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# What Sustainable Packaging Means to Brand Owners, and What We Can Do About It

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## Sustainable Packaging Drivers

In the absence of a consensus among consumers and legislators, major retailers, particularly Wal-Mart in the North American market, are driving the sustainability agenda. Their Packaging Scorecard and recently unveiled Sutainable Products Index provide a roadmap to brand owners and converters as to how they will be graded on the sustainability of their products and packaging.

Brand owners have responded in different ways, but in general there are three main areas of focus:

- Reducing the amount of packaging used & landfilled
- Reducing plant waste (energy, water, etc.)
- Reducing $CO_2$ emissions

When we look at flexible packaging compared to other packaging formats, it stacks up well along most metrics of interest to Wal-Mart and brand owners. Converters have been busy developing their own comprehensive sustainability programs, including sophisticated measurement tools and hard targets. In general, there are two main areas of focus:

- Driving waste out of operations (material, energy, GHG emissions, etc.)
- Innovating and bringing new products to market to meet the needs of brand owners

## Reducing Material Usage, Improving Landfill Diversion

As reported previously[1], the barrier properties of metallized film are almost independent of the base film gauge. This is verified in Figure 1, which shows OTR & WVTR values of three different PET gauges, all metallized on the non-treated side under similar metallizing conditions and at a 2.3 target OD. Error bars represent 95% confidence intervals based on several measurements on each base PET gauge. These have been updated to include newer barrier data generated in the past 12 months.

When compared to 48 g metallized PET, 40 g metallized PET has 17% less material in the barrier layer, and for a typical 3-ply packaging structure of 48 g PET/48 g m-PET/1.5 mil LLDPE, this represents a 3% material reduction in the overall structure.

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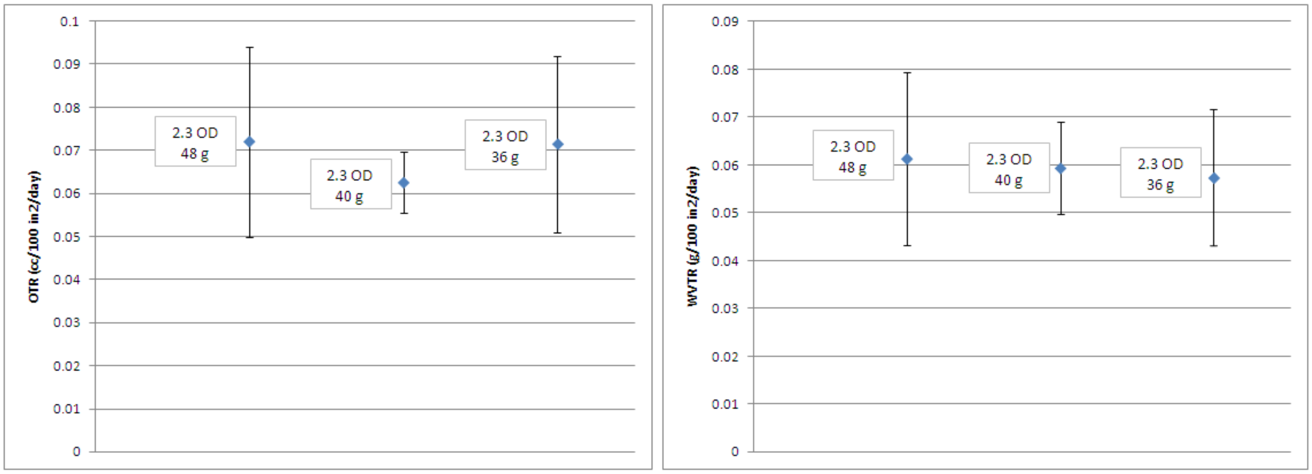
**Figure 1: Oxygen & Moisture Vapor Barrier of 2.3 OD Met PET Films at Different Gauges**




Another approach is layer elimination, where 2 plies can be replaced with a single ply. As shown in Figure 2, consolidating the metallized PET and LLDPE sealant layers into a single metallized sealant layer provides about a 25% material weight savings. This can be achieved in decorative, non-barrier applications, and with recently developed metallizing and sealant technologies it can also be achieved in applications that require high moisture or oxygen barrier as well.

**Figure 2: Metallized Sealant Material Reduction Consolidating From 3 Plies to 2 Plies**

| Layer Description | Material Weight (g/msi) |
|---|---|
| Reverse printed 48 g PET | 11.7 |
| Adhesive lamination | 0.8 |
| 48 g metallized PET barrier layer | 10.9 |
| Adhesive lamination | 0.8 |
| 1.5 mil sealant web | 22.8 |
| Total Material Weight (g/msi) | 47.0 |

| Layer Description | Material Weight (g/msi) |
|---|---|
| Reverse printed web | 11.7 |
| Adhesive lamination | 0.8 |
| 1.5 mil metallized sealant | 22.8 |
| Total Material Weight (g/msi) | 35.3 |
| **Savings with metallized sealant** | **24.9%** |

A third approach is to focus on landfill diversion. Here there are several different options in the realm of compostable and biodegradable films for use in food packaging. PLA films are still the only compostable films currently used in commercial food packaging applications, with copolyesters and PHA films under active development. Biodegradable solutions such as oxo-biodegradable and omni-biodegradable films have gained some commercial acceptance in food packaging applications as well, particularly in Canada and Mexico, but there are still questions around the acceptance of biodegradable claims in various jurisdictions, as these tend to be based more on ASTM guidelines rather than standard specifications. Figure 3 provides a summary of the landfill diversion options available, and the applicable ASTM standards or guidelines.

**Figure 3: ASTM Compostable & Biodegradable Standards and Guidelines**

| | PLA | Oxo- | Omni- | Copolyester | PHA |
|---|---|---|---|---|---|
| D6400<br>for Compostable Plastics | X | | | X | X |
| D6868<br>for Biodegradable Plastics Used as Coatings on Paper and Other Compostable Substrates | | | | X | |
| D6954<br>for Exposing and Testing Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation | | X | | | |
| D5511<br>for Determining Anaerobic Biodegradation of Plastic Materials Under High-Solids Anaerobic Digestion Conditions | | | X | | |
| D5338<br>for Determining Aerobic Biodegradation of Plastic Materials Under Controlled Composting Conditions | | | X | | |
| D5526<br>for Determining Anaerobic Biodegradation of Plastic Materials Under Accelerated Landfill Conditions | | | | | |
| D5988<br>for Determining Aerobic Biodegradation in Soil of Plastic Materials or Residual Plastic Materials After Composting | | | X<br>(EcoPure) | | X |

## Reducing Energy Usage

Converters need to start by looking at their own internal operations to identify opportunities for reducing energy usage.  We have reported[1] the example of applying less aluminum (lower OD) without compromising barrier properties, which leads to less energy being used in the metallizing process to heat boats, drive stepper motors, etc.  Calculations show that with this change in OD on certain products Celplast has achieved energy savings of **359,271 kW-hr per year**.

Other examples of operational energy reductions Celplast has achieved in the past 12 months:

- Brighter, energy efficient T5 fluorescent lighting throughout plant
  - Energy savings = **241,857 kW-hr per year**
- Motion sensors on lights in warehouse and certain office & production areas
  - Energy savings = **122,107 kW-hr per year**
- Centralized chiller system to only run chillers & pumps on demand, as needed
  - Energy savings = **43,581 kW-hr per year**

**Total operational energy savings = 766,816 kW-hr per year**

The value proposition of layer elimination in a flexible package becomes even more compelling when looked at from the standpoint of the energy reduction achieved by eliminating a laminating step.  Figure 4 shows the feedstock, transport & energy usage requirements for various lamination processes.  It is apparent that solvent-less lamination uses significantly less overall energy than other forms of lamination, but what if this step can be eliminated altogether? Figure 5a & 5b show the processing energy savings that can be achieved by eliminating one adhesive lamination step with a solvent-less and solvent-based laminator, respectively.  This can be achieved using the metallized sealant concept reviewed previously.  It should be apparent that if the structure is originally extrusion laminated, when this step is eliminated the energy savings become even more impressive, ranging from 35 – 45%.

## Figure 4: Energy Usage[2] and Associated $CO_2$ Equivalents of Laminating Processes

| | Feedstock Energy Usage (MJ/Ream) | Transport and Processing Energy Usage (MJ/Ream) | CO2 Equivalent (kg/Ream) |
|---|---|---|---|
| Solvent-less | 16 | 37 | 10.6 |
| Water Based | 31 | 122 | 30.5 |
| Solvent Based | 55 | 203 | 51.5 |
| 8.5lbs LDPE (15um) | 216 | 162 | 76.4 |
| 11lbs LDPE (20um) | 290 | 215 | 100.8 |
| 17lbs LDPE (30um) | 431 | 306 | 147.1 |
| Metallizing | 1 | 50 | 10.2 |

Note: $CO_2$ equivalents based on Ontario provincial energy source mix.
1 MT $CO_2$ equivalent produced per 1392 kW-hr. [3]

## Figure 5a: Converting Operation Energy Usage Comparison Between 3 Plies and 2 Plies in a Solvent-less Adhesive Lamination

| Layer Description | Energy Usage (MJ/ream) |
|---|---|
| Reverse printed 48 g PET | 258 |
| Adhesive lamination | 51 |
| 48 g metallized PET barrier layer | 51 |
| Adhesive lamination | 51 |
| 1.5 mil sealant web | - |
| Total Processing Energy (MJ/ream) | 411 |

| Layer Description | Energy Usage (MJ/ream) |
|---|---|
| Reverse printed web | 258 |
| Adhesive lamination | 51 |
| 1.5 mil metallized sealant | 51 |
| Total Processing Energy (MJ/ream) | 360 |

**Savings with metallized sealant 12.4%**

**Figure 5b: Converting Operation Energy Usage Comparison Between 3 Plies and 2 Plies in a Solvent Based Adhesive Lamination**

| Layer Description | Energy Usage (MJ/ream) |
|---|---|
| Reverse printed 48 g PET | 258 |
| Adhesive lamination | 258 |
| 48 g metallized PET barrier layer | 51 |
| Adhesive lamination | 258 |
| 1.5 mil sealant web | - |
| Total Processing Energy (MJ/ream) | 825 |

| Layer Description | Energy Usage (MJ/ream) |
|---|---|
| Reverse printed web | 258 |
| Adhesive lamination | 258 |
| 1.5 mil metallized sealant | 51 |
| Total Processing Energy (MJ/ream) | 567 |

**Savings with metallized sealant 31.3%**

## Reducing $CO_2$ Emissions

This is a broad, all-encompassing metric, as it can be applied not only to the material components of a structure but also to the converting operations employed to create a finished rollstock. That is one reason it is commonly used by legislators, brand owners and retailers alike. These numbers are also debatable as various scenarios are possible. Should $CO_2$ emissions of a plastic film be based on it being landfilled or incinerated? How much of a compostable material should we assume actually gets composted vs. other disposal methods? Is the ethylene feedstock to make LDPE originating from natural gas or oil? Here is where independent Life Cycle Analysis (LCA) is critical. Figure 6 shows some typical $CO_2$ emission equivalents based on LCA calculations for various polymers.

**Figure 6: $CO_2$ Emission Equivalents Based on LCA[4,5]**

| | PLA | PHA | PET | HDPE | LDPE |
|---|---|---|---|---|---|
| Cradle to Grave Non Renewable Energy (GJ/t) | 54.2 | 81 | 87.5 | 79.9 | 80.6 |
| GHG Emission (kg $CO^2$ equivalent/kg) | 3.45 | N/A | 5.4 | 4.84 | 5.04 |

Based on LCA figures for PET and LDPE films, plus the GHG emissions calculated for each converting operation from Figure 4, we can build a picture of the $CO_2$ emissions for various plastic film laminations. Figures 7a and 7b compare 3-ply and 2-ply structures of both solvent-less and solvent based adhesive laminations. The comparisons now take into account $CO_2$ emissions for both the substrates themselves as well as the converting operations. Once again, the reduction in $CO_2$ emissions going from 3-ply to 2-ply would be 35 – 45% if an extrusion lamination step was being eliminated.

**Figure 7a: Converting Operation $CO_2$ Emission Comparison Between 3 Plies and 2 Plies in a Solvent-less Adhesive Lamination**

| Layer Description | CO2 Equivalent (kg/ream) |
|---|---|
| Reverse printed 48 g PET | 76.9 |
| Adhesive lamination | 10.6 |
| 48 g metallized PET barrier layer | 35.6 |
| Adhesive lamination | 10.6 |
| 1.5 mil sealant web | 49.6 |
| Total CO2 Equivalent (kg/ream) | 183 |

| Layer Description | CO2 Equivalent (kg/ream) |
|---|---|
| Reverse printed web | 76.9 |
| Adhesive lamination | 10.6 |
| 1.5 mil metallized sealant | 59.8 |
| Total CO2 Equivalent (kg/ream) | 147 |

**Savings with metallized sealant 19.6%**

**Figure 7b: Converting Operation $CO_2$ Emission Comparison Between 3 Plies and 2 Plies in a Solvent Based Adhesive Lamination**

| Layer Description | CO2 Equivalent (kg/ream) |
|---|---|
| Reverse printed 48 g PET | 76.9 |
| Adhesive lamination | 51.5 |
| 48 g metallized PET barrier layer | 35.6 |
| Adhesive lamination | 51.5 |
| 1.5 mil sealant web | 49.6 |
| Total CO2 Equivalent (kg/ream) | 265 |

| Layer Description | CO2 Equivalent (kg/ream) |
|---|---|
| Reverse printed web | 76.9 |
| Adhesive lamination | 51.5 |
| 1.5 mil metallized sealant | 59.8 |
| Total CO2 Equivalent (kg/ream) | 188 |

**Savings with metallized sealant 29.0%**

As with energy usage, we shouldn't ignore opportunities to reduce operational $CO_2$ emissions. For example, Celplast's film yield improvement strategy is based on more efficient material utilization and less internal waste. This is expected to significantly reduce the total amount of plastic film that is scrapped during operations, and reduce its plastic waste by an equivalent of 182 MT of $CO_2$ emissions.

## Conclusions

Along with retailers, brand owners are developing clearer, more measurable sustainability strategies and goals. This is allowing converters to target their product development and operational improvement initiatives to support the sustainability goals of brand owners. Reducing material usage, increasing landfill diversion, reducing energy usage and lowering $CO_2$ emissions are all important aspects to the success of flexible packaging converters going forward. We have many tools at our disposal to enable our customers to succeed in meeting their objectives. In the long run this will create a more financially, socially and environmentally sustainable flexible packaging industry.

## References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