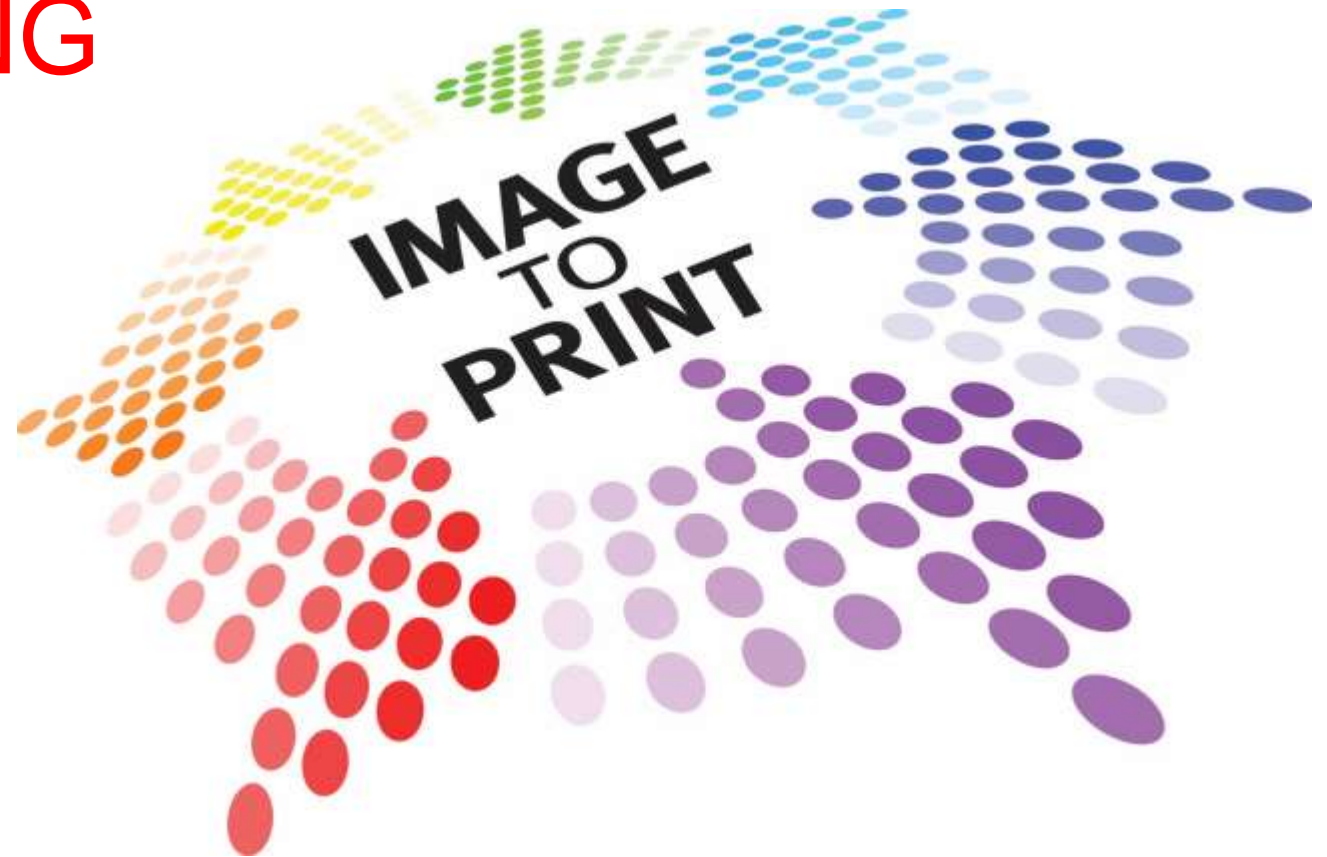


# PRINTING TECHNOLOGY & INNOVATION DAYS FOR FLEXIBLE PACKAGING

03 / 04 July 2019  
Istanbul, Turkey



# PRINTING TECHNOLOGY & INNOVATION DAYS FOR FLEXIBLE PACKAGING

HOSTED BY:

**Janoschka**



PRINTING TECHNOLOGY & INNOVATION  
DAYS FOR FLEXIBLE PACKAGING

## ADDING VALUE TO VACUUM COATED PRODUCTS BY IMPROVING METALLIZED

VINCENZO CERCIELLO  
VICE EXECUTIVE PRESIDENT, NORDMECCANICA





**We want to make our  
packaging safe !!**





# How do we reach safety ?

For sure the quality of the products is the first step but how you pack is second step.

So, the world is using high barrier laminating and metallized films reducing products waste through extending shelf life and giving protection from oxygen, mineral oil, moisture and against migration of others substances into our food.





## Metallizers Product range

Model	Web width (mm)	Max roll diam (mm)	Max. working speed (m/min)	Industry
NordMet 12-16	1000-1650	1000 (1100)	960	Converter
NordMet-Plus <b>20-25</b>	2000-2450	1000	960	Converter Film Mfr.
POWERmet 25-36	2500-3600	1270	1080(*)	Converter Film Mfr.

(\*) HR version : 1200



# Nordmet 12-16

**met** tech data  
nord

	12	16
Coating width - mm	1250	1650
Max. roll diameter - mm	∅ 1000	∅ 1000
(*) Mechanical web speed - m/min	960	960
Boats number	15	19
Average power consumption - Kwh/h <sup>(1)</sup>	165	225
Average output - T/yr <sup>(2)</sup>	2700	3600




**Available for both  
Film and Paper**

**Option of ZnS, Cu  
and Printed  
Metallization**

(\*) : option for 1100 mm diam.



# Nordmet 20-25PLUS

		20	25
Coating width - mm		2000	2450
Max. roll diameter - mm		⌀ 1000	⌀ 1000
Mechanical web speed - m/min		960	960
Boats number		22	27
Average power consumption - Kwh/h		240	300
Average output - T/yr <sup>(1)</sup>		4400	5500



**Designed for both  
converters and Film  
Manufacturers**





# Powermet 28-36

	25	28	32	36
Coating width - mm	2500	2800	3200	3600
Max. roll diameter - mm	ø 1270	ø 1270	ø 1270	ø 1270
(*) Mechanical web speed - m/min	1080	1080	1080	1080
Boats number	32	36	40	44
Average power consumption - Kwh/h	300	330	380	400
Average output - T/yr <sup>(1)</sup>	6400	7200	8200	8800



**Designed for  
High Volume  
Film  
Manufacturers**

(\*) : «HR» VERSION : UP TO 1200 m/min



# METALLIZED SOLUTIONS

**How the metallized vacuum process might helps to enhance film properties?**

**New Solutions and trials results**

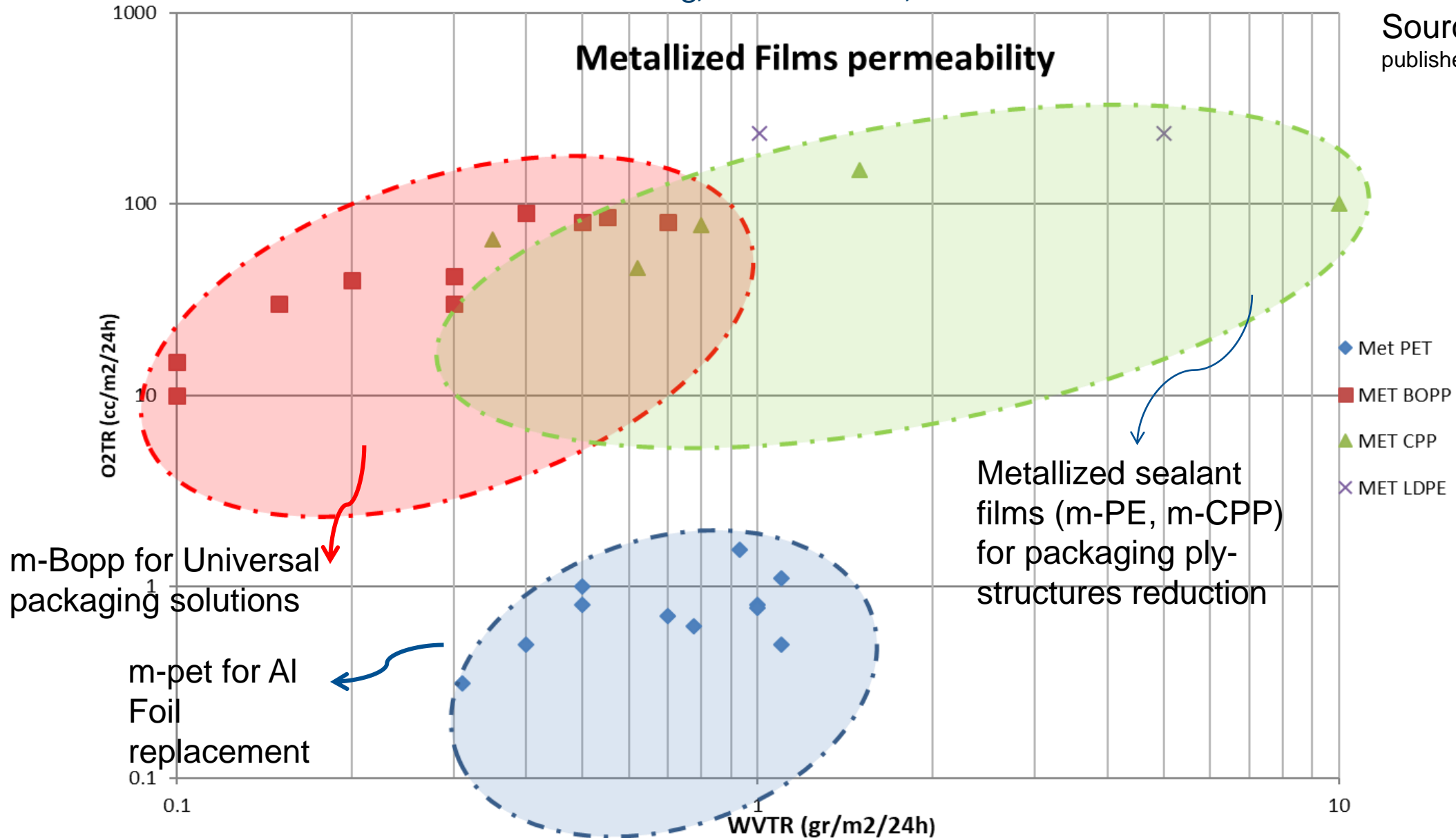
- High Gas barrier Bopp**
- Clear barrier Pet film**



# ADDING VALUE TO METALLIZED FILMS

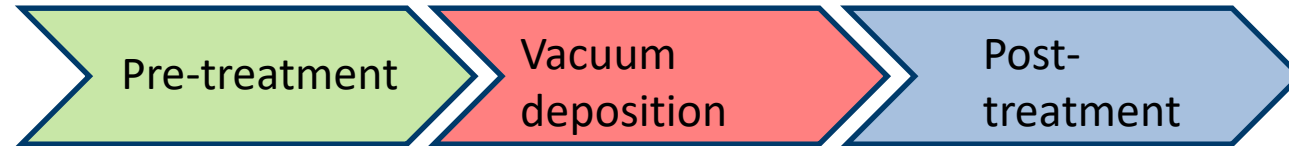
Motivations: Material saving, cost reduction, environmental friendler solution

Source : Major producers published data



# ADDING VALUE TO METALLIZED FILMS

## *Technologies and Processes overview*



- ✓ PLASMA
- ✓ SURFACE ACTIVATION by DEPOSITION «SEEDING»

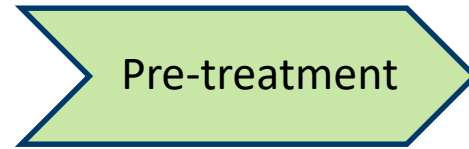
- ✓ PROCESS CONTROL (Vacuum, deposition, cleanliness etc.)
- ✓ STOICHIOMETRY (reactive processes)

- ✓ POST-PLASMA
- ✓ IN AIR TOP COATING



# ADDING VALUE TO METALLIZED FILMS

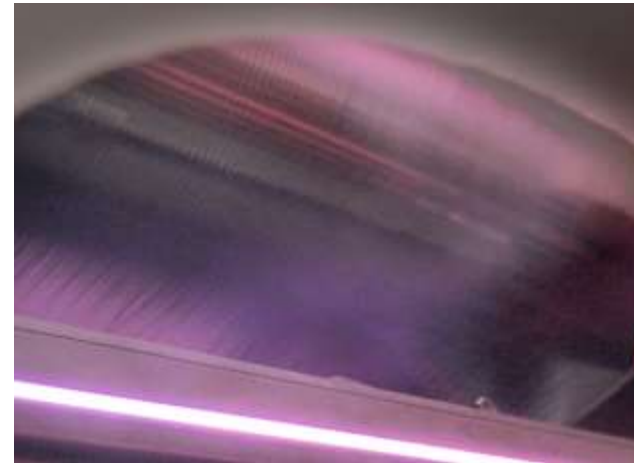
## *Technologies and Processes overview*



### PLASMA

#### Plasma action on polymer surface

- Cleaning and removal of organic contamination
- Oligomers Vaporization
- microetching, scission, crosslinking , grafting and functionalization
- Increasing wettability



Most Popular treaters categories

*DC magnetron based plasma treaters*

*AC type dual electrode plasma sources*

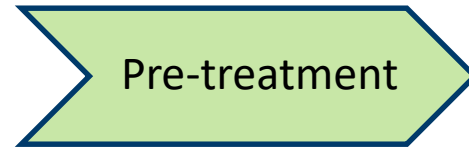
*AC hollow cathode*



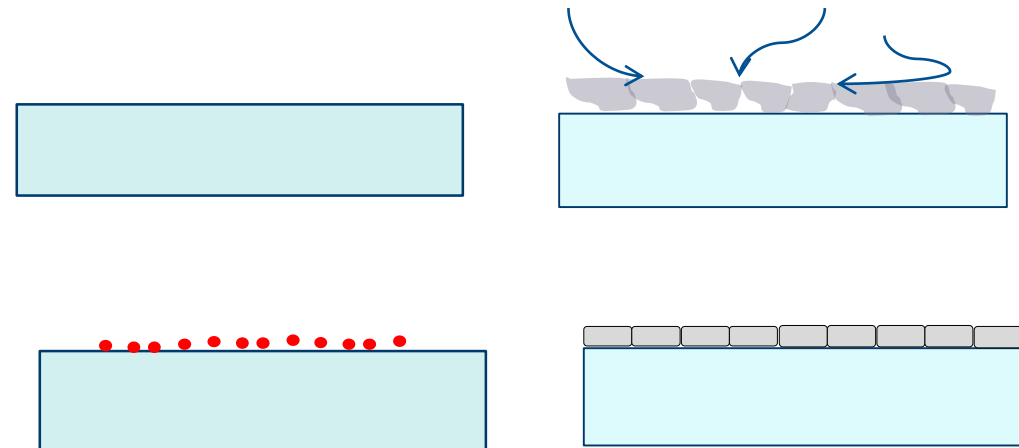


# ADDING VALUE TO METALLIZED FILMS

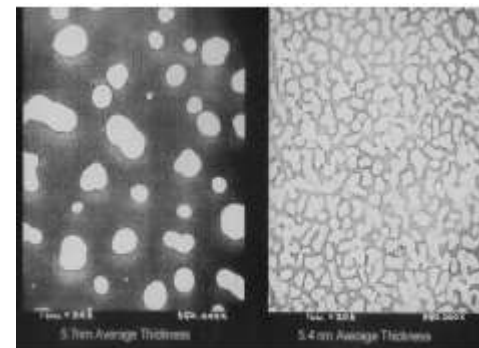
## *Technologies and Processes overview*



### Seeding /Tie layer formation



The “nucleation” concept : from low-density to more densely packed thin Film



Silver nucleation

Source : AIMCAL  
Reference Manual



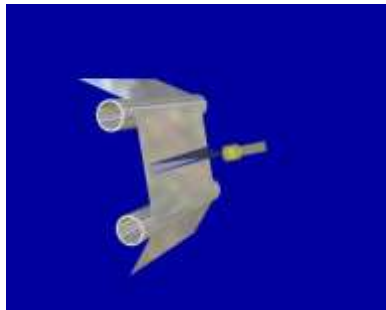
Functions :

- Forming a more suitable base for deposited film growth
- A few nanometer layer can improve metal adhesion and barrier

# ADDING VALUE TO METALLIZED FILMS

## *Technologies and Processes overview*

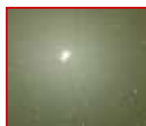
Vacuum  
deposition



LATEST GENERATION METALLIZERS DESIGNED AND BUILT FOR HIGH PRODUCTIVITY **AND** FILM PROPERTY CONTROL

MAJOR ITEMS :

- Vacuum Level
- Cooling
- Cleaning Convenience
- Deposition Control
- Careful film winding
- Defect monitoring
- User's friendly Automation
- Latest Information Technologies serving the production quality and efficiency control

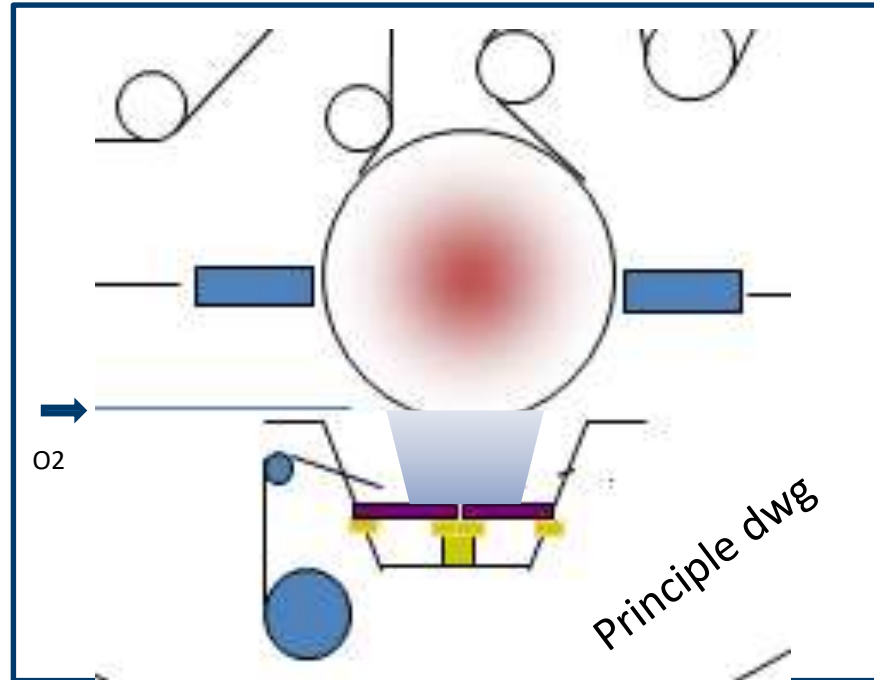


# ADDING VALUE TO METALLIZED FILMS

## *Technologies and Processes overview*

Vacuum  
deposition

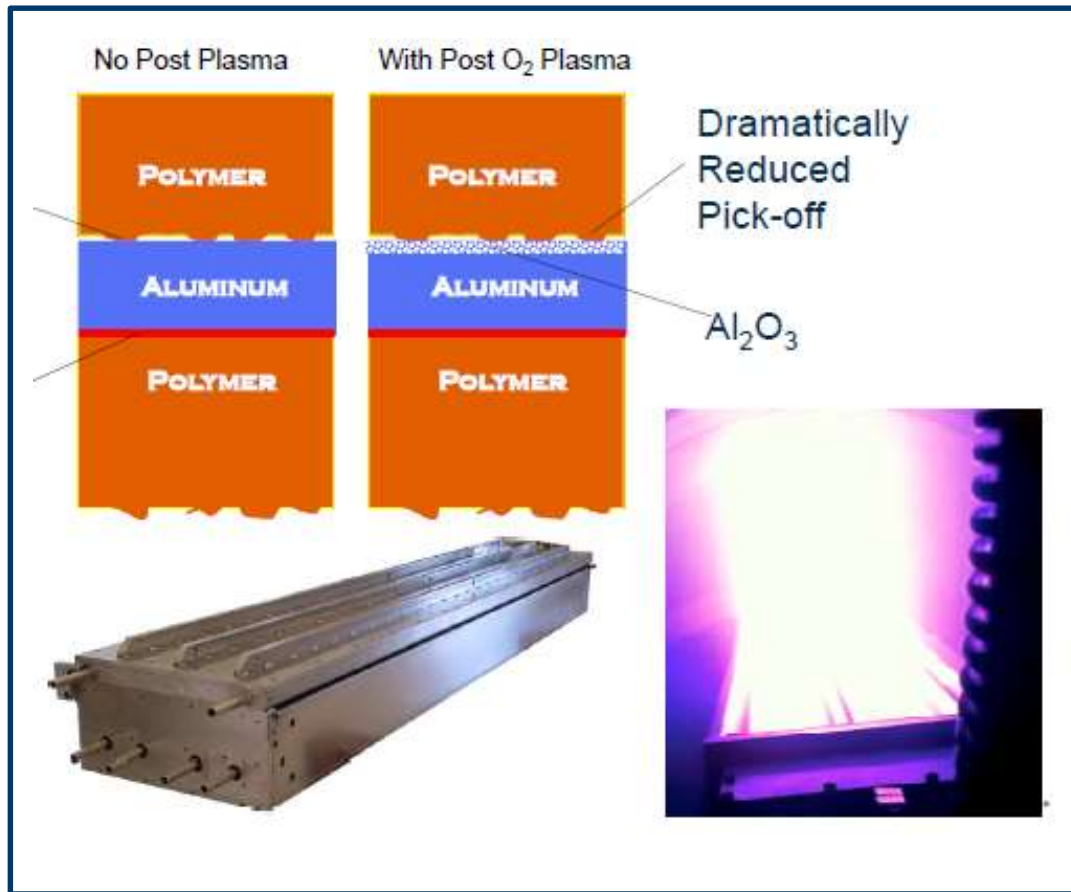
«Reactive evaporation «AlOX»»



# ADDING VALUE TO METALLIZED FILMS

## *Technologies and Processes overview*

Post-treatment



### PLASMA POST-METALLIZATION TREATMENT

- Al layer passivation to keep a stable metal surface energy for the subsequent converting
- Reported Barrier increase and consistency
- Post deposition oxidation - AlO<sub>x</sub> (3-5% T% increase)



# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

TWO PROJECTS FOR THE MOST POPULAR POLYMER FILMS

### PROJECT TARGET

1 – INCREASING GAS BARRIER OF METALLIZED BOPP

2 – PRODUCING A CONSISTENT AND ENDURING CLEAR BARRIER WITH ALOX - PET

### TOOLS

Pre-treatment :

✓ Plasma

✓ Tie-layer

✓ Vacuum Deposition

✓ Atmospheric Top Coating





# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### BOPP FILM PLASMA PRE - TREATMENT

#### PLASMA KEY FEATURES

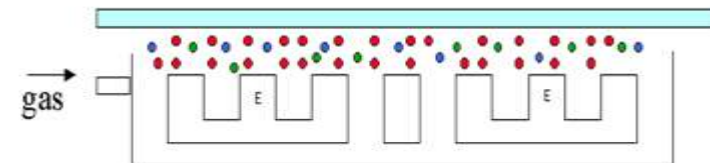
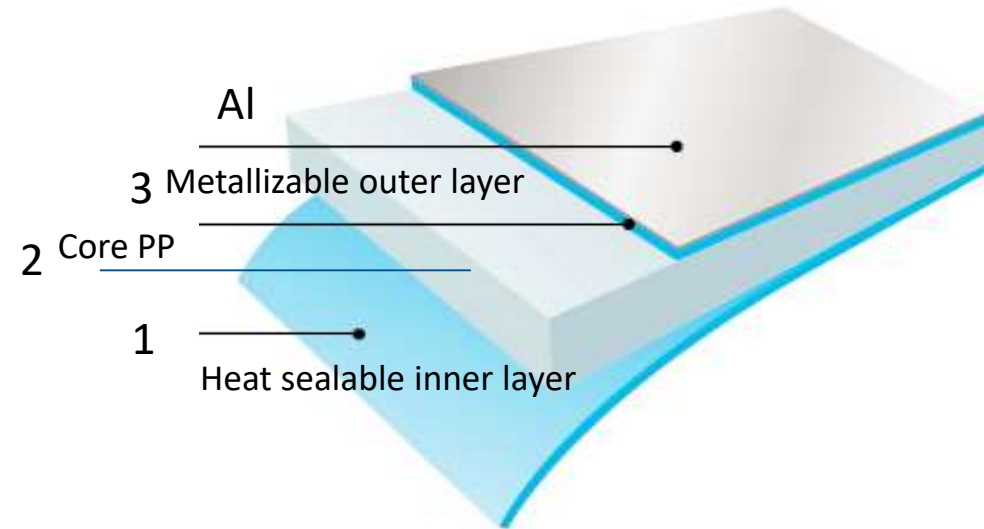
Construction : Dual Hollow cathodes,  
magnetically enhanced

Power : AC 80 KHz , quick arc detection  
and suppression system

Energy dose : up to 0.8 - 1 Kjoule/m<sup>2</sup>

#### ADVANTAGES

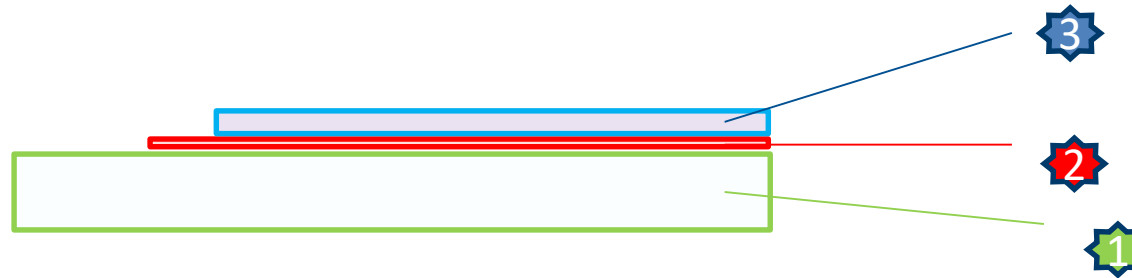
- High energy for receptive substrates
- Treatment continuity
- No back treatment
- Uniform power distribution



# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

BOPP SURFACE «SEEDING» AND «TIE LAYER»



1 - Film (Bopp)

Substrate, mechanical strength

2 – «Tie» Layer

- ✓ High bond with polymer surface (adhesion promotion)
- ✓ Polymer surface modification (Planarization, seeding etc.)

3 – Aluminium layer

Functional : barrier, gloss etc.

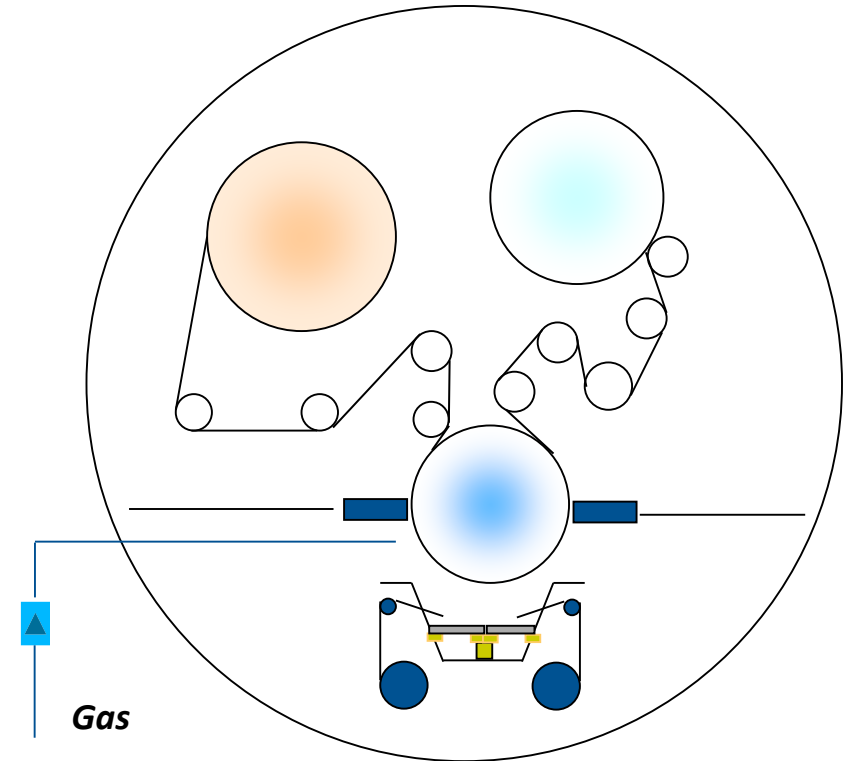


# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### BOPP SURFACE «SEEDING» AND «TIE LAYER»

- ✓ A «primer» layer generation within a conventional aluminium metallization process
- ✓ An accurately controlled gas distribution for tie-layer uniformity and thickness
- ✓ Complemented by plasma treatment



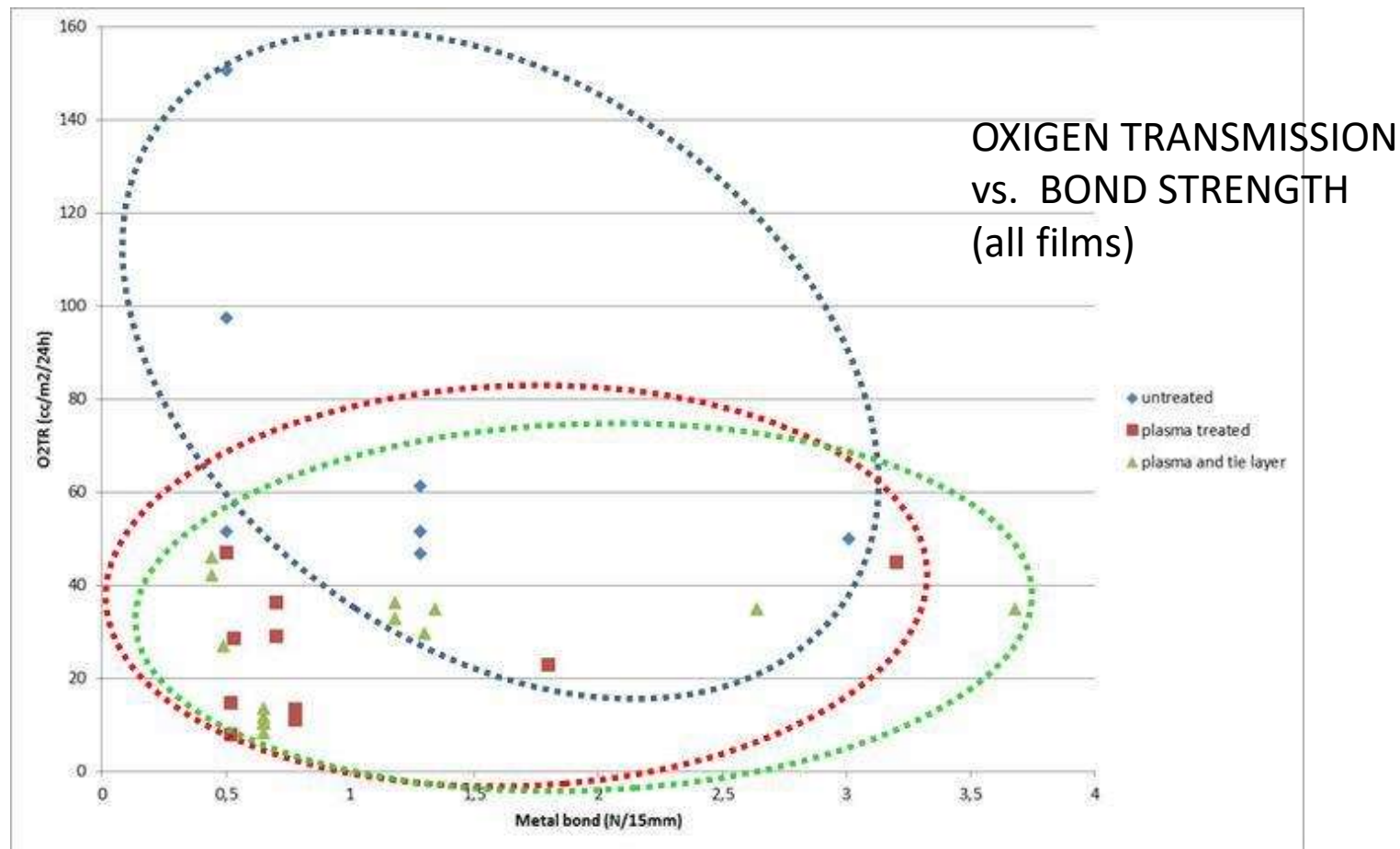
Conceptual dwg



# ADDING VALUE TO METALLIZED FILMS

## NEW SOLUTIONS & RESULTS

### BOPP PRE-TREATMENT



- Plenty of film types from diversified sources (points representing average values)
- A clear indication of pretreatment positive effect in decreasing gas permeability but the plurality of film properties would prevent a more specific analysis

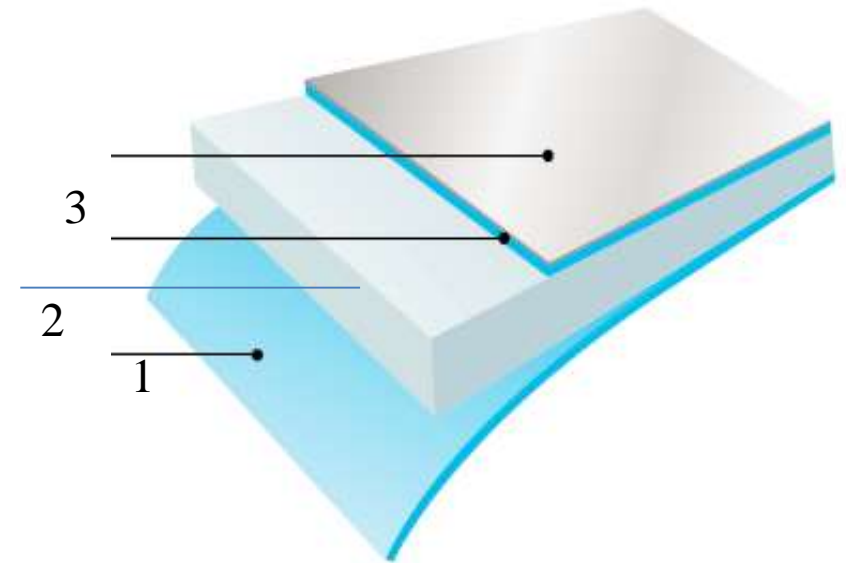


# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### BOPP PRE-TREATMENT

TEST FILMS CLASSIFICATION :



IDENTIFICATION	DESCRIPTION	CRITERIA
NT	No or minimum treatment on skin 3	$\sigma < 35$ dyne/cm
LT	Low corona treatment	$\sigma < 38$ dyne/cm
HT	Medium/high corona or flame treated	$\sigma > 40$ dyne/cm
NT+AM	Modifies skin for adhesion promotion , non treated	$\sigma < 35$ dyne/cm

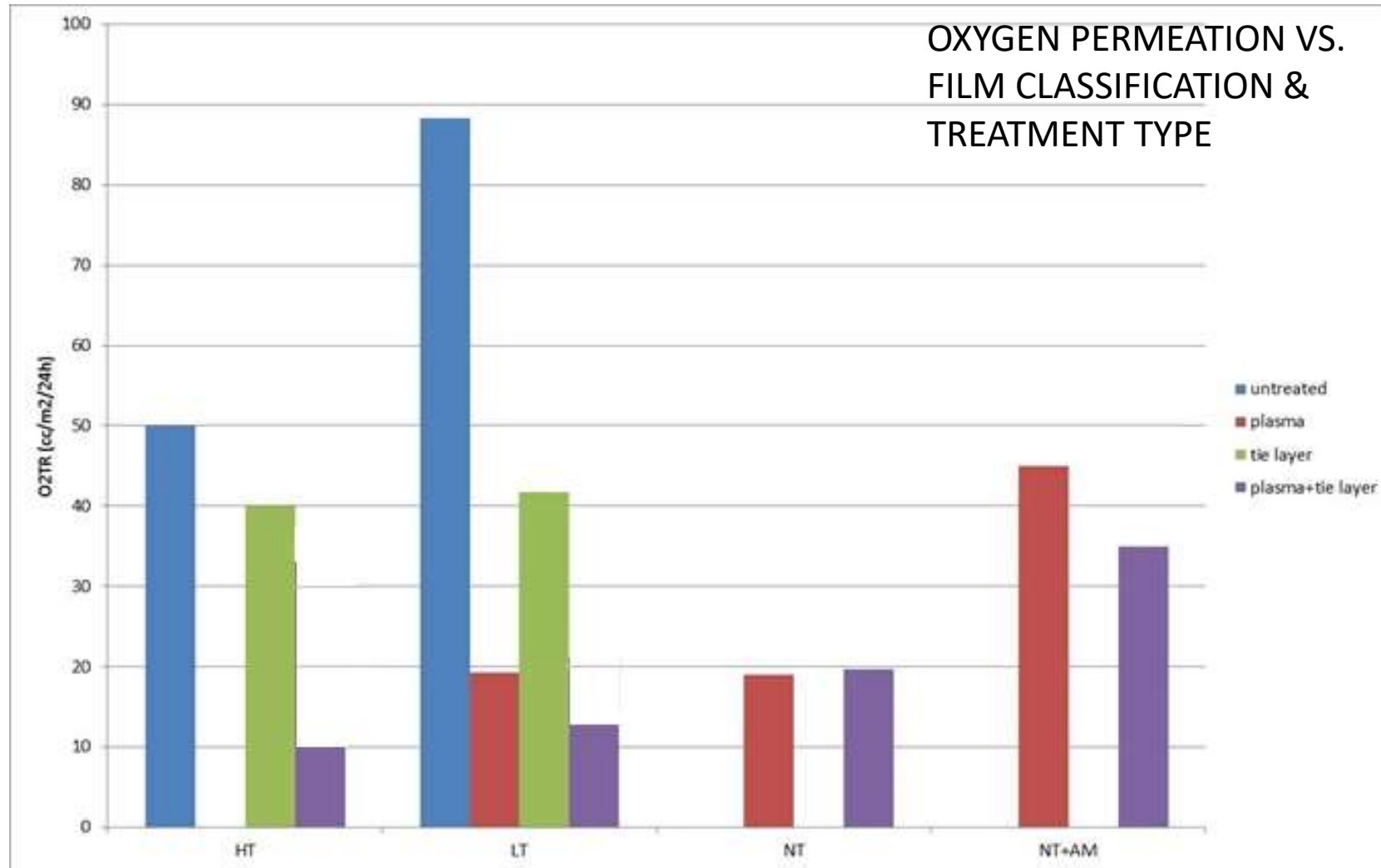




# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### BOPP PRE-TREATMENT

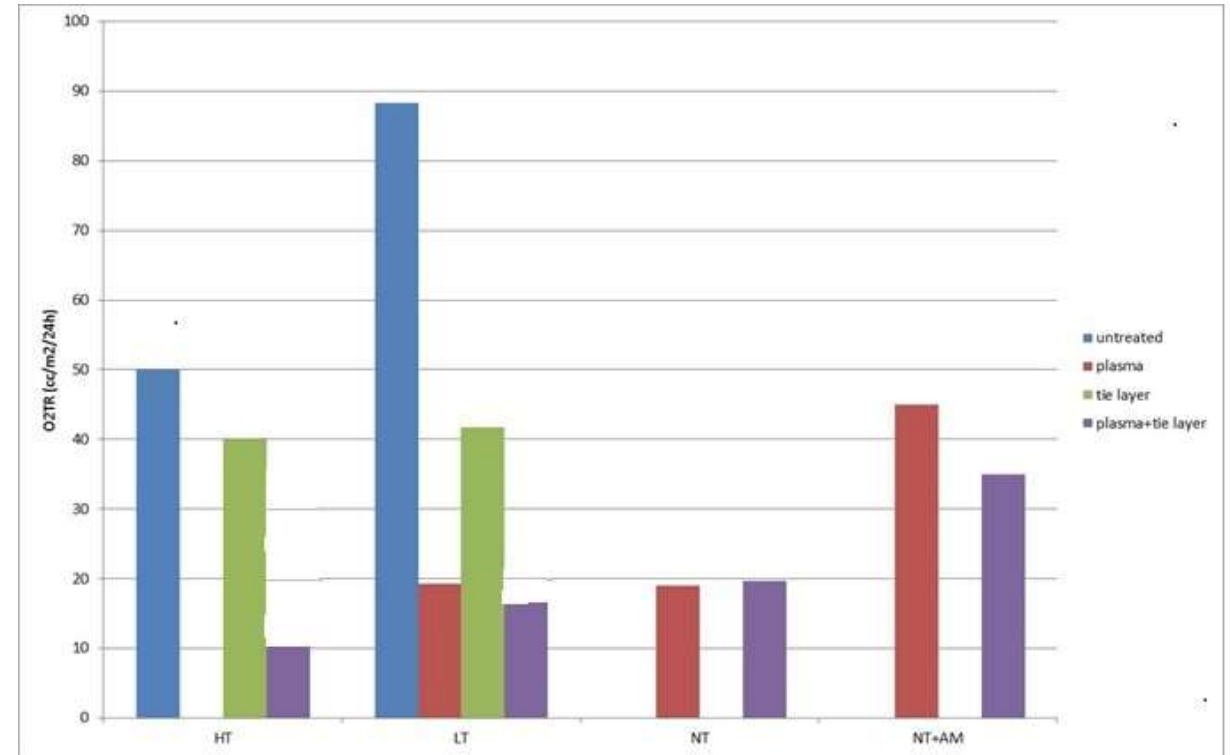


# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### Conclusions : BOPP PRE-TREATMENT

- ❖ PLASMA IS A POWERFULL TOOL FOR HIGH GAS BARRIER ESPECIALLY WHEN THE FILM TREATMENT LEVEL IS LOW (and consequently the adhesion is at low/medium level)
- ❖ THE COMBINATION OF PLASMA AND TIE LAYER ALLOWS FOR A BETTER ADHESION AND BARRIER TRADE-OFF
- ❖ FOR HIGH ADHESION MODIFIED SKINS THE TIE LAYER+PLASMA CAN INCREASE THE INTRINSICALLY «POOR» GAS BARRIER



IT IS POSSIBLE TO UPGRADE BOPP TO SUPERIOR OXYGEN BARRIER (<10 – 15cc/M2/day) BY TAILORING POLYMER SKIN DESIGN TO IN-VACUO PRE-TREATMENT



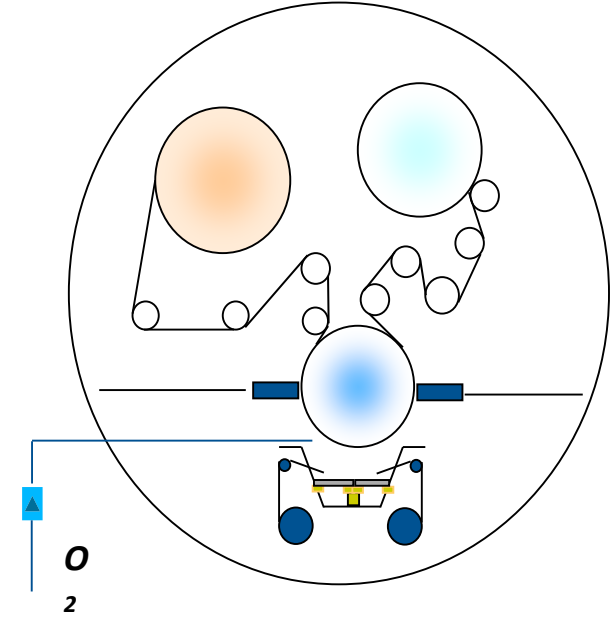
# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### ALOX - PET CLEAR BARRIER : ENDURING MECHANICAL STRESS

A widespread industry Concern:

«Oxide coatings are more brittle than metallic ones possibly leading to barrier loss during converting processes : Slitting, Printing, Laminating, Bag making»



THIS PROJECT AIMS TO MITIGATE OR SOLVE THE PROBLEM :

✓ Depositing a more «flexible» oxide

✓ Top Coating



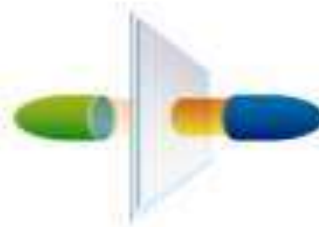
# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### ALOX - PET : A MORE «FLEXIBLE» ALOX BY PROCESS CONTROL

- ✓ A very thin – uniform AlO<sub>x</sub> film

10 nm : < 1gr/min Al per evaporator  
at 600 m/min



- ✓ A controlled sub stoichiometric oxidation (with subsequent atmospheric «curing» or plasma post treatment)

	T % (*)	OD
Uncoated	93-92	0.03-0.04
AlO <sub>x</sub> 10nm	89-91	0.05

(\*) 700 nm wavelenght

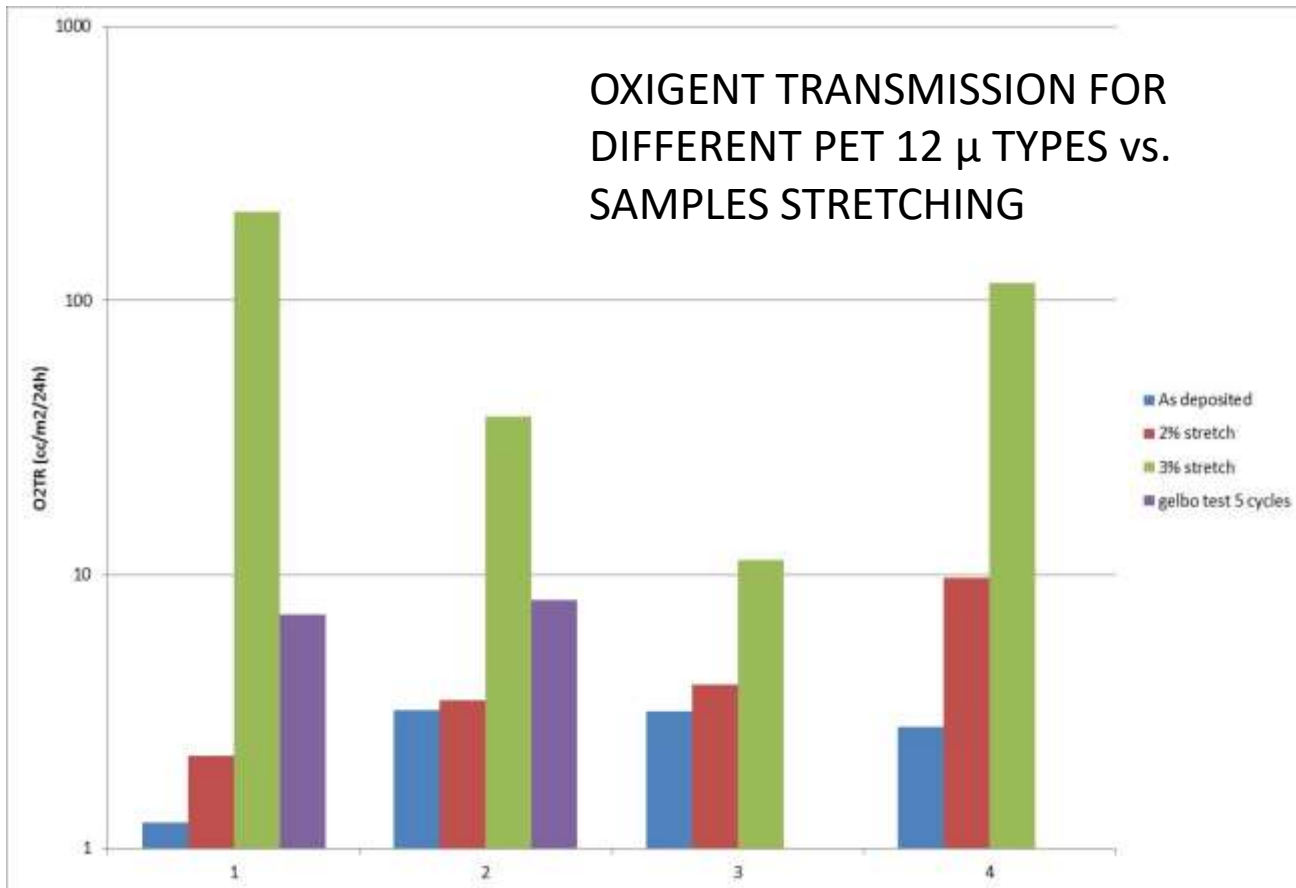
- ✓ Plasma pre-treatment may help depending on the pet original treatment (plain, corona or chemically treated)



# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### ALOX - PET : A MORE «FLEXIBLE» ALOX BY PROCESS CONTROL



- Till 2% stretching , limited barrier loss occurs on all film kinds
- «Gelbo» tests (5 cycles) on two samples seem to create a limited film damage
- 2% (equivalent to a tension of 1000 N per m width) look already a rather severe simulation of machine stress





# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### New High-Performance Protective Coating Technology

#### Protected AlOx-coated Film

High-performance  
Top-coating  
Technology

AlOx-layer

Substrate  
(e.g. PET, OPP)



- **AlOx-coated films**
  - Very good oxygen and moisture barrier
  - Very fragile
  - Converting leads to diminished barrier performance
- **Current top-coating technologies provide mechanical protection**
- **New top-coating technology**
  - Mechanical protection
  - Significant barrier improvement



# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### ALOX - PET : TOP COATING

#### GENERAL PRODUCT REQUIREMENT

- Compatible with Aluminium Oxide
- Good adhesion property
- Fully transparent
- Eco friendly and food compatible- water base
- Providing protection to avoid or compensate for the AlOx cracking
- Preferably contribute to reduce gas permeability to lower values than uncoated
- Low application weight to reduce cost



Trials description

Substrate : Pet 12  $\mu$  corona treated-EU

Metallized on : Nordmet 12 F

Top coated on : Combi 4000

Coating speed : 150 m/min

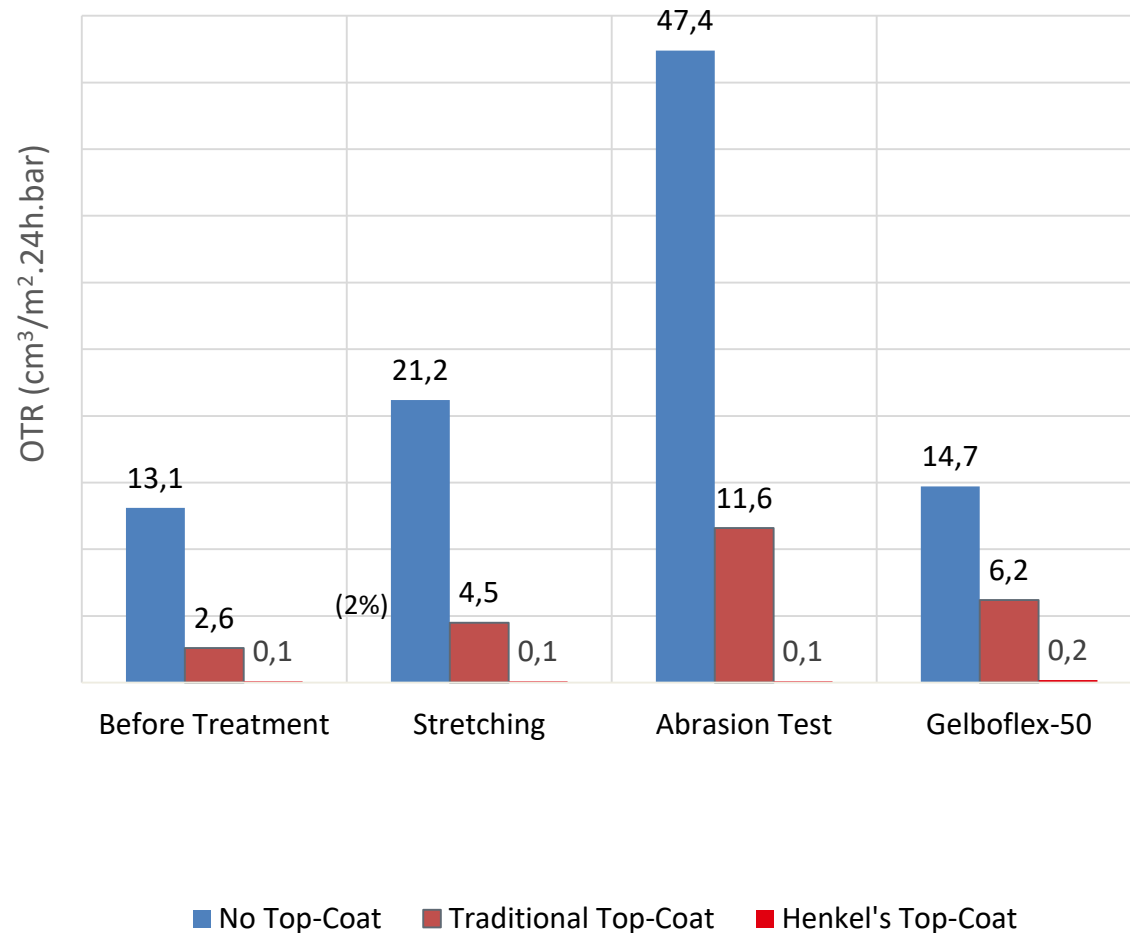
Application weight : 1 gr/m<sup>2</sup>



# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### *Testing Mechanical Protection*



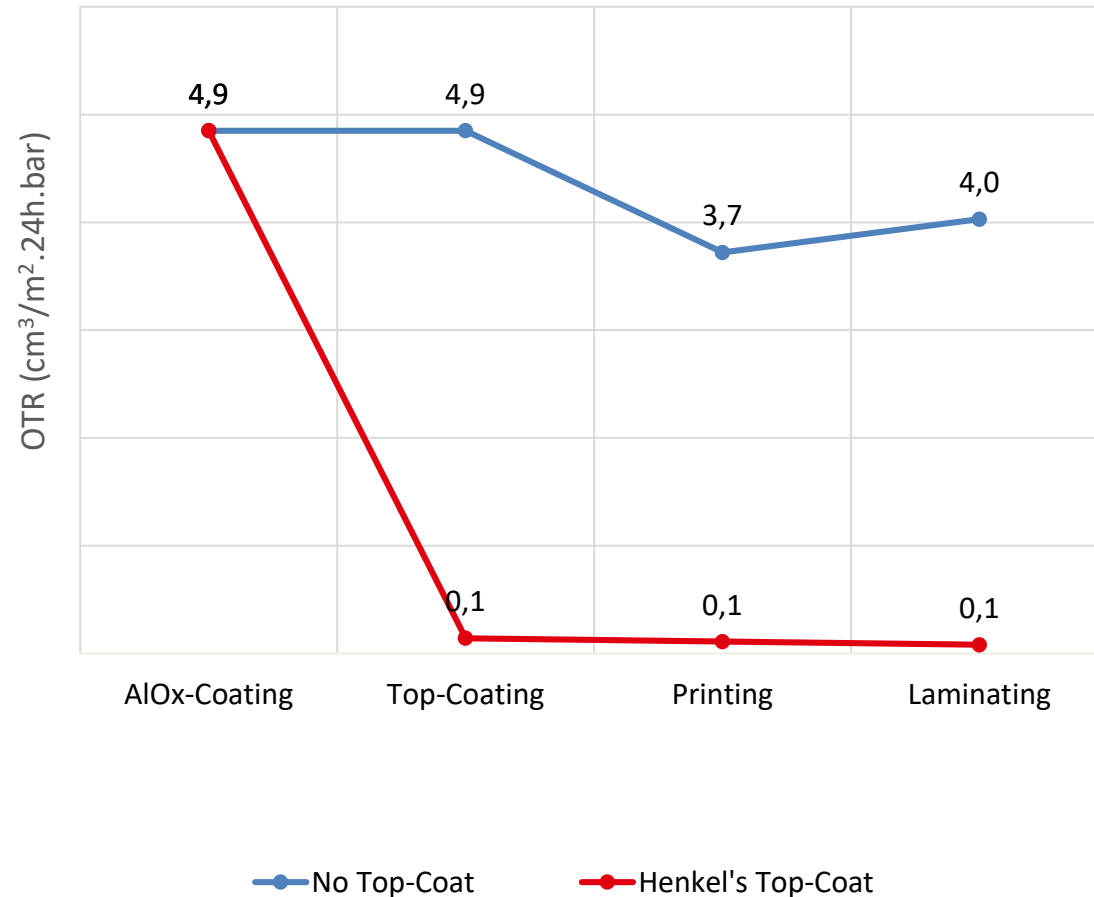
- **Strongly improved robustness**
  - Barrier performance not reduced by stretching or abrasion
  - Gelboflex testing
  - Significantly more robust than traditional top-coat



# ADDING VALUE TO METALLIZED FILMS

## *NEW SOLUTIONS & RESULTS*

### Production Scale Testing



- Strong barrier improvement by AlOx-coating
- Additional boost in barrier performance by Henkel's new top-coating technology
- Very good stability throughout entire process



# SUMMARY & CONCLUSIONS

- TO RESPOND THE INDUSTRY REQUIREMENT OF IMPROVING METALLIZED FILM BARRIER PROPERTIES, THIS PAPER PRESENTED TWO CASES :
  - MET - BOPP PRETREATMENT
  - ALOX – PET & TOPCOATING
- EXTENDED TRIALS DEMONSTRATED THAT SUPERIOR GAS BARRIER CAN BE ACHIEVED BY MATCHING BOPP NATURE AND SURFACE ENERGY WITH IN - VACUO PRE-TREATMENT
- REASONABLY STRESS RESISTANT ALOX - PET CLEAR BARRIER CAN BE PRODUCED WITH ADEQUATE PROCESS CONTROL. FOR A FULL PROTECTION, TOPCOATING IS A RELABLE SOLUTION: OUR PROJECT SCOUTED A NUMBER OF FORMULATIONS AND SORTED OUT A FEW OF THEM : WORK IS IN PROGRESS TO OPTIMIZE THE PRODUCT SELECTION.



THANK YOU FOR YOUR ATTENTION.

**janoschka**

