Meeting Sustainability Initiatives Without Compromising Performance or Increasing Cost

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Industry Drivers

A year ago we presented the fact that retailers were the main drivers of the sustainable packaging movement. Looking at what has happened in the 12 months since it is apparent that the major retailers have put their money where their mouths are. Wal-Mart, Tesco and many others have developed comprehensive sustainability programs, including sophisticated measurement tools and hard targets. Sustainability programs have come to encompass sustaining the economics of the packaging as well as sustaining the environment, which means the most successful offerings will improve the bottom line as well. Consumers and governments continue to apply pressure as well, as they become increasingly green conscious and energy policy is a major election issue on both sides of the border this fall.

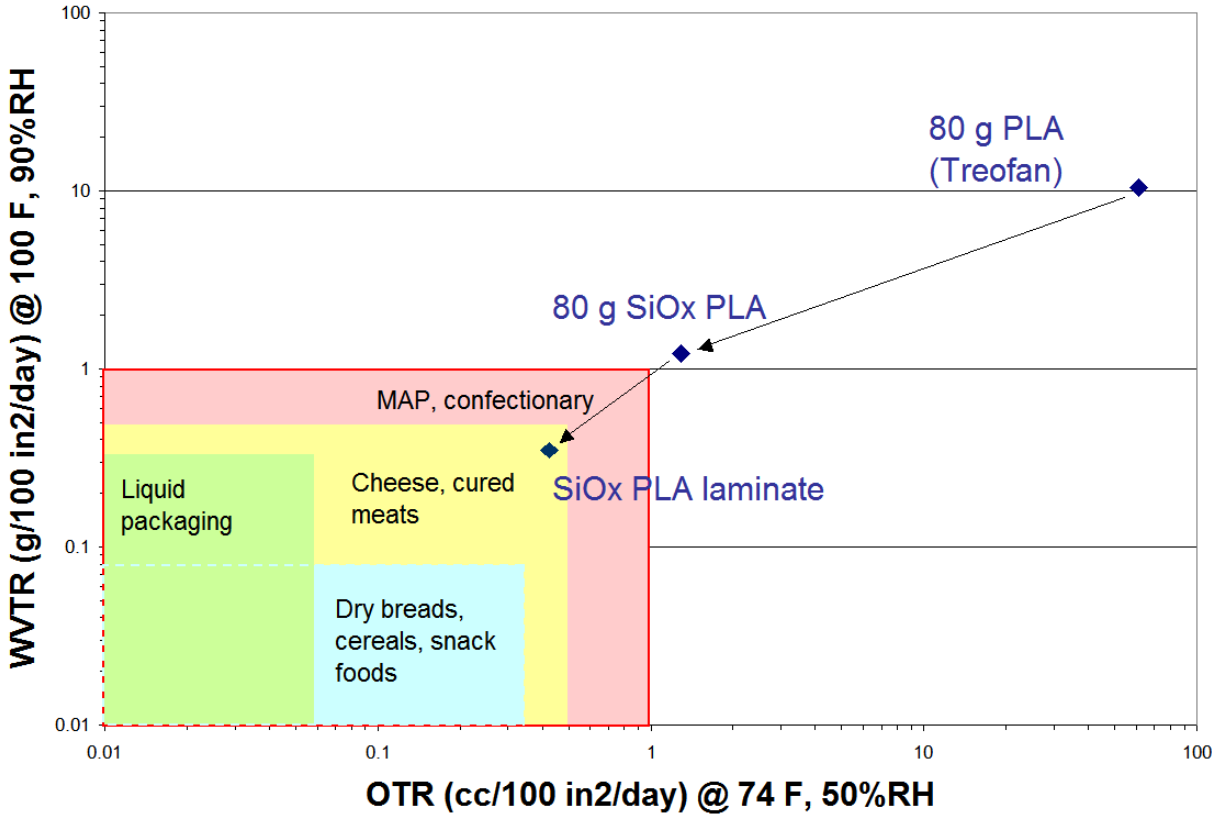
The converting industry and CPG's are critical to sustainability's success, and they have both stepped up to develop sustainable solutions for retailers. The movement has high visibility at trade shows, sustainability-related symposia & conferences and industry sustainability groups. We will look at three sustainability solutions applicable to barrier films.

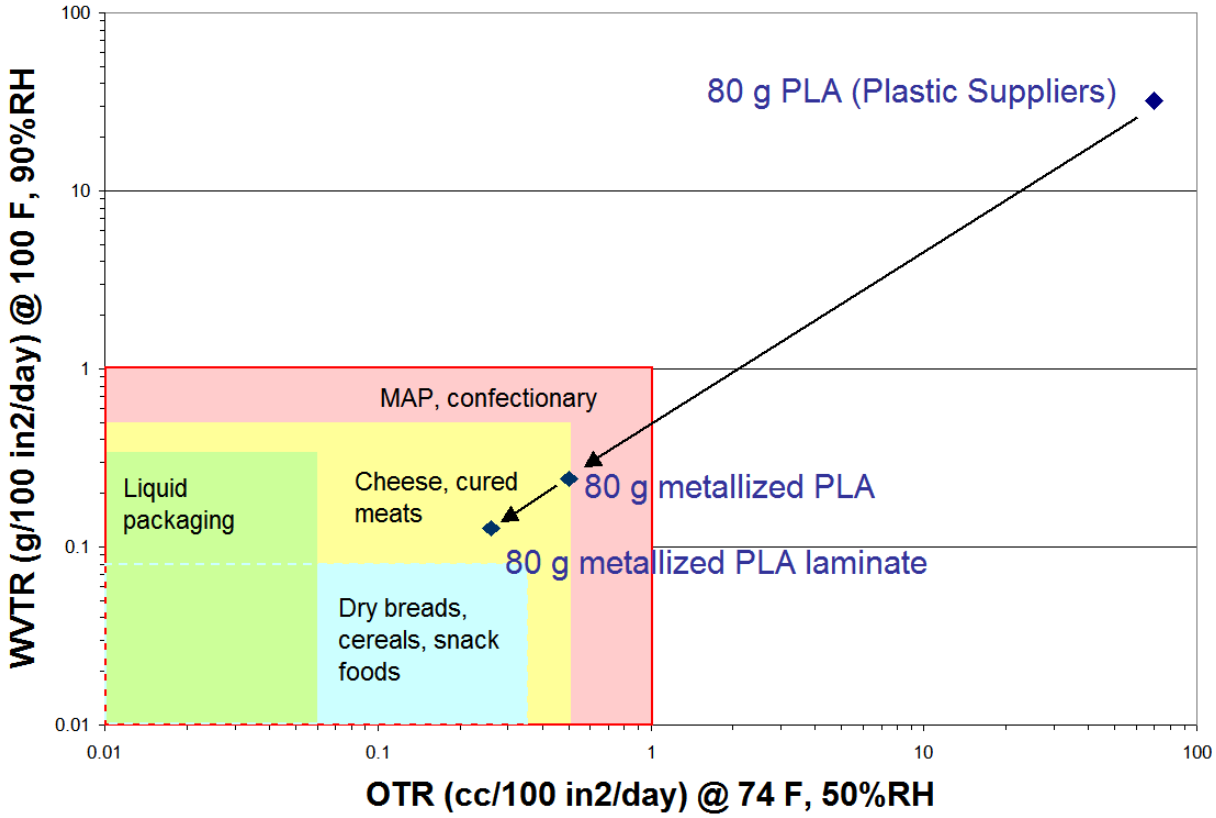
Biodegradable Films

The most commercially advanced and available biodegradable, renewable resource based film on the market continues to be PLA. It has good clarity, sealability and deadfold, and all commercially available films meet the ASTM D6400 compostability requirements. This film's main drawbacks are its poor temperature resistance and poor barrier properties.

Two solutions to the barrier issue are to apply an SiOx clear barrier layer or a metallized barrier layer to the PLA film. Neither of these inorganic nanolayers negatively impact the compostability of the base PLA film. Furthermore, the improvements in barrier properties achievable with these layers are virtually independent of the thickness of the base film. We have measured metallized and SiOx-coated barrier properties on several different gauges of PLA film from several different film suppliers including 80 g, which is the thinnest commercially available gauge.

The improvement in barrier properties can be seen in the barrier maps on the following page. These maps compare the barrier properties of the original, uncoated 80 g PLA film to the coated PLA, and then the coated PLA laminated to another 80 g PLA layer. These properties are overlayed against boxes showing the barrier requirements of some typical food packaging applications.


100
10
1
0.1
0.01
WVTR (g/100 in2/day) @ 100 F, 90%RH
80 g PLA
(Treofan)
80 g SiOx PLA
MAP, confectionary
Liquid
packaging
Cheese, cured
meats
SiOx PLA laminate
Dry breads,
cereals, snack
foods
0.01
0.1
1
10
100
OTR (cc/100 in2/day) @ 74 F, 50%RH


100
10
1
0.1
0.01
WVTR (g/100 in2/day) @ 100 F, 90%RH
80 g PLA (Plastic Suppliers)
MAP, confectionary
Liquid
packaging
Cheese, cured
meats
80 g metallized PLA
80 g metallized PLA laminate
Dry breads,
cereals, snack
foods
0.01
0.1
1
10
100
OTR (cc/100 in2/day) @ 74 F, 50%RH

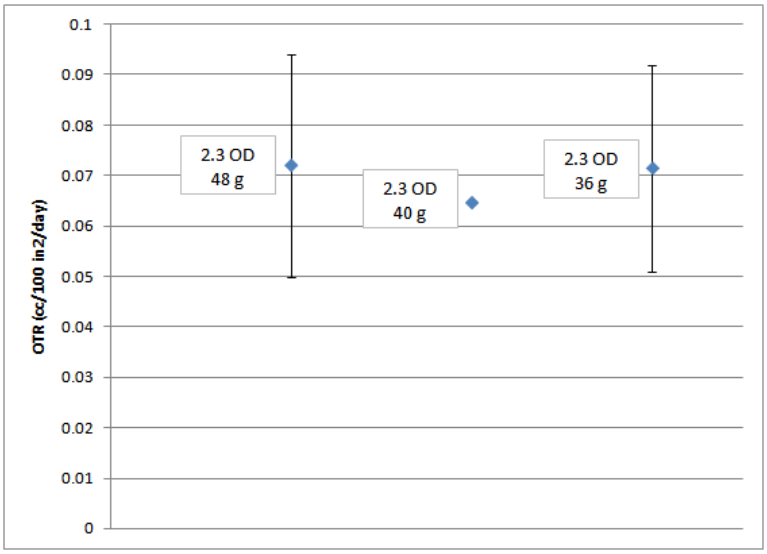
Source Reduction

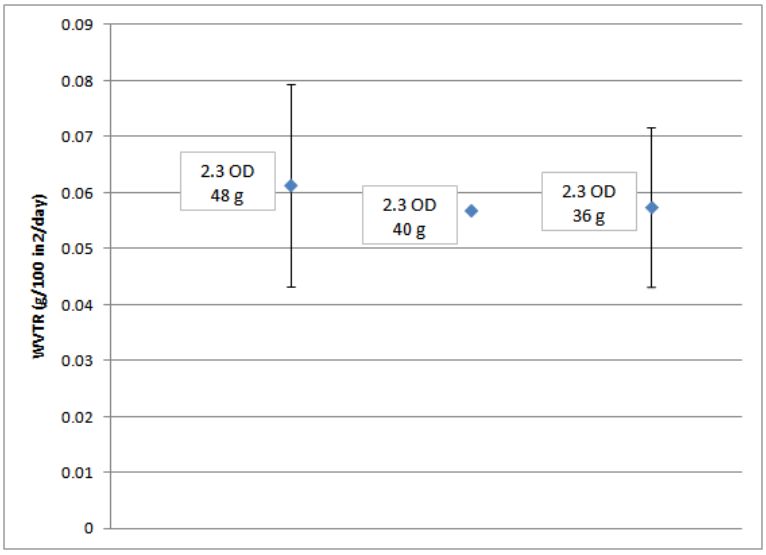
Today's reality is that packaging economics is the largest driver of sustainability. One way to marry these two concepts together is through source reduction. There are three main approaches that can be taken for metallized films:

- Downgauging
- Less aluminum
- Layer elimination

In the first case, the vast majority of food packaging applications in North America continue to utilize 48 g PET. It is the most readily available and one of the most cost effective gauges on the market. Recently, several PET suppliers have been developing their thinner gauge PET films, and metallizers have put greater effort into metallizing these films in a high quality, reproducible, cost effective manner.

As with PLA film, the barrier properties of the metallized film are almost independent of the base film gauge. This is proven in the following figures, which show 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.

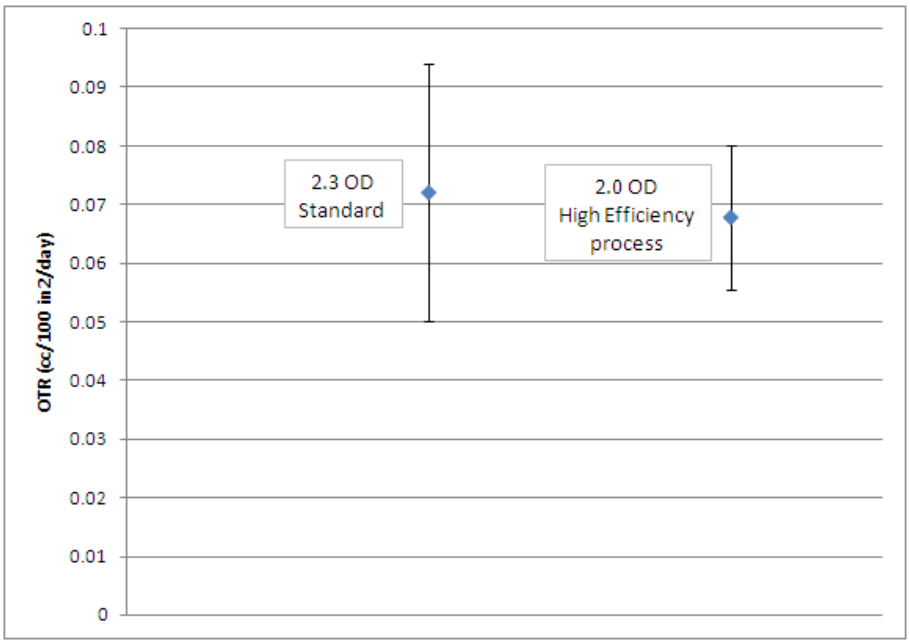


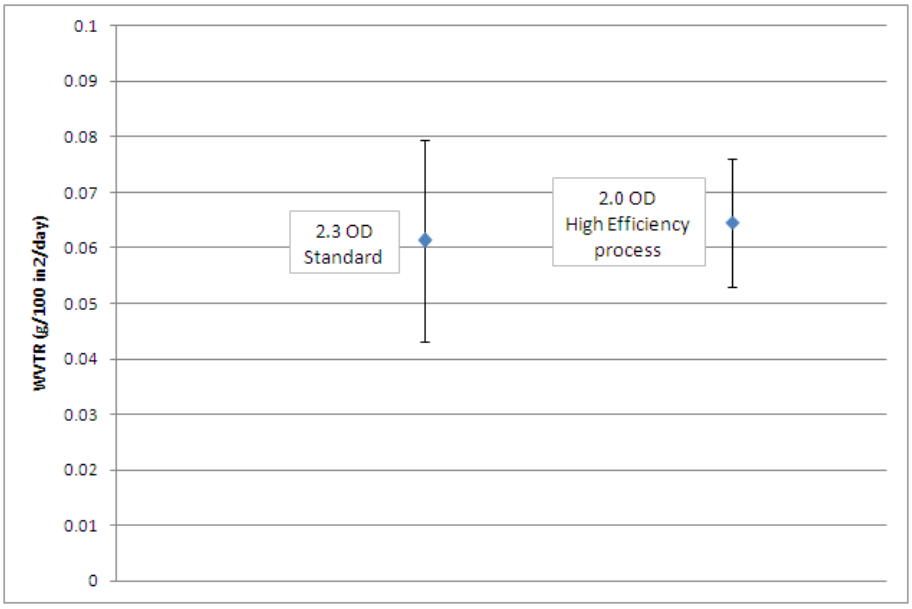


In the case of applying less aluminum (lower OD), in order to do so without compromising barrier properties the quality of the metal layer needs to be significantly improved. In addition to OD, the density, level of pinholes and adhesion to the substrate all play critical roles in determining the barrier properties of a metallized film.

Less aluminum not only leads to source reduction, but also means less energy is used in the metallizing process, to heat boats, drive stepper motors, etc.

The following figures show the oxygen and water vapor barrier properties of two different sets of metallized PET films, again showing 95% confidence intervals. As with the charts on the previous page, OTR was measured at 50%RH, 23C, while WVTR was measured at 90%RH, 38C. One set was run under standard metallizing conditions, to a 2.3 OD target. The other set was run on the same metallizing equipment, using the same set of base films, but run to a 2.0 OD target using a "High Efficiency" metallizing process.





The last form of source reduction we have examined is layer elimination. More specifically, we have looked at combining two separate layers, the barrier and the sealant web, into a single "barrier sealant" layer. This can be used to replace metallized PET in the case of high oxygen barrier applications, or to replace metallized OPP or foil in the case of high moisture barrier applications. The following tables demonstrate the various layer elimination opportunities, and show barrier and sealant properties achievable in a single ply structure.

Table 1: Layer Elimination Opportunities Using Metallized Films

Metallized Sealant	Barrier Target	Typical Applications	Laminated plies being replaced	Thicknesses Evaluated (g)
1	Oxygen	Liquid packaging, fatty or oily foods	Met PET & LLDPE sealant	125 – 175
2	Moisture	Dry powder packaging, moist/wet products	Met OPP or foil & LLDPE or LDPE sealant	120 – 175
3	Moisture	Dry powder packaging, moist/wet products	Met OPP or foil & LLDPE or LDPE sealant	80 - 120

Table 2: Measured Barrier & Sealant Properties

Metallized Sealant	OTR (cc/100 in^2/d)	WVTR (g/100 in^2/d)	Metal Adhesion (g/in)	Sealant COF*	HSIT (F)	Ultimate Seal Strength (lb_f/in)
1	0.04	0.07	400	0.16	220	>4 (destruct)
2	4.0	0.02	470	0.3 – 0.4	265	>6 (destruct)
3	4.0	0.008	>600	0.18	230	N/A

*Sealant-to-sealant, kinetic COF

Note that these barrier numbers are only achievable with a high barrier metallizing process. These metal adhesion numbers are only achievable with an adhesion-promoting surface on the metallizable side of the sealant web. Standard sealant webs metallized under standard metallizing conditions will not perform to the specifications outlined above.

Other opportunities exist as well to improve the overall sustainability of a company's operation, through energy conservation, packaging recycling and reduction programs, and more efficient supply chain management.

Conclusions

Retailers have put their money where their mouths are, proving that they are serious about sustainability and it will continue to be a driving force in the flexible packaging industry for years to come. In the barrier packaging space, there are many opportunities to improve packaging economics while becoming more sustainable. Converters need to make a conscious decision to innovate and work with customers, suppliers, government and other firms to achieve their sustainability goals.