

Case Studies for Improved Sustainability in Packaging

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ABSTRACT

Sustainability has grown to be a top priority for many businesses. Many packaging producers struggle to understand how they can positively contribute to sustainability, especially given the limitations of resources and the stringent performance requirements that producers are being asked to meet. A discussion of sustainability as related to packaging and case studies demonstrating the sustainability advantages of various packaging alternatives is presented.

INTRODUCTION

The term sustainability has many meanings to many people. Dictionary.com defines the term sustain as “to keep in existence” while a similar definition “to cause or allow something to continue for a period of time” is offered by Cambridge International. The term sustainable is defined as being “of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged” by Merriam-Webster. Sustainability is more difficult to describe as most sources use either the word “*sustain*” or the word “*sustainable*” in their definitions. For some, the term sustainability is synonymous with the concept of sustainable development [1]. Perhaps one way to describe sustainability is on a multi-axis scale where products that maximize performance and minimize the combined use of scarce resources provide the best sustainability. Although many definitions neglect the performance part of this description it is an important consideration especially when discussing sustainable packaging. All packaging, after all, exists for a purpose – to protect, store, and/or use a product from the time of manufacture to the time of use. In most cases the value of the product far exceeds the cost of the packaging, so it would be an unwise decision to attempt to eliminate the packaging in the name of sustainability. But there are always choices for how a product can be packaged and sustainability is increasingly becoming a key criteria for the selection of packaging.

DISCUSSION

There are many elements that contribute to improved sustainability. Some of the things that may contribute to better sustainability of packaging are:

- reduced raw material consumption
- reduced energy usage
- increased recyclability
- reduced greenhouse gas emissions
- decreased waste generation
- increased re-use
- decreased use of non-renewable sources of energy and raw materials

Because sustainability is a concept relating to the continuity of the entire system, no single attribute can define sustainability. Packaging materials which provide only a single attribute of sustainability should be evaluated in the same manner as all other products and processes, by considering the total impact that particular selection has on the entire system. One way to consider the total impact is through life cycle analysis (LCA).

Life Cycle Thinking

Life cycle analysis is an important tool for understanding the sustainability of various alternatives. Different methodologies have been reported by numerous groups [2-5]. Life cycle analysis looks at combining into a single evaluation all the resources used to create, transport, and use a product, including raw materials and energy. The user of life cycle data must fully understand the boundary conditions used to generate the comparison in order to make maximum benefit of the information.

Paper or Plastic

One example of recent debate over sustainability is the choice between paper bags and plastic bags. On the surface it might seem that paper, being made from a renewable resource and one that breaks down under the right conditions, is the obvious choice. But if we consider the “cradle to grave” view that includes all of the factors involved in determining sustainability it is not that simple. This great debate was well summarized by Robert Lilienfeld of ULS (Use Less Stuff) in June of 2007 in response to San Francisco’s ban on non-degradable plastic grocery bags [6]. He summarized various studies considering materials consumption, energy and water usage, pollution, and greenhouse gas (GHG) production. The studies used a life cycle approach and cited studies by several groups, including the EPA, Carrefour, and the Swiss Agency for the Environment, Forests and Landscape.

The conclusion from Lilienfeld’s research was that:

- Paper’s biodegradable advantage over plastic is rarely realized due to the fact most all paper bags end up in landfills which do not have an environment conducive to biodegradation. The difference is realized only when the bags are sent to dedicated composting facilities.
- Plastic bags produce 60% less greenhouse gas emissions than uncomposted paper bags, use only 4% of the water to produce, consume 40% less energy during production and generate 80% less solid waste than paper bags. Paper bags generate 70% more air, and 50 times more water pollutants than plastic bags. Additionally, it takes 91% less energy to recycle a pound of plastic than it takes to recycle a pound of paper. And plastic also offers many times over the re-usability of paper bags.
- Littering of plastic grocery bags, although visible, is a small contributor to the overall litter burden and thus should not be over-weighted as compared to the other environmental impacts including increased energy usage and solid waste created during production.

The results of the report do not conclude that plastic is always better than paper. The message is that there is no one right answer for every situation and what may seem to some to be the “obvious” solution may not be the best choice when considering all life cycle impacts. Given a state-of-the-art collection program and properly designed composting facility, paper bags may be preferred. But given the typical infrastructure in most U.S. cities, Lilienfeld found that when considering full life cycle impacts, plastic bags are preferred over paper bags.

Individual Circumstances & Scarce Resources

Just as the case when comparing plastic and paper bags, your most sustainable solution will depend on your individual frame of reference and your particular situation. Utmost consideration must be given to defining your most limited resources. If water resources are scarce then washing and reprocessing packaging may not be as advantageous as it would be in locations that have plenty of water but limited landfill space. Even more important is understanding the performance requirements of a particular product. A bag used to take lawn clippings to a municipal composting facility may benefit from being compostable and breaking down under conditions of high humidity and high temperature. An extrusion blow molded HDPE bottle that is intended to last for several years and is designed for ease of recycling into another container after its initial use is completed has a completely different set of performance requirements.

Although individual circumstances will affect final decision-making, the single most important factor affecting the sustainability of packaging materials is the weight of the packaging used. Lighter weight packages have an advantage over heavier packages. Not only do they automatically use fewer raw materials for production, but they use less energy for processing and result in the use of less energy for

transportation, which reduces waste generation and greenhouse gas emissions, two additional contributors to sustainability. Plastic packaging in particular can provide a significant savings in terms of package weight.

Sophisticated companies today also realize that sustainability is about improved long-term business viability. It combines elements of environmental, social, and financial responsibility – the triple bottom line of attention to planet, people, and profit. Without any part of this three-legged stool of success a business enterprise can not be viable as a long-term entity – that is to say it can't be sustainable. Just as businesses now recognize that sound environmental and safety practices are good for the bottom line they are increasingly recognizing that a commitment to sustainability is also good for business.

Sustainable Packaging in Action: Industrial Stretch Film

In the past ten years the typical thickness of industrial stretch film has been reduced by approximately 25%. With a total global demand of over 3 billion pounds, this downgauging results in savings of 1 billion pounds of polyethylene each year. In addition to using less stretch film for wrapping pallets, this means that less oil/gas is extracted from the earth, this raw material doesn't need to be transported and processed into ethylene, fewer polyethylene manufacturing plants need to be constructed, and less polyethylene is transported and processed into stretch film. At the end of life less stretch film is disposed of in a landfill. The one billion pounds of polyethylene translates into 36.6 trillion BTUs of energy savings. This is equivalent to 293 million gallons of gasoline or enough energy to heat and cool 643,000 typical U.S. homes for the year [7].

Sustainable Packaging in Action: Mixed Nuts

Two commercial packages of mixed snack nuts were purchased for comparison. A traditional composite can and plastic lid contained 17 ounces of nuts and had a total packaging weight of 64.2 grams, including the can, foil lid-stock, and resealable plastic lid. This translates to 13.3 grams of packaging for every 100 grams of product. A second package, a stand-up plastic pouch, weighed 11.5 grams and contained 16 ounces of nuts. The stand-up pouch had a ratio of 2.5 g of packaging for every 100 grams of product. The packaging in the flexible plastic pouch uses 81% less packaging per unit of product [8]. Since package weight is a strong influencer of overall sustainability this represents a tremendous improvement.

Sustainable Packaging in Action: Heavy Duty Shipping Sacks

Heavy duty shipping sacks are used to transport many different types of industrial and consumer goods such as plastic resin pellets, fertilizer, concrete, pet food, salt, and fertilizer. Since 1993 one large resin producer [8] has reduced the thickness of the heavy duty shipping sacks used to package its polyethylene and polypropylene resins by approximately 40%. This downgauging results in the saving of approximately 5 MM pounds of plastic each year for this type of packaging. And that is just for one resin manufacturer. Total savings across the industry would be substantially higher as many manufacturers have reduced the thickness and weight of their packaging through the use of improved design, higher strength resins.

Sustainable Packaging in Action: Loop Carriers

There are many different ways of packaging multiple cans of juice or other beverage for retail sale. Two options that are commonly used for six packs of small juice cans are the paperboard and the loop carrier. A typical 6-pack of pineapple juice packaged using printed paperboard as the secondary packaging (meaning in addition to the primary package which is the can itself) uses 24.1 grams of paperboard to unitize the 6 small cans of juice. A 6-pack utilizing a plastic loop carrier uses only 2.7 grams of polymer, an 89% reduction in the weight of the packaging used [8].

SUMMARY

Plastic packaging contributes positively to improved sustainability. High performance materials provide excellent product protection with low package weight to minimize resource intensity and maximize

sustainability performance. Life cycle analysis can be used to quantify the benefits of various packaging alternatives. Downgauging, package redesign, and material substitution all offer alternatives for reducing material usage and improving sustainability performance.

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KEY WORDS

Sustainability, sustainable packaging, life cycle analysis

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Case Studies for Improved Sustainability in Packaging

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Agenda

- Definitions
 - Life Cycle Thinking
 - Paper or Plastic?
 - Examples of Sustainable Solutions
 - Summary
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Definitions

- Sustain:
 - to keep in existence (dictionary.com)
 - to cause or allow something to continue for a period of time (Cambridge International)
 - Sustainable:
 - of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged (Merriam-Webster)
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Definitions

- Sustainability:
 - A concept relating to the *continuity* of various aspects of human society (Wikipedia)
 - The equivalent of Sustainable Development

 - institutional
 - economical / financial
 - ecological / environmental
 - social
-

Other Possible Definitions

- Sustainable = made from a material that is grown
 - Sustainable = something that is recyclable
 - Sustainable = something that can be compostable
 - Sustainable = something with the potential to be reused
 - Sustainable = something that is degradable
-

Sustainability

- Sustainable = made from a material that is grown ? ? ?
 - Sustainable = something that is recyclable ? ? ?
 - Sustainable = something that can be compostable ? ? ?
 - Sustainable = something with the potential to be reused ? ? ?
 - Sustainable = something that is degradable ? ? ?

 - Sustainable = maximizing performance while minimizing the total combined use of scarce resources --- life cycle thinking
-

Life Cycle Thinking

- Life cycle thinking is an **objective, scientific approach** and provides a **comprehensive view** of a product from cradle to grave.
 - It is critical to look at a packaging application and its function.
 - Not appropriate to compare a pound of one material vs. a pound of another
 - It is important to look at how much of a given material is needed to provide the functionality required in that packaging application.
 - A balanced look at end-of-life options is also necessary.
 - For example, recycling is great to a certain extent; however, studies have shown that trying to capture too high a percentage of any material leads to wasted resources... mostly in the form of energy.
 - Composting is only desirable if composting is readily available to the consuming public. If these materials end up in landfills, they are actually worse for the environment, since they evolve into green house gases.
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Thoughts on Life Cycle Thinking

- A recent Athena/Franklin life cycle study of several polymers revealed the following for 16 oz drink cups (basis – 10,000 cups):

	Total Energy (GJ)	Post consumer Solid Waste (kg)	Greenhouse Gases (kg of CO ₂ eq)
PLA	14.5	118	510
HIPS	13.3	98.4	576
PP	9.82	84.0	345
PET	16.1	126	719



- The PP cup uses less total energy, creates less waste, and creates less greenhouse gas emissions.

What solution would you consider the most sustainable choice?

Paper or Plastic

- According to a recent report by Robert Lilienfeld of ULS:
 - Paper's biodegradability advantage is rarely realized
 - Plastic bags produce 60% less green house gas emissions
 - Plastic bags use less than 4% as much water to produce
 - Plastic bags consume 40% less energy during production
 - Plastic bags generate 80% less solid waste

Some Other Factors to Consider

- Scarce Resources
 - Water
 - Energy
 - Labor
 - Raw materials
 - Land
 - Origin of Raw Materials
 - Health & Safety Profiles
 - Consumer Behavior
 - Secondary Effects (e.g. the effect of package weight on transportation costs)
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Examples of Sustainable Solutions



Industrial Stretch Film

- Made from Linear Low Density Polyethylene
- Improvements in resin design and polymer processing have allowed downgauging of industrial stretch film.
 - Critical property requirements
 - Extensibility
 - Puncture resistance

Year	Standard Stretch Film*	High Performance Stretch Film*
1998	80	60
2001	70	51
2004	65	51
2007	57	45
Reduction	29%	25%

* Units are gauge. 80 gauge = 20 micron



Industrial Stretch Film

- With a global market size of nearly 3 billion pounds, this downgauging saves over 1 billion pounds per year of PE from being used to make stretch film.
- 1 billion pounds = 36.6 trillion BTUs
- Equivalent to 293 million gallons of gasoline
- Enough to heat and cool 643,000 homes for a year



While this reduction and savings have taken place, recycling has grown.

Snack Nuts

- The stand-up pouch uses 80% less packaging material per unit weight of product sold

Package Format	Product Weight	Weight of Packaging	Product to Package Ratio	Package per 100 g Product
Composite Can with Plastic Lid	17 ounces	64.2 g	7.5	13.3 g
Stand Up Pouch with Zipper	16 ounces	11.5 g	39.5	2.5 g



Heavy-Duty Shipping Sacks

- By using higher-performance resins, a major resin manufacturer has been able to downgauge heavy-duty shipping sacks used to package and transport its PE and PP resins by **40%**
- As a result, approximately 5 MM pounds LESS polymer is used for packing plastic resins each year

Year	Thickness
1993	7.8 mil
1994	7.0 mil
1995	6.3 mil
1998	5.5 mil
2001	4.7 mil



Canned Juice (Six Pack)

- The loop carrier uses 89% less packaging material compared to the secondary packaging of these juice six packs



Product	Secondary Package	Weight of Packaging	Reduction
Apple Juice	Loop Carrier (ECO)	2.7 g	89%
Pineapple Juice	Printed Paperboard	24.1 g	

Summary

- Sustainability includes multiple aspects of performance
 - Different materials can provide different sustainable attributes under different conditions
(assuming everything else stays the same)
 - Life cycle analysis can be used to quantify the effects of various choices
 - Downgauging, package redesign, and material substitution all offer alternatives for improving sustainability performance
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Sustainability = Long Term Viability

Profitability
Environmental Responsibility
Social Accountability

Sustainability is Here to Stay

Thank You

PRESENTED BY

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*Please remember to turn
in your evaluation sheet...*