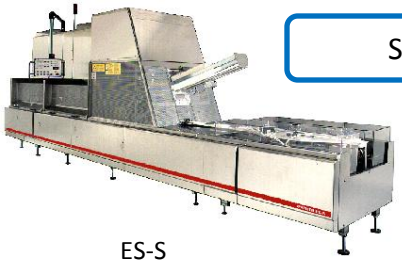
Transport

PHASE 2c

Filling/Packaging Distribution
(Michelina's)



MP-HT



ES-S

Form Traytite

Denester

Fill

Seal

Seal

Cartoning

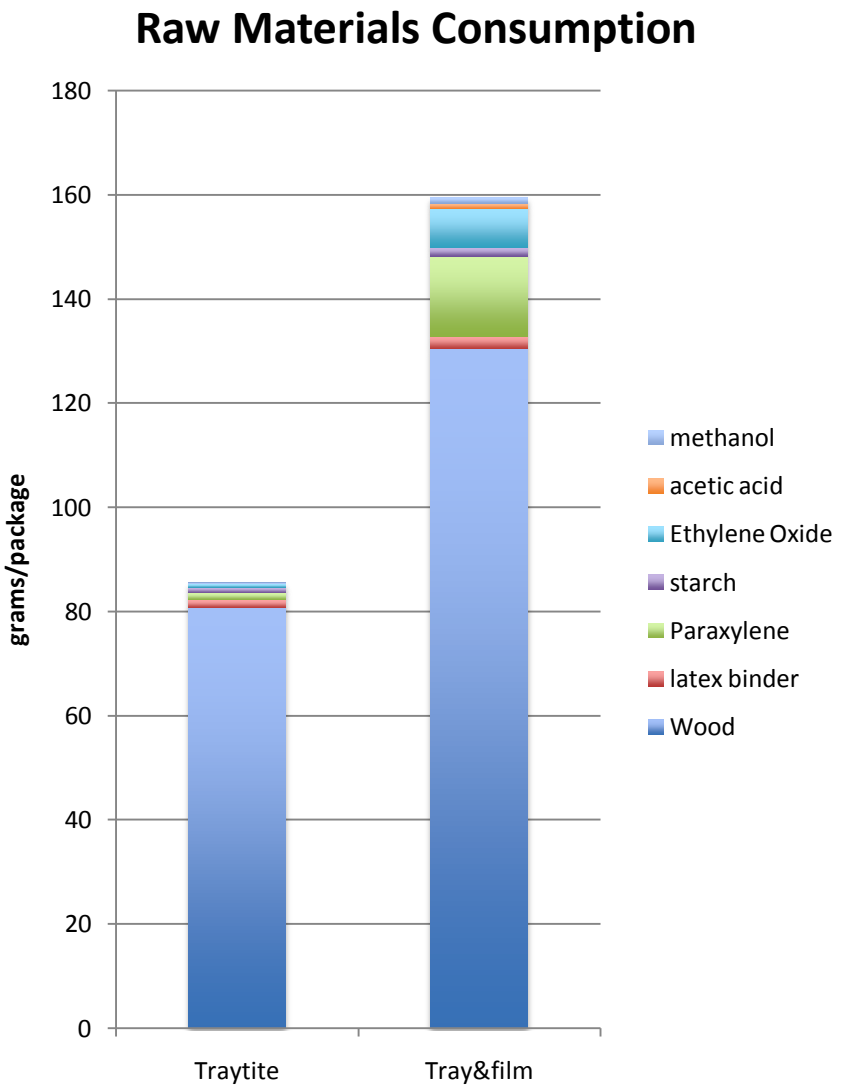
Freeze

Transport

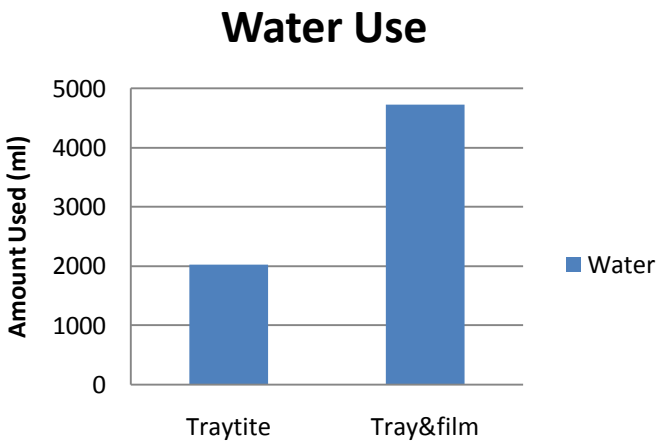
To Consumer

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

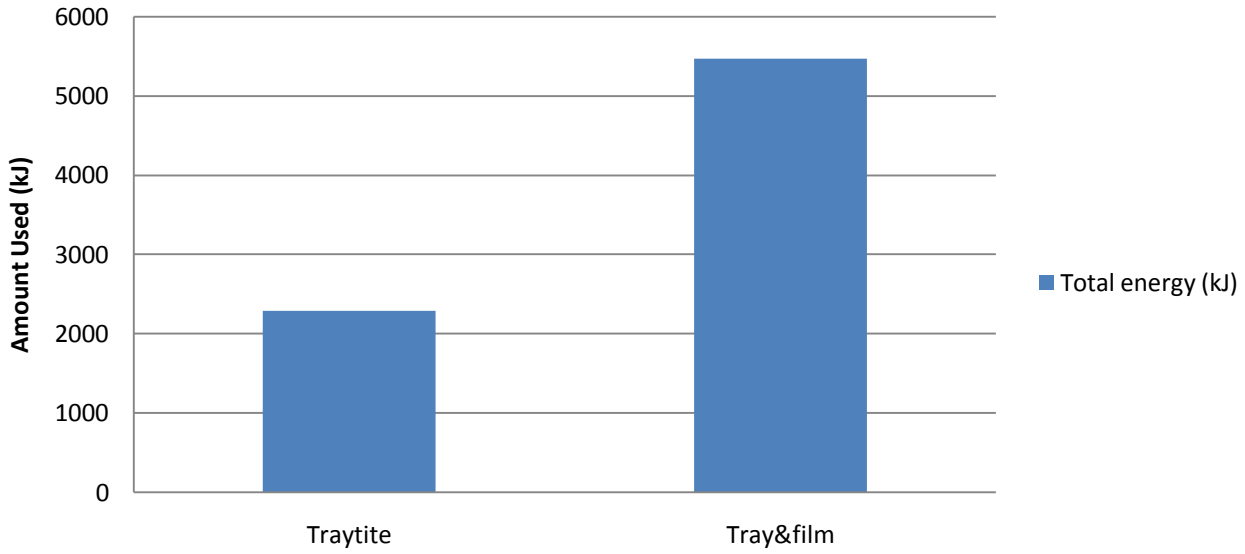
Results



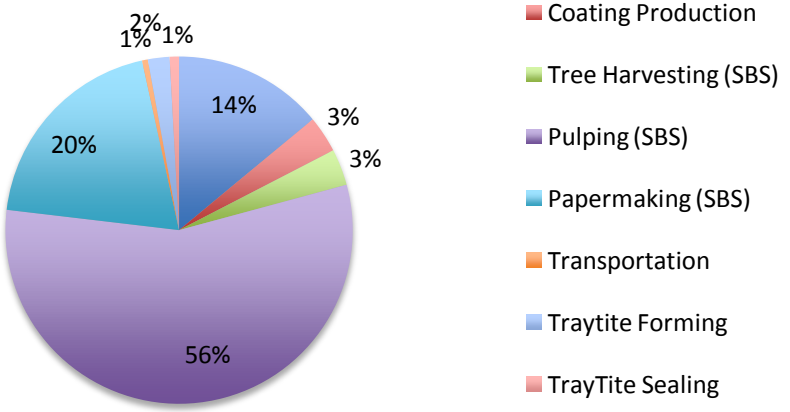
- The TrayTite required less raw materials than the Tray-and-Film
- The consumption of water was the largest component of the raw materials for both product.
- The second largest resource used was wood used for the paper board of the TrayTite, and the Tray-and-Film carton



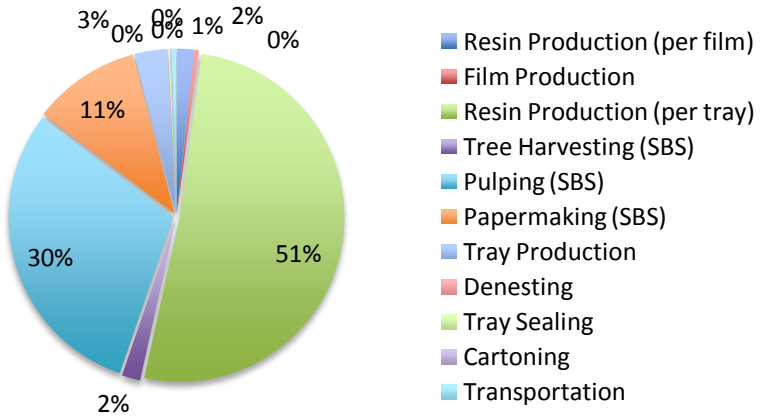
Energy use (KJ)

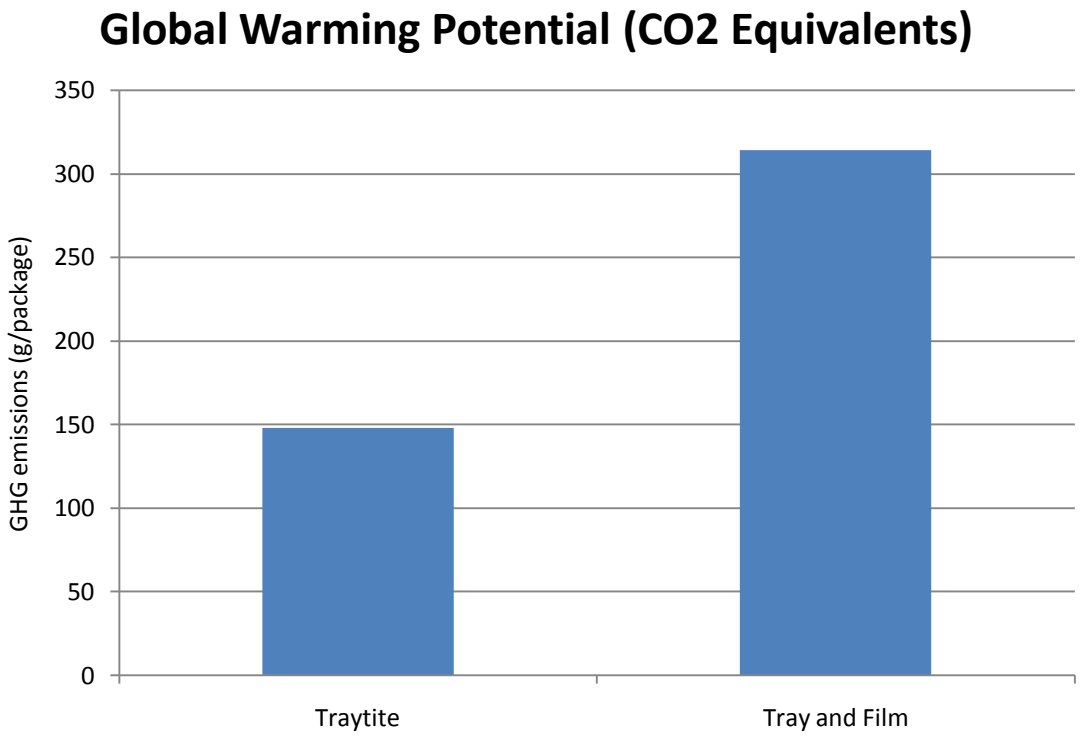


Energy Consumption by Process (Traytite)



Energy Consumption by Process (Tray-and-Film)



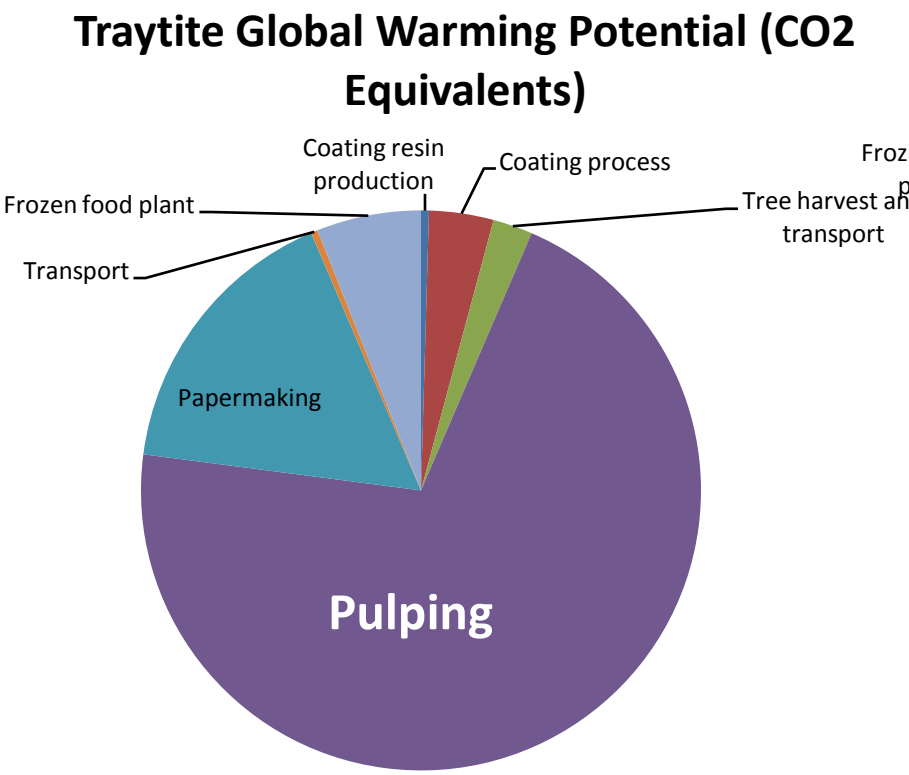


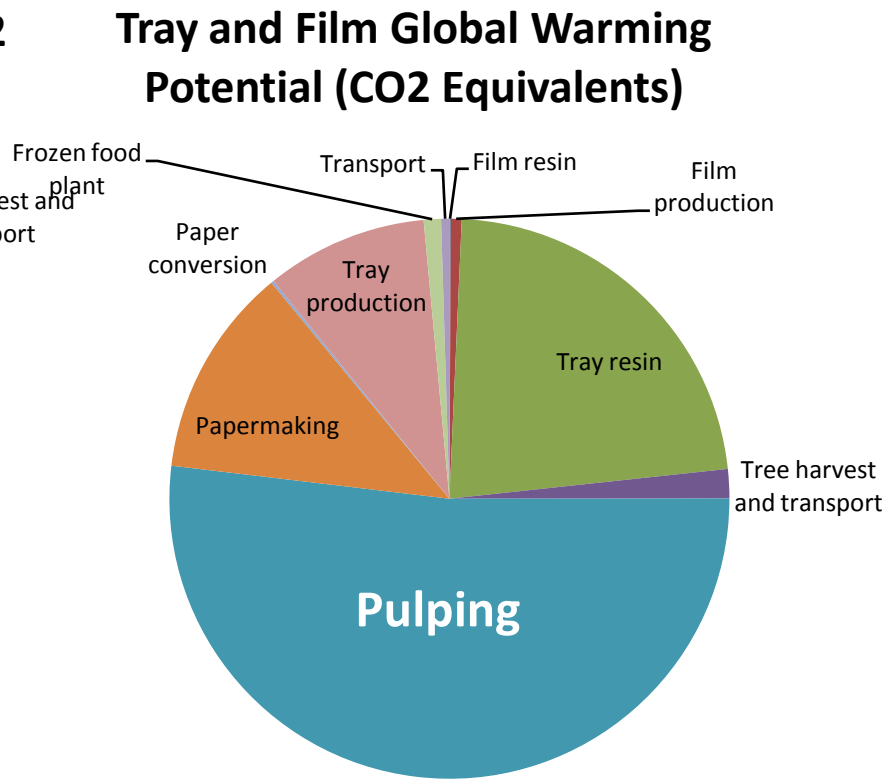
•The Tray-and-Film emits almost twice as much CO_2 Equivalents as the Traytite

•Even though the breakdown of contributions from product, one process from each stands out clearly as the most

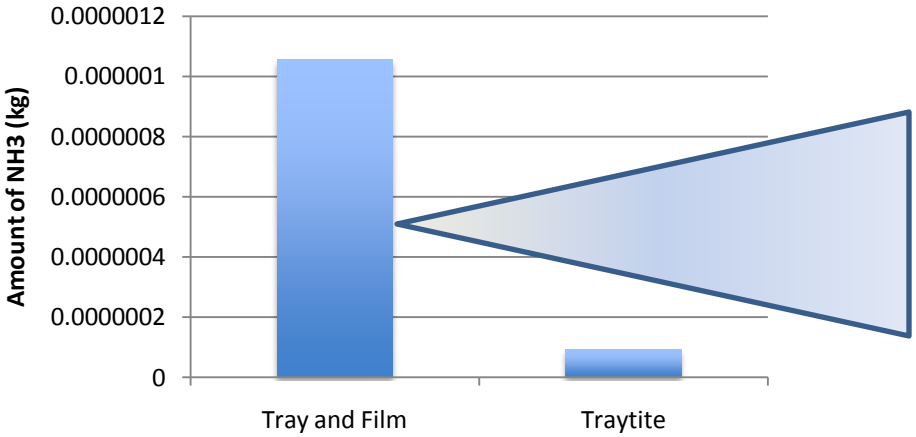
•Pulping involved with SBS paperboard production is the largest contributor for both products

•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.

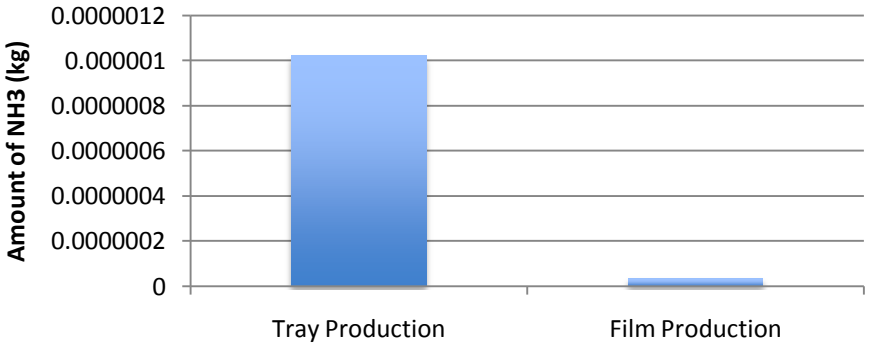




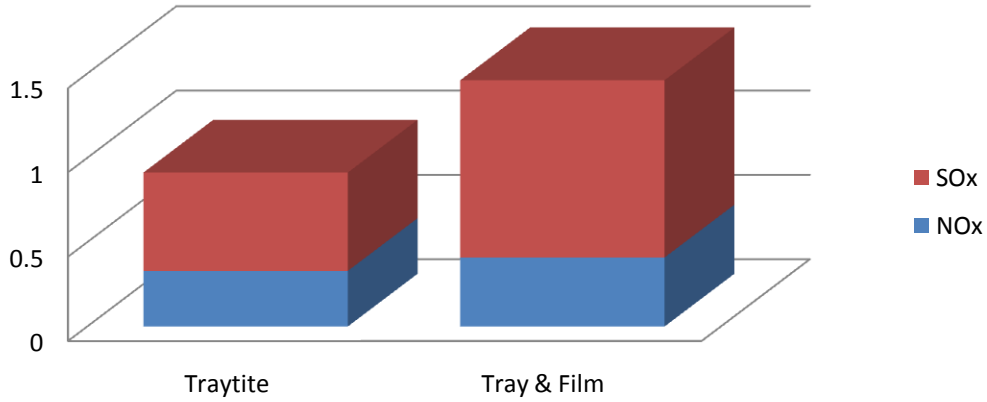
Euthrophication Potential



Eutrophication Potential for Tray-and-Film



Acidification (g/unit)



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

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

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