An Economic Value Model for Converters
Comparing the Total Cost of Metallized Film vs. Foil in Flexible Packages

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Introduction

As the pressure on converters to reduce costs increases in the flexible packaging industry, they have to rely on film suppliers to develop new and more economical products that still maintain performance. Metallized films have historically had some success in replacing foil for reasons such as esthetics and improved barrier properties. As the price of ingot continues to increase, metallized films are now starting to make head way in applications that have historically been foil for economic reasons.

This study examines the economic value of metallized film compared to foil by examining the impact of material cost, productivity savings, and inventory. The study will also demonstrate that you can reduce your overall package cost using metallized film over foil and still maintain performance integrity.

Technical Performance

The focus of this study is to compare the economics of metallized film to aluminum foil. However, it was important to compare the barrier performance of each substrate to ensure that the cost savings were not being obtained at the expense of product performance. The charts below outline the results of studies conducted, which compared barrier values of metallized polyester to that of aluminum foil.

Typical Transmission Rates
(Measured by Rollprint, from Global Pouch Forum 2006)

	Test Conditions	0.00035" Foil (Unflexed) 3-ply structure	0.00035" Foil (Flexed) 3-ply structure	48g Metallized PET (Unflexed) 2-ply structure	48g Metallized PET (Flexed) 2-ply structure
OTR (cc/100 in^2/day)	50% RH, 73.4°F	0.03	3.2	0.1	0.7

Transmission Rate Ranges

	Test Conditions	Standard 48 g Metallized PET	Required Barrier Metallized PET
OTR (cc/100 in²/day)	50% RH, 73.4°F	0.05 - 0.08	<0.02
WVTR (g/100 in²/day)	90% RH, 100°F	0.04 – 0.07	<0.02

Methodology

It was important to not only capture the area cost comparison of metallized film to foil but also understand the impact of productivity, inventory, and other associated costs. In order to ensure our study was complete and accurate we did the following during our study:

1. Researched historical and future prices of ingot.
2. Interviewed several leading converters on how foil and metallized film perform during the production process. These converters historically processed both film and foil in the same plant, so could provide an accurate comparison between the two substrates.
3. Analyzed the cost of carrying inventory of film vs. foil based on current lead times.
4. Researched other papers that have conducted head to head studies comparing metallized film to aluminum foil.

Cost Comparisons

The charts below demonstrate that using metallized film over foil offers a significant price advantage per msi today, without having to sacrifice barrier performance.

Raw material cost of metallized film vs. foil

	Yield (msi/lb)	Relative Cost	Relative Cost	Savings over 0.00035" foil
Aluminum foil (0.00035")	29.32	1.00	1.00	
Aluminum foil (0.000275")	37.31	1.09	0.86	14.3%
Standard Met PET (48 g)	41.50	0.64	0.45	54.7%
High Barrier Met Pet (2.3 OD)	41.50	0.89	0.63	37.4%
Ultra Barrier Met Pet (2.8 OD)	41.50	0.93	0.66	34.2%

The following chart shows the total relative cost/msi of metallized film and foil, once taking into account raw material, productivity and inventory costs. This total cost model shows that metallized films offer up to a 58% cost saving vs. 0.00035" foil.

Relative cost summary of metallized film vs. foil

	Total Relative Cost	Savings over 0.00035" foil
Aluminum foil (0.00035")	1.00	
Aluminum foil (0.000275")	0.87	12.8%
Standard Met PET (48 g)	0.42	58.5%
High Barrier Met Pet (2.3 OD)	0.56	43.7%
Ultra Barrier Met Pet (2.8 OD)	0.59	41.0%

Conclusions

Metallized films have always been available as an alternative to foil. Historically metallizing has been seen as an excellent replacement over foil for esthetic reasons in decorative applications or stand up pouches. In recent history metallized films have also been used in barrier applications that have typically used foil because a new generation of metallized films can now meet the high barrier demands in applications such as dry powders and liquids.

As we stated earlier, the pressure to reduce costs in flexible packaging continues to mount and metallized films has risen to the challenge. Metallized films have proven to be a more cost effective alternative to foil through material cost, production costs, and shorter lead times, which help reduce inventory costs. These savings ensure that the total cost of metallized films will continue to be lower than foil, both now and well into the future.

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Celplast Metallized Products

OUTLINE

- Foil replacement opportunities
- Improved barrier metallizing process
- Economics of metallized film vs. foil
- Conclusions

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FOIL REPLACEMENT OPPORTUNITIES

- There are some inherent issues with foil in barrier applications:
  - Difficult to print or laminate without creasing
  - Prone to pinholing & cracking when flexed, which compromises barrier properties
  - Long lead times, few good suppliers
  - Generally higher cost and more weight than 48 g metallized PET on an msi basis
  - Foil laminations typically not recyclable

FOIL REPLACEMENT OPPORTUNITIES

- Foil is still required for many applications where high barrier properties are required

Typical Transmission Rates
(Measured by Celplast)

	Test Conditions	0.00035" Foil (Unflexed)	Standard 48 g Metallized PET
OTR (cc/ 100 in^2/day)	50%RH, 73.4°F	0.01	0.05 - 0.08
WVTR (g/ 100 in^2/day)	90%RH, 100°F	0.01	0.04 – 0.07

FOIL REPLACEMENT OPPORTUNITIES

- Are these barrier numbers over-engineered for many foil applications?

Typical Transmission Rates
(Measured by Celplast)

	Test Conditions	0.00035" Foil (Unflexed)	Standard 48 g Metallized PET
OTR (cc/ 100 in^2/day)	50%RH, 73.4°F	0.01	0.05 - 0.08
WVTR (g/ 100 in^2/day)	90%RH, 100°F	0.01	0.04 – 0.07

FOIL REPLACEMENT OPPORTUNITIES

- Are foil barrier numbers representative of foil performance in a flexible package?

Typical Transmission Rates
(Measured by Rollprint, from Global Pouch Forum 2006)

	Test Conditions	0.00035" Foil (Unflexed) 3-ply structure	0.00035" Foil (Flexed) 3-ply structure	48g Metallized PET (Unflexed) 2-ply structure	48g Metallized PET (Flexed) 2-ply structure
OTR (cc/ 100 in^2/day)	50%RH, 73.4°F	0.03	3.2	0.1	0.7

FOIL REPLACEMENT OPPORTUNITIES

- Some markets currently use foil where a superior barrier metallized PET may be suitable:
  - Lidding- Foil/PET or Paper/PE/Foil/PE
  - Dry powder pouches- Paper/PE/Foil/PE
  - Oxygen-sensitive pouches- PET/Foil/PE
  - Medical/Pharmaceutical- PET/Foil/PE

FOIL REPLACEMENT OPPORTUNITIES

- A high barrier metallized PET is sufficient to replace foil in some applications

Transmission Rate Ranges

	Test Conditions	Standard 48 g Metallized PET	Required Barrier Metallized PET
OTR (cc/ 100 in^2/day)	50%RH, 73.4°F	0.05 - 0.08	<0.03
WVTR (g/ 100 in^2/day)	90%RH, 100°F	0.04 – 0.07	<0.04

FOIL REPLACEMENT OPPORTUNITIES

- An ultra-high barrier metallized PET is sufficient to replace foil in many other applications

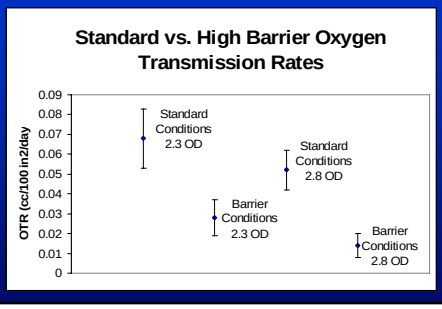
Transmission Rate Ranges

	Test Conditions	Standard 48 g Metallized PET	Required Barrier Metallized PET
OTR (cc/ 100 in²/day)	50%RH, 73.4°F	0.05 - 0.08	<0.02
WVTR (g/ 100 in²/day)	90%RH, 100°F	0.04 – 0.07	<0.02

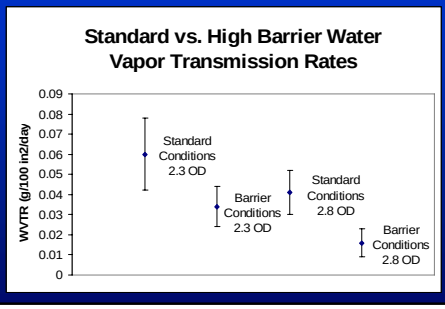
OUTLINE

- Foil replacement opportunities
- **Improved barrier metallizing process**
- Economics of metallized film vs. foil
- Conclusions

IMPROVED BARRIER METALLIZING PROCESS



IMPROVED BARRIER METALLIZING PROCESS



IMPROVED BARRIER METALLIZING PROCESS

Are we able to satisfy foil replacement requirements?

- High barrier metallizing conditions at 2.3 OD have achieved high barrier properties:
  - <0.03 cc/100 in^2/day OTR
  - <0.04 g /100 in^2/day WVTR
- High barrier metallizing conditions at 2.8 OD have achieved ultra-high barrier properties:
  - <0.02 cc/100 in^2/day OTR
  - <0.02 g /100 in^2/day WVTR

IMPROVED BARRIER METALLIZING PROCESS

High barrier metallized film performance

- Metal adhesion was not compromised.
- Oxygen barrier improved in solventless & solvent based laminations.
- Water vapor barrier maintained in solventless & solvent based laminations.

IMPROVED BARRIER METALLIZING PROCESS

Metallized film vs. foil: an end user's perspective

- Metallized film improves flex cracking and puncture resistance= LONGER SHELF LIFE
- Less wear and tear from handling on the store shelves= IMPROVED AESTHETICS THAT LAST
- Faster Line Speeds= HIGHER PRODUCTIVITY

OUTLINE

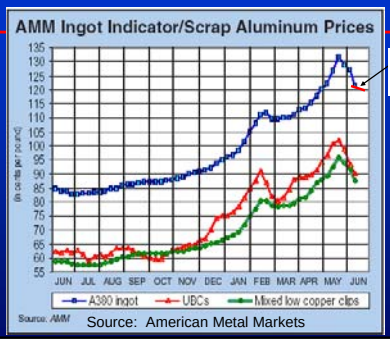
- Foil replacement opportunities
- Improved barrier metallizing process
- **Economics of metallized film vs. foil**
- Conclusions

Economics of Metallized Film vs. Foil

Methodology

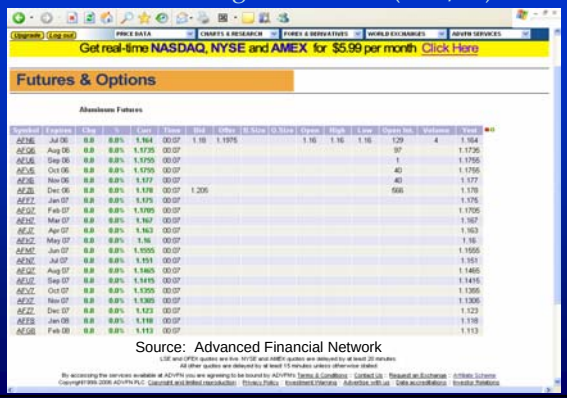
- Historical price trends of aluminum ingot
- Long range forecast of ingot prices
- Research with converters that use both film and foil

Aluminum Ingot – Historical (US$/lb)



Source: American Metal Markets

Aluminum Ingot – Futures (US$/lb)



Source: Advanced Financial Network

Economics of Metallized Film vs. Foil

Costing out Foil

- **Density of aluminum (g/cc): 2.70**
- **Density of aluminum (lb/in³): 0.0975**

Aluminum foil gauge (in)	Yield (msi/lb)
0.00025	41.04
0.000275	37.31
0.0003	34.20
0.00035	29.32

Economics of Metallized Film vs. Foil

Raw material cost of metallized film vs. foil

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Economics of Metallized Film vs. Foil

Productivity advantages of metallized film vs. foil

	Relative Material Cost	MD Yield Loss From Start-up, Creasing and Tear-Outs (%)	MD loss of other material (at 2.5 x barrier layer cost)	Relative Cost, Including Yield Losses	Savings over 0.00035" foil
Aluminum foil (0.00035")	1.00	5.0%	0.1250	1.18	
Aluminum foil (0.00275")	0.86	5.0%	0.1250	1.03	12.8%
Standard Met PET (48 g)	0.45	1.5%	0.0375	0.50	57.8%
High Barrier Met Pet (2.3 OD)	0.63	1.5%	0.0375	0.67	42.8%
Ultra Barrier Met Pet (2.8 OD)	0.66	1.5%	0.0375	0.71	40.1%

Economics of Metallized Film vs Foil

Inventory cost of metallized film vs. foil

	Relative Cost, Including Yield Losses	Lead Time (weeks)	Inventory Needed (weeks)	Inventory Carrying Cost (%), Based on 12% COC	Relative Cost, Including Inventory	Savings over 0.00035" foil
Aluminum foil (0.00035")	1.18	12	8	1.85%	1.20	
Aluminum foil (0.000275")	1.03	12	8	1.85%	1.05	12.8%
Standard Met PET (48 g)	0.50	1	1	0.23%	0.50	58.5%
High Barrier Met Pet (2.3 OD)	0.67	1	1	0.23%	0.67	43.7%
Ultra Barrier Met Pet (2.8 OD)	0.71	1	1	0.23%	0.71	41.0%

Economics of Metallized Film vs. Foil

Relative cost summary of metallized film vs. foil

	Total Relative Cost	Savings over 0.00035" foil
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- Foil replacement opportunities
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- **Conclusions**

CONCLUSIONS

- Relative to 0.000275″ foil raw material cost:
  - Standard met PET offers 40% savings
  - Ultra barrier met PET offers 20% savings
- Relative to 0.00035″ foil raw material cost:
  - Standard met PET offers 55% savings
  - Ultra barrier met PET offers 34% savings

CONCLUSIONS

- Relative to the total cost of 0.000275" foil, including raw material, productivity and inventory costs:
  - Standard met PET offers 46% savings
  - Ultra barrier met PET offers 28% savings
- Relative to the total cost of 0.00035" foil:
  - Standard met PET offers 58% savings
  - Ultra barrier met PET offers 41% savings

CONCLUSIONS

"I skate to where the puck is going to be, not to where it has been"

Wayne Gretzky- Hockey Legend

Thank You

PRESENTED BY
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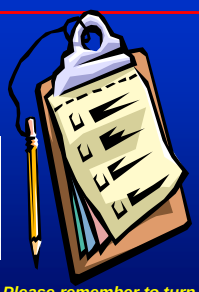
CELPLAST METALLIZED PRODUCTS LIMITED



Please remember to turn in your evaluation sheet...