Flexible Packaging Association

Flexible Packaging Lightweighting Strategies and Innovation

A Flexible Packaging Association White Paper

Prepared for the Flexible Packaging Association by Packaging & Technology Integrated Solutions, LLC

Less Resources
Less footprint. More value.SM

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Executive Summary

Flexible packaging is recognized as the lightweight package format. The industry has achieved significant source reductions in the past decade, and will continue to further innovate in the upcoming decade to optimize materials and systems.

Innovations which have resulted in further lightweighting flexible packaging without compromising product protection include:

- Material Toughness
- Coextrusion Technology Advances
- Barrier Enhancements
- Process Optimization
- Equipment Advances
- Use of Metrics

Strategies and innovations that made lightweighting advances in flexible packaging possible often involve a holistic system approach. Barrier enhancements, for instance, were enabled by equipment modifications, which allow lighter material to be properly controlled during manufacturing. The following are a few examples of lightweighting:

- The weight of a national branded hot dog flexible package was reduced by nearly 30% in just 6 years.
- The weight of a candy bar flexible package was reduced by 60% in a 6 year time frame.
- A barrier enhancement was made possible with equipment modifications, which can enable lighter material to be properly controlled during manufacturing.
- Cereal bag liners and stretch wrap are two examples of materials that have been significantly reduced through use of more engineered and tougher ionomer films.
- The use of coextrusion technology allows some cheese packages to reduce the overall thickness of the package by 33%, while still maintaining the oxygen and moisture barrier.
- Advancement in the area of barrier enhancement through “cross-linking” results in better properties such as material toughness or water and oxygen barrier, while using less material.
- Process optimizations, utilizing new equipment technology, the latest resins, and manufacturing process innovations, enabled shrink film to be reduced by 50%.
- Stretch films, which typically were about 0.8 mils (.0008” in thickness) ten years ago, have been reduced to 0.4 mils due to better tension handling systems and improved material toughness.
- Improved filling equipment has allowed brand owners to fill flexible packages at higher speeds, with thinner materials.

Flexible Packaging Lightweighting Strategies and Innovation Since 2005

Lightweighting Strategy	Overview
Material Toughness Advances	New polymer technologies have improved material toughness/puncture resistance and product protection and equipment handling. In the last decade, materials have been reduced by up to 50% through these new polymer technologies.
Coextrusion Technology Advances	Coextrusion technology allows the properties of different polymers to be combined into a single film. This technology has allowed some packages to be reduced in weight by 33%.
Barrier Enhancement	Up to 50% less material can achieve the same barrier properties as a result of improved application techniques, and barrier science.
Process Optimization	New equipment technology, resins, and manufacturing process innovations enable process optimization. Through process optimization, thickness of shrink film can be reduced by 50%.
Equipment Technology	Many of the advancements in flexible packaging lightweighting have been achieved through collaboration between flexible packaging suppliers and equipment providers. This has allowed some film thicknesses to be reduced by 50% over the last decade.
Tools and Metrics	Measurement tools and metrics are being used to track lightweighting achievement and opportunity.
Multiple Sustainability Advantages	Flexible packaging offers a number of additional sustainability advantages when compared to other package options. These advantages include: lower carbon footprint, reduced energy use, and less waste when disposed.

Flexible Packaging Lightweighting Strategies and Innovation

Flexible packaging provides a broad range of advantages including consumer convenience, product protection, high product to package ratio, great shelf appeal, high moisture and vapor barrier properties, and source reduction.

Source reduced flexible packaging consumes fewer resources, generates less greenhouse gas emissions, reduces transportation costs, increases capacity utilization in distribution and storage, and produces less waste in the first place.

Flexible packaging is generally considered the lightweight package and the flexible packaging industry is continually innovating to reduce and optimize the resources required to provide packaging that meets the needs of consumer product companies, retailers, consumers and other stakeholders. Innovation and technical advances have enabled significant additional lightweighting over the last decade.

Research examining a number of national branded products packaged in flexible packaging shows a dramatic reduction in package weight for the same product between 2005 and 2011. SAI Industrial LLC, a professional services company, estimates that technology enabled flexible packaging, on average, to be reduced 40 percent by weight between 2002 and 2010. As an example, the weight of a flexible package for a national branded hot dog was reduced by nearly 30% in just 6 years, and the weight of a flexible package for a candy bar was reduced by 60% in this same time frame.

Innovations which have resulted in further lightweighting flexible packaging without compromising product protection include:

- Material Toughness
- Coextrusion Technology Advances
- Barrier Enhancements
- Process Optimization
- Equipment Advances
- Use of Metrics

Specific Lightweighting Strategies

Material Toughness

Flexible packaging material toughness providing puncture resistance is an important property for both product protection, and for ease of handling on equipment. Equipment manufacturers and flexible material producers have been able to enhance material toughness in recent years, allowing thinner films to be handled on equipment which can run up to 2000 feet/minute. Tougher materials have also allowed lighter weight films to be used for products such as nuts and tortilla chips which could puncture previous generation materials and result in increased spoilage, unsaleable products and increased product waste. As an example, stretch film that was 0.8 mils in thickness just 10 years ago, is now down to 0.4 mils.

Cereal bag liners and stretch wrap are two examples of materials that have been significantly reduced through the use of highly engineered and tougher ionomer films. Traditionally, cereal bag liners and pretzel bags would need additional polyethylene layers to provide puncture resistance properties but the use of ionomer films results in significant lightweighting and puncture resistance. These ionomer films also offer a consumer benefit of providing a seal, while still being peelable, so consumers can open flexible bags easily.

Coextrusion Technology

Coextrusion technology used to produce flexible packaging materials is the combination of two or more molten polymers in a single extrudate. It offers many advantages, including the possibility of decreasing the amount of polymer used, and minimizing thickness by eliminating a layer of material, while bonding substrates that offer different benefits such as material toughness and moisture and oxygen barriers.

Coextrusion has been used recently in some cheese packages to reduce the overall thickness of the package by 33%, while still maintaining the oxygen and moisture barrier.

Barrier Enhancement

Improvements in barrier properties of flexible materials often enable lighter weight materials. As an example, Ethylene Vinyl Alcohol Polymer (EVOH), is a polymer that is used to provide gas barrier protection extending the shelf life of a number of products.

In recent years, equipment modifications have allowed producers to better control the amount of EVOH that is applied to a sheet in multiple thin layers, rather than a single, thick layer. The ability to more consistently control thickness of the layers allows packaging producers to use less of a particular material because they no longer need to compensate for large variances in the layer thickness. As a result, applications that once required 0.3 mils of a single layer of EVOH can now achieve a better barrier by having multiple layers of EVOH that are 50% thinner than previous applications.

Another advancement in the area of barrier enhancement is through “cross-linking” technology between multiple polymers resulting in enhanced material toughness, and water and oxygen barriers, while using less material.

Process Optimization

Flexible packaging advancements can also occur when a material or packaging producer optimizes the steps in their process, utilizing new equipment technology, the latest resins, and manufacturing process innovations. As an example, the thickness of shrink film was reduced by 50% by optimizing each of these stages. The new material offers exceptional attributes such as enhanced seal strength, increased durability, and retail ready optics and clarity while ensuring the combination of strength, tear, and burn resistance properties. (8)

Equipment Technology Advancements

Many of the advancements in flexible packaging lightweighting have been achieved through collaboration between flexible packaging material suppliers and equipment providers. Some examples include advancements in winders and rewinders (the equipment that rolls up flexible films at very high speeds), which can now handle much lighter weight films through improvements in the tension control system. In the past, heavier weight film thickness was required for some applications in order to prevent the film from breaking during the winding process. For example, stretch films, which typically were about 0.8 mils (.0008" in thickness) about ten years ago, have been reduced to 0.4 mils due to better tension handling systems and improved material toughness.

Improved filling equipment has allowed brand owners to fill flexible packages at higher speeds, with thinner materials. Modifications to filling equipment have also enabled brand owners to fill the same amount of product in smaller packs using less material. A major food producer recently was able to reduce their flexible packaging by 14% while still providing the same amount of product to the consumer, through better film controls and smaller seal requirements. (1) (2)

Tools and Metrics

To help better quantify the benefits of lightweighting, a number of brand owners, converters, and raw material suppliers are using tools to track and measure their source reduction achievements and opportunities. This may include the use of evaluation tools such as:

- Lifecycle assessment tools: SimaPro and GaBi
- COMPASS (a Comparative Packaging Assessment Tool from the Sustainable Packaging Coalition)
- Walmart/ECRM Package Modeling Software
- Proprietary tools that can help brand owners and retailers understand the environmental impact of design decisions based on material and package format selection.
- Advanced modeling and simulation computer tools can help converters and resin suppliers show how different combinations of flexible layers can provide both the barrier and structural requirements for different applications.

The goal of each of these tools is to compare and/or quantify the environmental effects/outputs of different package formats and materials.

Other Sustainability Advantages of Flexible Packaging

In addition to lightweighting, Flexible packaging offers other sustainability advantages when compared to other packaging options. Flexible packaging generally uses less material, has a lower carbon footprint, reduced energy use, and produces less waste than other packaging formats.

The product to package ratio for flexible packaging also represents a significant advantage. Flexible packaging materials are often shipped in a roll format (rollstock) and formed on line, offering a significant inbound truck advantage vs. for example, a formed bottle. (3)

The chart on the following page is one of several case studies described in the *FPA Flexible Packaging Less Resources, Less Footprint, More Value.* brochure shows a number of critical environmental factors across a wide range of package formats. The flexible beverage pouch in the case study uses ½ the amount of energy compared to the nearest alternative, and generates 75% fewer greenhouse gas emissions than the closest alternative. (4)

Other product/package case studies are described in the *Flexible Packaging Less Resources, Less Footprint, More Value.* brochure and on the FPA website, www.flexpack.org.

Package Format Environmental Assessment

Beverage Package	Product Weight	Package Weight	Product : Package Ratio	Pkg Weight per 100 g of product	MSW Landfill per 100g product*	Energy Consumption MJ / 8 oz.	Emissions Kg CO_2 e / 8 oz.
Glass bottle & metal cap	8 oz. (236 g)	198.4 g	1:1	83.9 g	54.5 g	3.36	0.29
Plastic PET bottle & cap	8 oz. (236 g)	22.7 g	10:1	9.6 g	6.0 g	3.00	0.18
Aluminum can	8 oz. (236 g)	11.3 g	21:1	4.7 g	2.4 g	0.99	0.08
Stand-up flexible pouch	6.75 oz. (199 g)	5.7 g	35:1	2.8 g	2.8 g	0.45	0.02

Sources:

- Cradle-to-grave life cycle energy consumption and CO2 emissions data developed for the FPA by Battelle Memorial Institute.
- Product assumed to be water.
- * Recycling rates factored: U.S. EPA 2007 MSW Report.
- Packaging weight, product weight, and product-to-packaging ratio calculated by Packaging & Technology Integrated Solutions, LLC (PTIS).

Recycled Content

Some flexible packaging applications also incorporate post consumer recycled (PCR) content. (6) This is typically done utilizing recycled HDPE milk containers, which are then incorporated into flexible packaging. These structures typically either incorporate the recycled content into the middle layer of a structure, or they are used in non-food applications. One example is in the use of paper towel products where a flexible package overwrap that contained 20% PCR for the HDPE layer was utilized. (7) While PCR in itself does not result in a lighter weight package; it does result in less use of virgin material.

Waste Reduction/Material Recovery

Flexible packaging producers and converters have also implemented a number of waste reduction measures at their manufacturing facilities. Most manufacturing scrap is reground and used in production of new flexible packaging films. Additionally, much of the waste materials that had previously been sent to landfills is now sent to other manufacturing outlets to be turned into other products like plastic lumber, high strength pond liners and flower pots.

Flexible packaging producers run highly efficient processes in which they achieve very high levels of utilization of raw material usage. Some converters, for instance, have a material efficiency (percentage of product sent out of their facility against raw materials purchased) of over 99%.

Flexible Packaging Recycling

Some flexible packaging can be difficult to recycle because it is composed of highly engineered and/or multiple layers of materials required to provide the many benefits of flexible packaging such as barrier enhancements and prolonged shelf life. However, even when taking into account the recycling rates of other packaging formats, flexible packaging typically contributes less to landfills.

Additionally, resource recovery technologies including gasification, pyrolysis and Energy from Waste (EfW) hold promise in the recovery of flexible packaging resources. Flexible packaging is very high in BTU content and has the potential to be utilized in Energy from Waste systems in the U.S. in the future, as is currently done in Europe. (5)

Case Stories - Advances in Flexible Packaging Lighweighting

Several case stories of lightweighting that has taken place in flexible packaging can be found on the FPA website at **www.flexpack.org, click on Sustainable Packaging, then click Research/Reports/Information under the Sustainable Packaging Table of Contents, then Lightweight Advances in Flexible Packaging: FPA Member Case Stories.** These case studies have been submitted by FPA members.

References:

(1) http://www.catererresearch.com/Articles/2010/11/26/336346/Nescaf233-single-serve-stick-packs-from-Nestl233.htm

(2) http://www.costsectorcatering.co.uk/online_article/Nestl%C3%A9-single-serve-sticks-save-22.4-tonnes-of-packaging-material/12260

(3) http://www.frenchrabbit.com/press/packagine-world-0807.pdf

(4) http://flexpack.org/MEMONL/mo_sustainable_packaging/sustainable_packaging_toolkit/Final_Case_Story_Brochure200909.pdf?ContactID=

(5) http://www.nytimes.com/2010/04/13/science/earth/13trash.html

(6) Post Consumer comment based on Genpack website - http://www.genpak.com/cfm/recycled-content.cfm

(7) Bemis PCR white paper – found at - http://leadwise.mediadroit.com/files/9800PCR_WP.pdf

(8) http://www.shrink-pkg.com/eu/en/shrink-films/cryovac-ct301.aspx

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