When evaluating the environmental aspects of a packaging material or system, it is necessary to take into account the package performance, environmental impact during its lifecycle and end-of-life options. Expanded polystyrene (EPS) transport packaging is smart, safe and sustainable. With EPS cold chain shipping systems you can achieve less weight and lower damage rates that translate into positive sustainability factors across the board. EPS can be same-recycled into a product of equal value or up-cycled into a product of higher value. And, EPS is often less energy intensive than alternative choices. Based on the Sustainable Packaging Coalition definitions for sustainable packaging, EPS demonstrates favorable environmental performance in most aspects, making it a worthy consideration for product shipments that require superior protection.

Contents

EPS Industry Alliance

Expanded Polystyrene Environmental Profile Report for Cold Chain Seafood

Executive Summary

This report evaluates various packaging systems to ensure cold chain shipping materials are in compliance with corporate sustainability mandates and presents information for a science-based review of expanded polystyrene (EPS) and Cascades' ThermaFresh fish box containers. To address this question we propose obtaining both generic and specific information to conduct a thorough side-by-side comparison of the two packaging systems and to communicate directly with other parties in the supply chain including fisheries and waste haulers to verify the information being presented by the respective packaging suppliers.

Reliance on factual information is a keystone of environmental assessments and while time consuming, it will help overcome potential risk impacts. In this particular case, risks may include increased material costs, increased waste disposal or recycling fees, increased environmental impacts, decreased product quality and farther reaching implications for other packaging customers. Substituting a new packaging system that does not have a substantial track record may pose other risks not evident at the onset.

EPS-IA recommends a thorough review and assessment of all available information to determine the best fish packaging system. The key points of consideration are:

- Sustainability Metrics
- Cold Chain Performance
- Warehouse & Distribution Logistics
- Disposal Cost Factors

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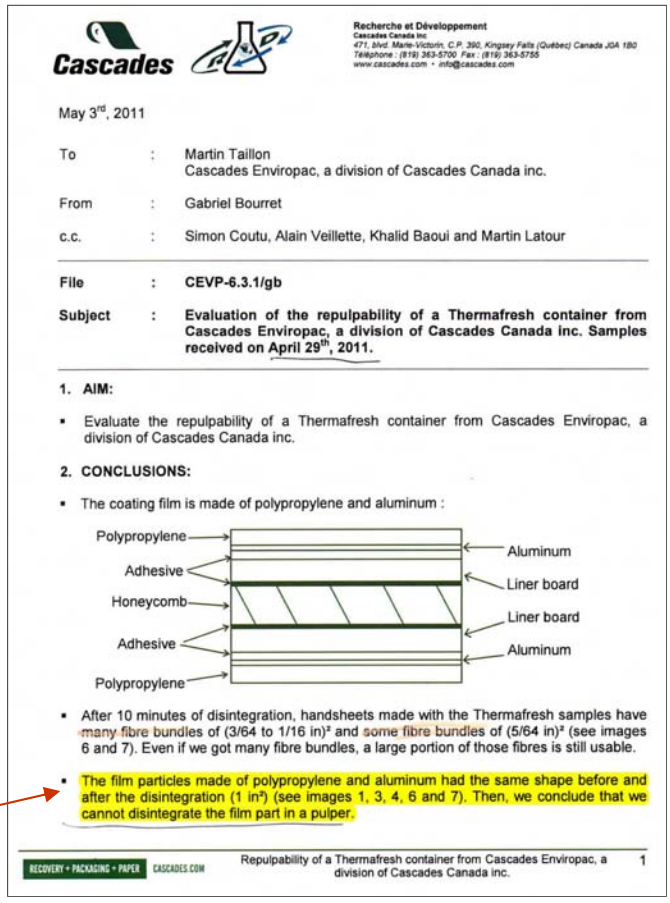
Recycling Indicators

Compacted EPS currently sells for CAN $0.25/kg

Expanded polystyrene is incorrectly assumed to be non-recyclable by the majority of corporations when in fact there are hundreds of companies that successfully recycle EPS, including **Walmart**, **Whirlpool®**, **Omaha Steaks**, **Nutrisystem®** and others.

There is also an incorrect assumption that cardboard (OCC) is always recyclable. ThermaFresh's recyclability is limited to within the Cascades collection system. Further limitations are indicated in the internal Cascades report "Evaluation of the repulpability of a ThermaFresh container" (2011). This report says that even when using the Cascades repulping process ThermaFresh containers can only be incorporated at a 5% rate because:

- it is a polymer coated material;
- the adhesive used to laminate the honeycomb with the liner is insoluble; and
- the film itself cannot be disintegrated in a pulper.



Cascades

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May 3rd, 2011

To : Martin Taillon
Cascades Enviropac, a division of Cascades Canada inc.

From : Gabriel Bourret

c.c. : Simon Coutu, Alain Veillette, Khalid Baoui and Martin Latour

File : CEVP-6.3.1/gb

Subject : **Evaluation of the repulpability of a Thermafresh container from Cascades Enviropac, a division of Cascades Canada inc. Samples received on April 29th, 2011.**

1. **AIM:**

- Evaluate the repulpability of a Thermafresh container from Cascades Enviropac, a division of Cascades Canada inc.

2. **CONCLUSIONS:**

- The coating film is made of polypropylene and aluminum :

Polypropylene
Adhesive
Honeycomb
Adhesive
Polypropylene
Aluminum
Liner board
Liner board
Aluminum

- After 10 minutes of disintegration, handsheets made with the Thermafresh samples have many fibre bundles of (3/64 to 1/16 in)² and some fibre bundles of (5/64 in)² (see images 6 and 7). Even if we got many fibre bundles, a large portion of those fibres is still usable.
- The film particles made of polypropylene and aluminum had the same shape before and after the disintegration (1 in²) (see images 1, 3, 4, 6 and 7). Then, we conclude that we cannot disintegrate the film part in a pulper.

RECOVERY + PACKAGING + PAPER CASCADES.COM
Repulpability of a Thermafresh container from Cascades Enviropac, a division of Cascades Canada inc. 1

Therefore, we strongly recommend obtaining detailed information on what percentage of the shipping container is or is not recyclable and to what extent Cascades anticipates the ThermaFresh packaging system's recyclability will perform in accordance with the 2011 test report. This is especially important since the Cascades report only indicates how ThermaFresh performs in laboratory handsheet tests and not in a dynamic recycling environment either within the Cascades collection program or in a regular waste collection scheme. You may wish to request third-party certification since there is no public information available regarding ThermaFresh recyclability.

Considering An EPS Collection Program

For some companies it is favorable to introduce an individual recycling program. Many major electronic and car manufacturers and electrical retailers have successful, economically viable solutions in place. The waste diversion savings and EPS recycling profits for these and other companies can be significant depending on market conditions. Currently EPS waste sells for up to CAN $0.25/kg.

EPS is a mono material packaging system—with no adhesives or other material contaminants to be removed prior to disposal—making recycling more efficient from a labor standpoint . EPS recycling is reliant on three basic components:

- Compaction – EPS packaging is typically segregated from other materials and can be compacted up to 1/40 of its original size to facilitate cost-effective transportation.
- Collection – the densified or compacted material will be collected by the designated recycling entity. This may be a local EPS manufacturer, recycling business or waste hauler.
- Reprocessing – the material can be used in a variety of recycling processes: regrind, extrusion and waste-to-energy incineration.

New densifiers cost as little as $18,000 and there are over 70 types of densifiers available in a range of sizes to accommodate specific space and use requirements. In some cases densifier suppliers provide equipment, offer transportation services or other incentives. Below is an example of how cost comparisons on landfill disposal versus recycling can look for EPS.

40 Yard Compactor Bin — Landfill	
1 lift/week	
Quantity (tonnes/week)	0.5
Disposal Cost @125/tonne	$63
Transportation @ $175/lift	$175
Total Weekly Cost	$238
Total Annual Cost	**$12,350**
Densify/Sell — Recycling	
Quantity (tonnes/week)	0.5
Revenue ($/week@$300/tonne)	$150
Total Annual Revenue	**$7,800**
Net Savings	**$ 20,150**
Capital Cost	**$ 15,000**
Simple Payback (Years)	**0.74**

Recyclability in and of itself does not indicate sustainability. As referenced in the life cycle inventory, "Packaging Options for Shipping Soft Goods in E-Commerce & Catalog Sales", commissioned by the Oregon Department of Environmental Quality, some packaging materials that are easily recycled do not have lower environmental burdens than materials which are more difficult to recycle. When considering a materials' recyclability, it is essential to balance other environmental performance attributes to determine sustainability. Based on the available life cycle data and recycling profiles , EPS is more sustainable than ThermaFresh in both design and performance.

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Life Cycle Analysis

Data transparency is key to understanding environmental tradeoffs.

While paper-based materials are often considered to be an attractive alternative to plastics it is necessary to conduct an in-depth analysis to determine which packaging system has the environmental attributes of most value. Having identified which environmental metrics best align with a sustainability strategy, it will be easier to identify a packaging system that meets your criteria. This takes into account that one packaging system will have *different* strengths and weaknesses from an environmental standpoint. These include: water eutrophication, CO2 emissions, solid waste production, energy consumption, air acidification and nonrenewable resources, to name just some of the key life cycle metrics that should be taken into account. For materials that don't provide hard data on these life cycle tenets, it is far too easy to substitute emotional *beliefs* — most likely based on societal myths — to take the place of facts. The environmental emissions for expanded polystyrene transport packaging are quantified below.

ENVIRONMENTAL EMISSIONS - TOTAL POLLUTANTS*

CATEGORY	PARAMETER	INVENTORY VALUE (lb Per 1,000 Units)	PRIMARY SOURCE (Fuel or Process-Related)	% REDUCTION 10% Open-Loop Recycling	% REDUCTION 10% Closed-Loop Recycling	% REDUCTION 20% Closed-Loop Recycling
GLOBAL WARMING	CO_2 (Carbon Dioxide)	1867	99% Fuel-Related	2%	4%	9%
	N_2O (Nitrous Oxide)	N/A	N/A	N/A	N/A	N/A
	CH4 (Methane)	0.029	100% Fuel-Related	0%	3%	6%
ACIDIFICATION	SO_x (Sulphur Oxides)	7.33	83% Fuel-Related	2%	4%	8%
	NO_x (Nitrogen Oxides)	5.85	90% Fuel-Related	2%	6%	9%
	NH_3 (Ammonia)	0.02	99% Process-Related	5%	10%	20%
EUTROPHICATION	NO_x (Nitrogen Oxides)	5.85	90% Fuel-Related	2%	6%	9%
	N_2O (Nitrous Oxide)	N/A	N/A	N/A	N/A	N/A
	NH_3 (Ammonia)	0.02	99% Process-Related	5%	10%	20%
PHOTOCHEMICAL	C_5H_{12} (Pentane)	15.7	100% Process-Related	0%	0%	0%
	CO (Carbon Monoxide)	2.5	98% Fuel-Related	2%	4%	8%
	Other Organics	0.53	100% Fuel-Related	2%	4%	8%
	CH_4 (Methane)	0.029	100% Fuel-Related	0%	3%	6%
	HC's (Hydrocarbons)	19.7	65% Fuel-Related	4%	7%	14%

*Does not reflect all impact categories in Resource and Environmental Profile Analysis of EPS Packaging Products report

It may surprise many that a recent peer reviewed study[1] on a variety of fish box packaging systems covering three sizes demonstrates that in eight (8) life cycle categories, paper is better than EPS in six (6) instances, worse than EPS in 11 instances and equivalent to EPS in seven (7) instances. Here's the bottom line when comparing three different packaging materials.

- Paper and polypropylene both produce more solid waste during manufacture production than EPS;
- Paper manufacture results in higher water eutrophication & water consumption than EPS;
- EPS produces more photochemical oxidants than paper or polypropylene based packaging; and
- EPS compares favorably to other materials in the area of non-renewable resources and energy, air acidification and greenhouse gas emissions.

LIFE CYCLE ASSESSMENT OF THE INDUSTRIAL USE OF EXPANDED POLYSTYRENE PACKAGING IN EUROPE CASE STUDY: **COMPARISON OF THREE FISHBOX SOLUTIONS**

INDICATOR	FRANCE			SPAIN			SCANDINAVIA		
	EPS	PP	Cardboard	EPS	PP	Cardboard	EPS	PP	Cardboard
	4kg	4kg	4kg	6kg	6kg	6kg	20kg	20kg	20kg
Non Renewable Primary Energy in MJ	1.0	1.1	0.9	1.0	1.3	1.0	1.0	0.8	0.6
Depletion of Non Renewable Resources in kg q. SB	1.0	1.2	0.9	1.0	1.3	1.0	1.0	0.9	0.6
Emission of Greenhouse Gases in kg CO_2 eq. 100 yrs	1.0	0.9	1.0	1.0	1.0	1.4	1.0	0.8	0.7
Air Acidification in g SO_2 eq.	1.0	1.0	2.0	1.0	1.2	2.0	1.0	0.8	1.0
Photochemical Oxidants Formation in g eq. Ethylene	1.0	0.3	0.2	1.0	0.3	0.2	1.0	0.2	0.1
Water Consumption in m^3	1.0	0.8	3.3	1.0	0.7	3.5	1.0	1.0	4.1
Water Eutrophication in g eq. PO4-3	1.0	1.3	5.9	1.0	1.2	5.3	1.0	0.9	2.4
Total Waste Production in kg	1.0	3.4	7.6	1.0	2.1	4.1	1.0	1.5	2.4

Where performance is **within 20% of the EPS value, the two are considered equivalent.**

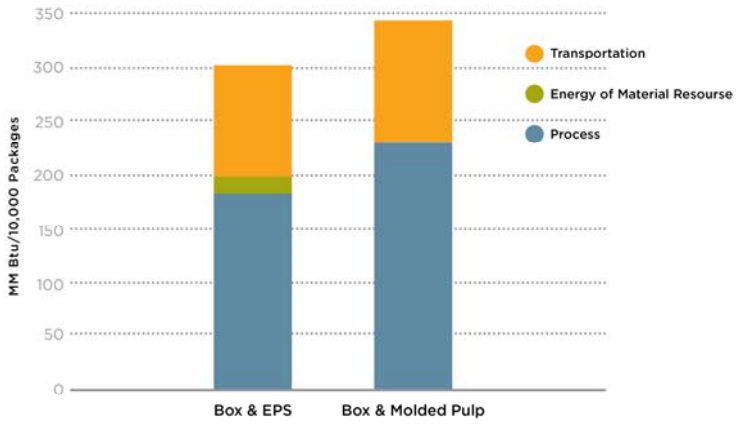
Where performance is **worse than EPS by more than 20%**

Where performance is **better than EPS by more than 20%**

In another life cycle study comparing EPS to corrugated, paper-based alternative, expanded polystyrene production and transportation shows more favorable results when considering total environmental impacts.

EPS VS. MOLDED PULP COMPARISON

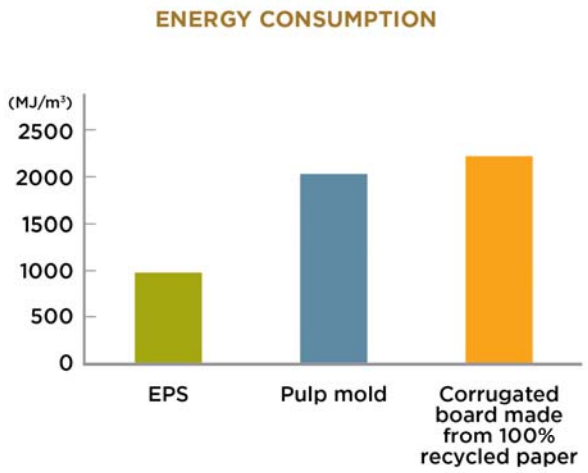
Oregon Dept of Environmental Quality, "Energy & Environmental Results for Packaging Options for Shipment of Retail Mail-Order Soft Goods," Franklin Associates 2003

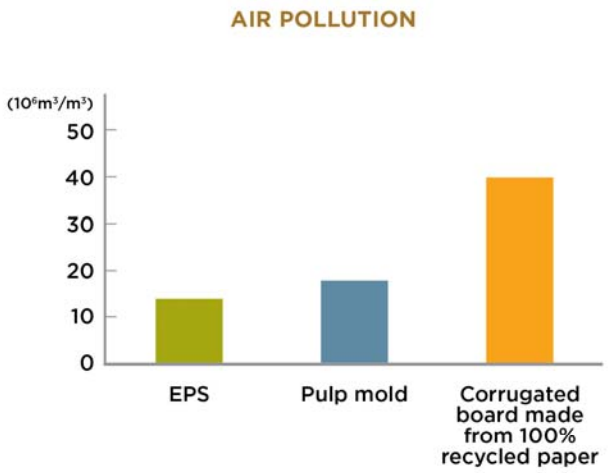


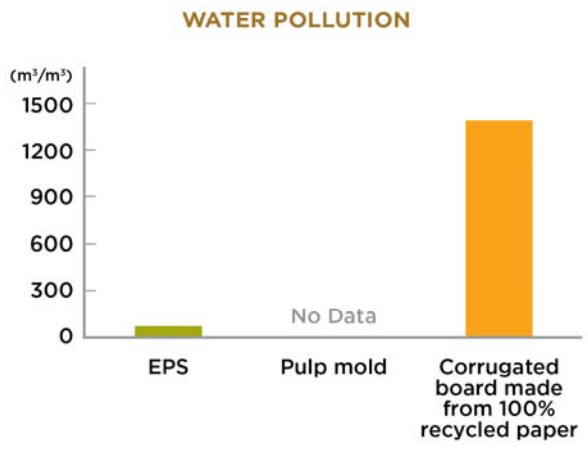
A life cycle analysis by InFo Kunststoff e.V. compared EPS to corrugated cardboard. The study quantified the energy use, global warming potential, air pollution and water pollution associated with 1 cubic meter of EPS packaging or corrugated cardboard packaging. EPS packaging clearly has lower energy consumption and CO_2 emissions than cardboard packaging.

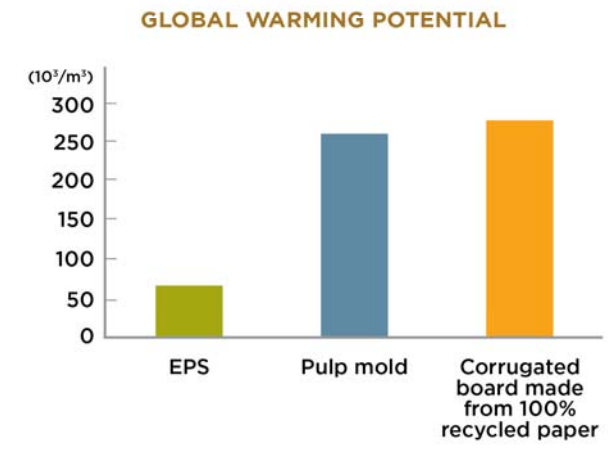
EPS is the better environmental choice.

Note: Does not take other ThermaFresh system materials, including polypropylene, aluminum and adhesives, under consideration.









Glossary of Terms

Acidification	A process whereby compounds like ammonia, nitrogen oxides and sulphur dioxides are converted in a chemical reaction into acidic substances.
End-of-Life	The management of all used and discarded products, components and materials with an objective of recovering as much of the economic (and ecological) value as reasonably possible, thereby reducing the ultimate quantities of waste.
Environmental Emissions	Substances that are released into the air as waste. Many times, these emissions are the result of combustion, manufacturing and natural waste.
Global Warming	A gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect caused by increased levels of carbon dioxide, chlorofluorocarbons and other pollutants.
Laboratory Handsheet Test	This procedure describes the testing of pulp handsheets, prepared in accordance with TAPPI T 205 for their strength and other physical properties as well as their light scattering coefficient. Information derived from handsheet testing is a measure of the potential contribution of the pulp to the strength of the finished paper product.
Life Cycle	Consecutive and interlinked stages of a product or service system, from the extraction of natural resources to the final disposal.
Life Cycle Analysis (LCA)	A technique to assess the environmental aspects and potential impacts associated with a product, process or service.
Life Cycle Inventory (LCI)	The process of quantifying energy and raw material requirements, atmospheric emissions, waterborne emissions, solid wastes and other releases for the entire life cycle of a product, process or activity.
Nonrenewable Resource	A resource of economic value that cannot be readily replaced by natural means on a level equal to its consumption.
Photochemical Oxidants	Formed when sunlight falls on a mixture of chemicals in the air, creating smog.
Water Eutrophication	A process by which a body of water becomes enriched in dissolved nutrients (as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

References

1. *"EPS Packaging Versus Moulded Pulp Packaging LCA",* InFo Kunststoff, 2002
2. *"Resource and Environmental Profile Analysis of EPS Packaging",* Franklin Associates, 1997
3. "*Life Cycle Assessment of the Industrial Use of Expanded Polystyrene Packaging in Europe Case Study: Comparison of Three Fishbox Solutions*", Pricewaterhouse Coopers and ECOBILAN, November 2011
4. "*Energy & Environmental Results for Packaging Options for Shipment of Retail Mail-Order Soft Goods*", Oregon Dept of Environmental Quality/Franklin Associates, 2003
5. "*Life Cycle Assessment of the Industrial Use of Expanded Polystyrene Packaging in Europe Case Study: Comparison of Three Fish Box Solutions*", Price Waterhouse Cooper, November 2011
6. "*Impact of Plastics Packaging on Life Cycle Energy Consumption & Greenhouse Gas Emissions in the United States and Canada*," Franklin Associates, 2014
7. *Life Cycle Inventory (LCI) for EPS Products*, Japan Expanded Polystyrene Association, 2007
8. "Which Bag is Best: Paper or Plastic?" M. Milstein, *The Oregonian*, 2007
9. *Facts & Myths*, www.reusablebags.com, 2015
10. "*Profile of the Pulp and Paper Industry*", U.S. Environmental Protection Agency, 2002
11. *"*California Town Repealing Plastic Bag Ban*", Plastics News*, April 15, 2015
12. *Canada: Scrap PS Plastic Prices,* http://www.scrapindex.com/plastic/canada/polystyrene/index.html, 2015

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