

2007 Lake States Tappi

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New Barrier Coating Offering From Dow Chemical

Breaking the Extrusion Barrier

Presented by:

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Application Technology Leader



Outline

- Background
 - Market Opportunity and drivers
 - GAPS
 - Testing techniques
 - Performance Requirements
- Technical approaches
- Dow Technology offering
 - Latex Based Formulated Coating
 - Polyolefin Dispersions
- Summary

Barrier Coating - Background

- *A coating that is applied on the package substrate (paper, papboard, plastics etc) to provide a lower permeability of Oxygen, aroma, moisture, grease, etc. , and therefore extend the shelf life of the package content.*
- **Technical Approaches**
 - » F.C. Treatment
 - » Wax Treatment
 - » Poly Coating/Extrusion
 - » Water based coating

Current Market Gap & Challenge

- F.C Free
- Wax Free
- Replupable
- Easy to convert
 - » No Blocking

- Many of the water based alternative coating rely on applying a physical barrier to block the movement of oils, water...etc.
 - » Possible get good barrier by applying film of binder rich coating
 - » A major challenge is to covert the coated substrate without blocking

Sustainability

- There is a drive for increased awareness around the subject of sustainability
 - Environmental Aspect –
 - Fluorinated organic compounds (FOCs),
 - » PFOS , PFOSA, PFOA
 - Recyclable
 - Less waste
 - Focus on renewable resources
- Major players in the market are pushing for this trend
 - Wal-Mart for example

Opportunity to develop barrier coating that are FC free, Wax free and Repulpable for the packaging industry

The Opportunity For Barrier Coating

- Develop functional (Barrier) coating solutions for the packaging industry for OGR, OTR, MVTR (Humidity), Water (Wickening), ODOR, CO2 applications
 - **F.C. Free**
 - » Free of telomer and florochemical chemistry
 - **Wax Free**
 - » Can be used in the mill waste recycling stream
 - **Cost competitive as compared with other available offering**

Natural Extension of our portfolio as a major supplier to the packaging industry

Testing & Requirement

- **OGR (Oil and Grease Resistance)**
 - » 3M-Flat Kit - Variable >12 (Pet food)
 - » 3M-Folded Kit - Variable > 9
 - » RP2 Test & Oleic Acid @ 140 deg F
 - » Staining techniques
- **MVTR (Mocon)**
 - » 18 – 32 gsm/24 hrs.
 - @ 90% RH and 100 deg F (tropical conditions)
- **Water Resistance**
 - » 30 Min Cob ? < 1 gsm for some applications
 - » 10 min Cob ?
- **Gluability**
- **Release**
- **Processing**
 - » No Blocking
 - » No smell and
 - » FDA compliance



Opportunity Fit / Technology Offering

- A natural extension of our product mix and portfolio
 - Product mix
 - Industry position as a key supplier to the paper industry
- Latex Emulsion Based Dispersion
- Polyolefin Dispersion

Latex Based Barrier Coating Concepts

Latex Emulsion Based Formulation Concepts

Proper surface energy modification

Special packages to improve replup

Novel formulations approaches to reduce blocking issues

Special modifications for different barrier performance

Performance Examples

Sample	Description	Coat Weight	Folded Kit	Flat Kit	Blocking
		lbs/3300 sq ft			Decibel Level
1	Control	4	4.4	7.4	61
		6	4.8	9.4	73.3
		10	6.2	11.2	70.6
2	OGR Latex Based	4	7.2	11.2	84.8
		6	11	12	88.2
		10	12	12	87.6

OGR Staining Performance

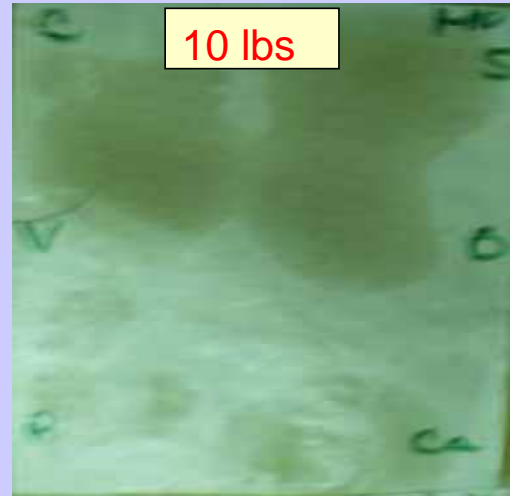
4 lbs



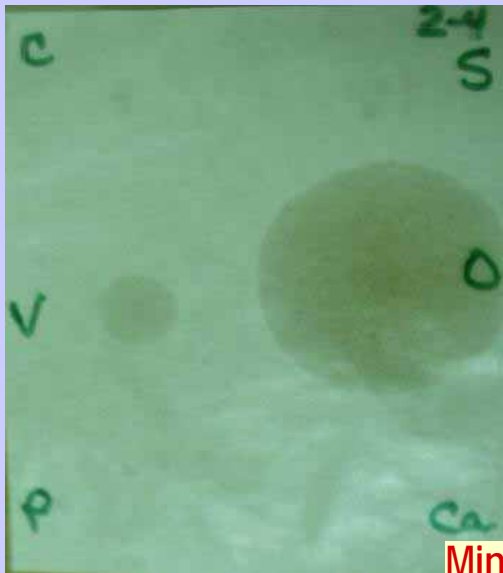
6 lbs



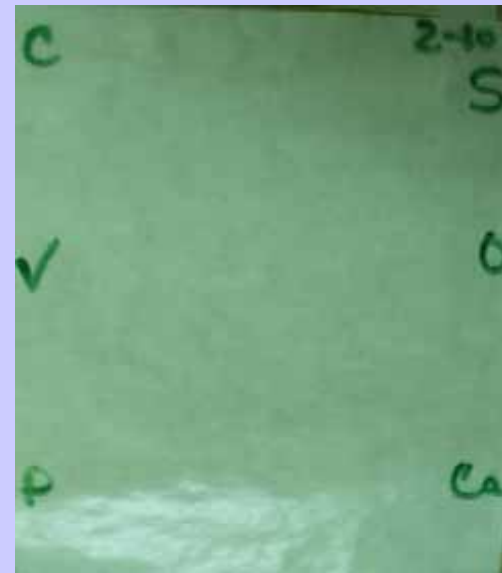
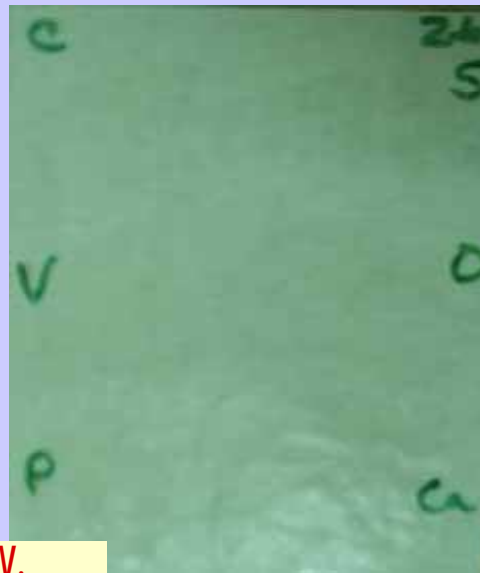
10 lbs



Neg. Ctl



Min C.W.



OGR Coating

Summary

- Good stain resistance OGR
 - » 3M Kit
 - » Dow Staining technique
- Can improve the stain resistance with
 - » higher coat weight
 - » Double coating vs single coating
 - » Choice of binder and additive package
- Good blocking resistance
 - » Dow Gravure blocking Test Method
 - » Dow field experience
- This is and F. C Free alternative water based Coating
- Another offering using a parallel technology exist for MVTR

Polyolefin Dispersions - Barrier Coating Concepts

What comes to mind when you think of polyolefins ?



Plastic Pellets



Films



Molded Articles & Containers

Traditional Polyolefin Converting Processes

conventional thermoplastic forming processes



Blown / Cast Film



Molding – Injection, Compression, Blow



Extrusion Coating / Lamination

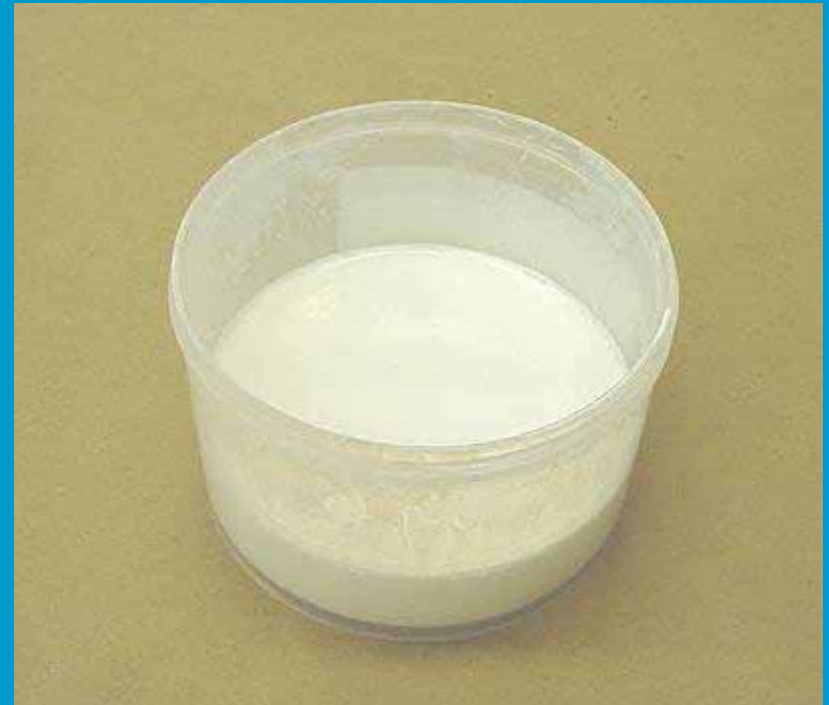
high viscosity
polymers



Foam Extrusion

Waterborne Polyolefin Dispersions (PODs)

High Solids Liquid Plastic



Converting Options for PODs



Printing/Coating Processes (Rotogravure)



Dipping



Frothed Foams



Spray Application

Paper Coating

Can also apply on a blade/Rod coated

Recent pilot coater trials

1000 ft/min

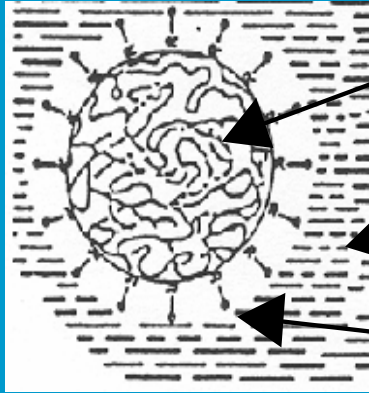
Applicator Roll/Rod metering

excellent runnability

Waterborne Application Vs Extrusion for Coating of Polyolefins

- Thinner coatings
- Use existing waterborne application equipment
- Higher line speeds
- Penetrate porous / fibrous webs
- Coat at low temperature
- Coat complex geometry
- Coat in pattern

POD Characteristics

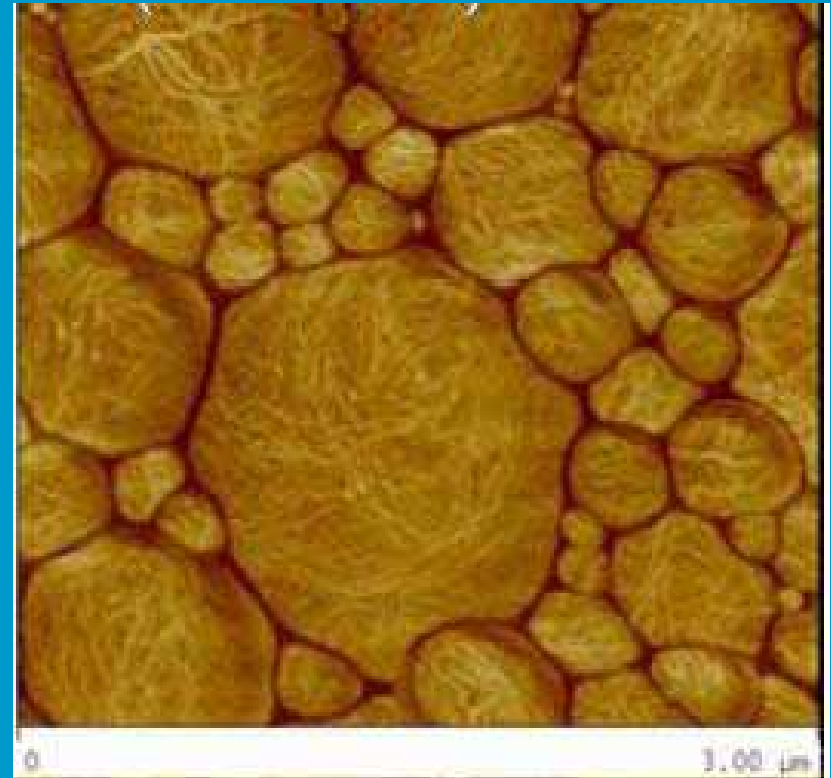


Polyolefin

Water

Stabilizing Agent

- Avg. Particle Size ~ 1 μ
- Solids Content (by wt) 40 to 55% solids
- Typical pH ~ 9.5
- Viscosity (Brookfield @ 25°C) < 500 cps



Example POD Products

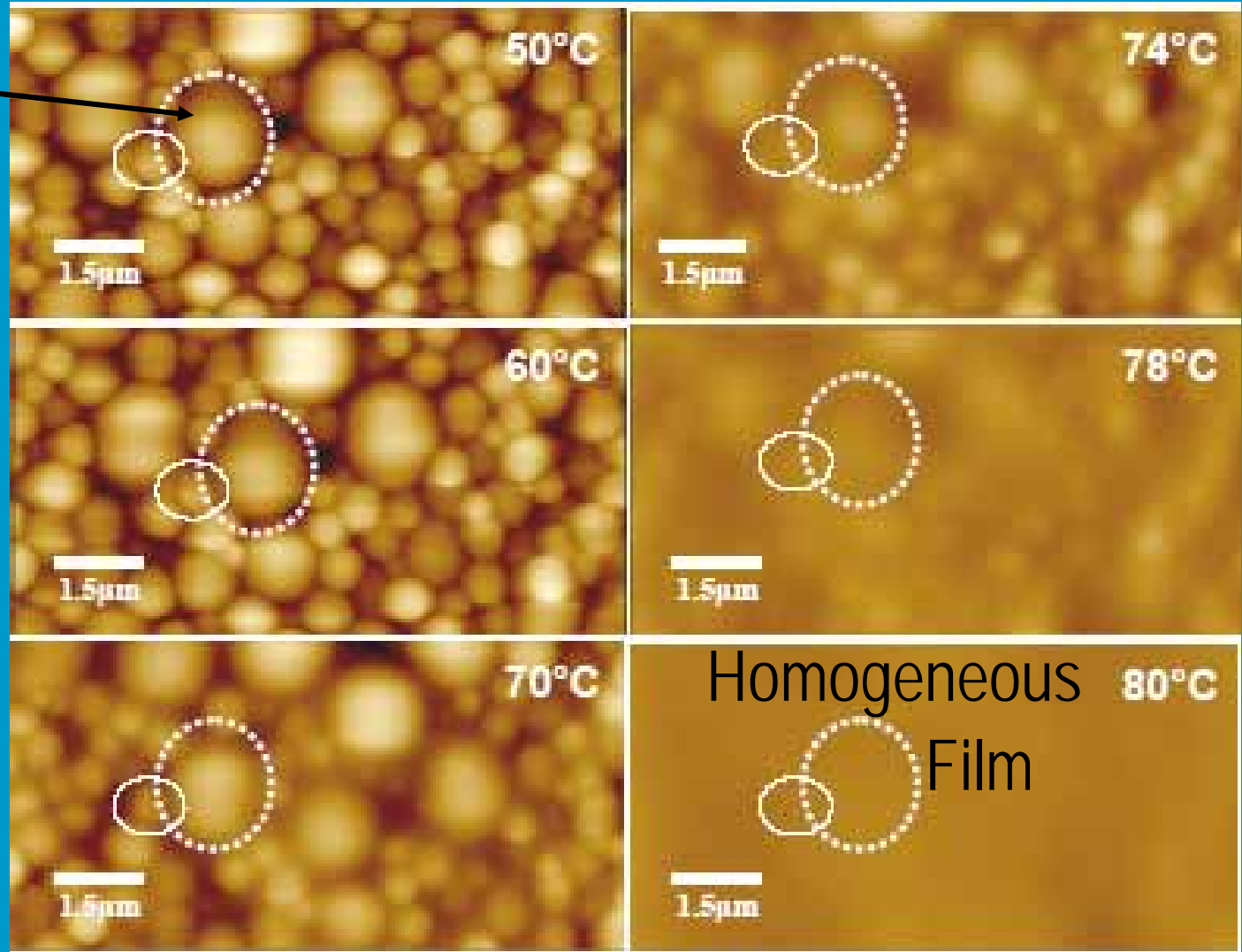
Dispersion	Polyolefin Type	Carboxyl Functionality	Polymer Melting Point (°C)	Polymer Tg (°C)
A	Ethylene	Yes	60	-55
B	Ethylene	Yes	116	-55
C	Propylene	Yes	85	-25
D	Ethylene	No	60	-55
E	Propylene	No	85	-25

PO Dispersions are not possible via emulsion polymerization!

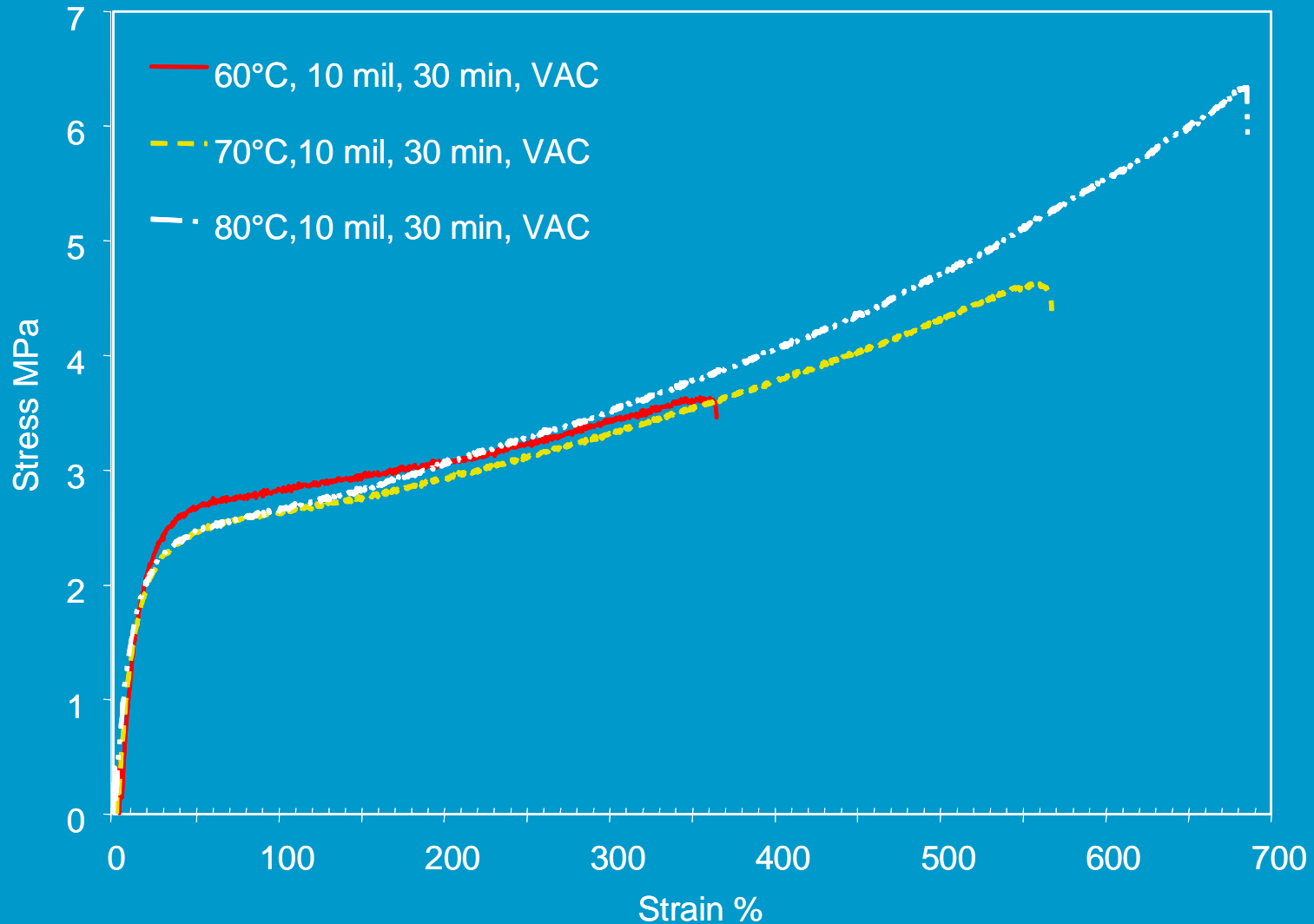
Flexibility to change the crystalline nature and Functionalization

Film Formation – Hot Stage Microscopy

Polyolefin
Particles

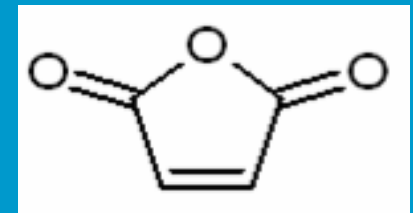
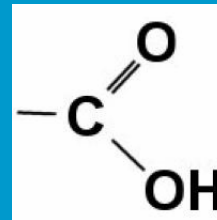
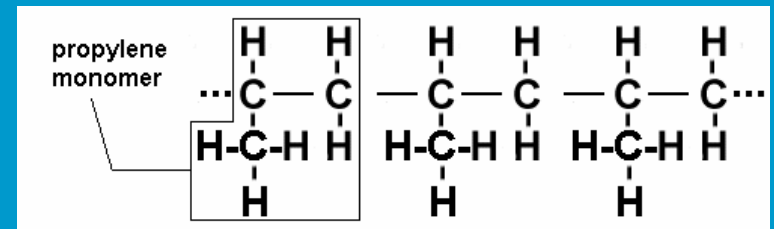
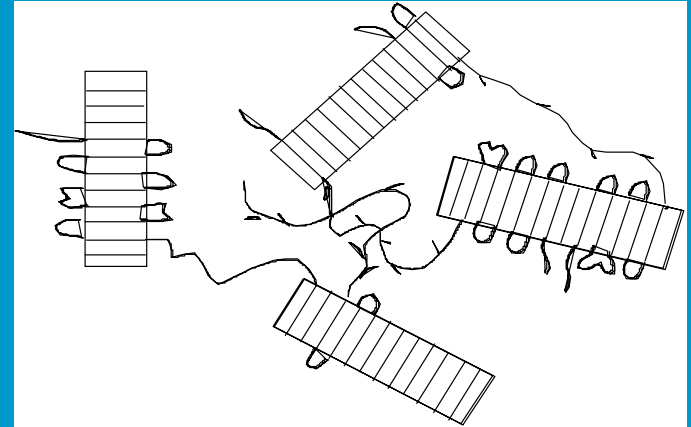


Mechanical Properties of 250 μ Films Cast from Dispersion D



Properties of PODs

- Water resistance
- Oil & grease resistance
- Heat sealability
- Elasticity /flexibility
- Adhesion to polyolefins
- Adhesion to polar substrates



Fit in Packaging (Paper, Board, and Film)

- Extruded Polyolefins have been widely used to modify paper

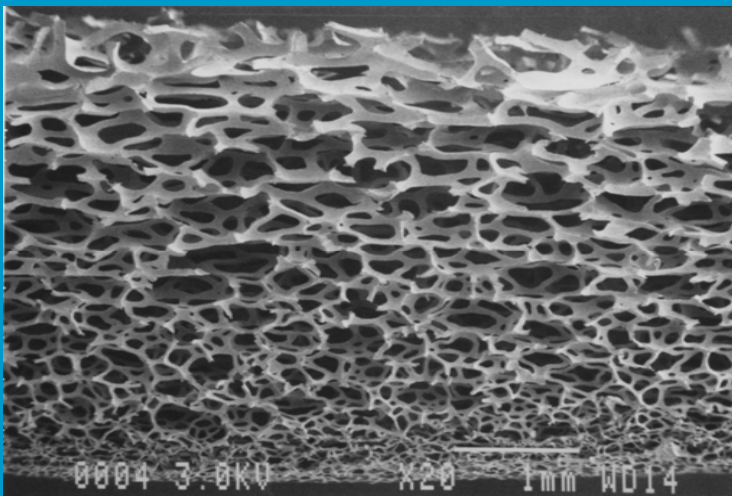
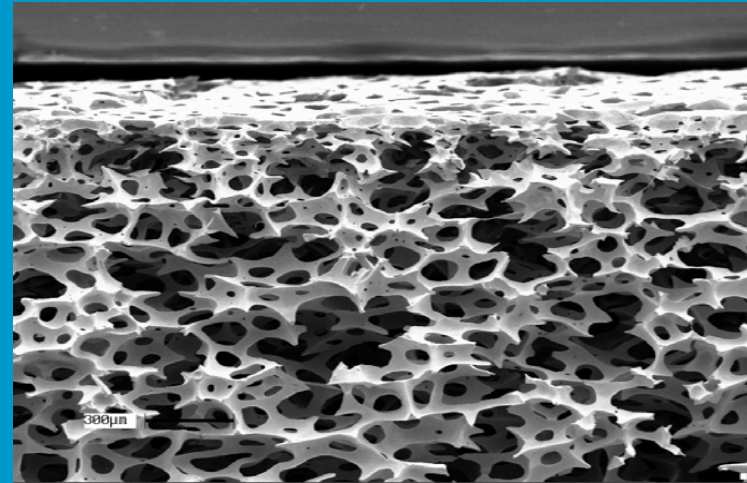
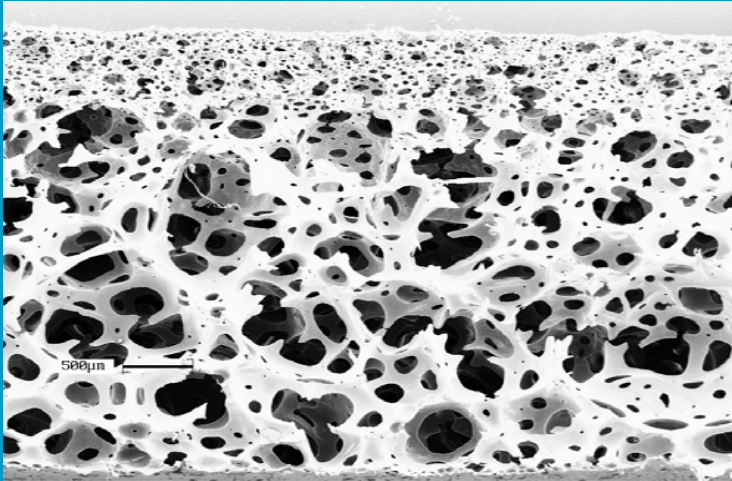
Limitations exist for extruded Polyolefins

- » Thickness (> 10 microns)
- » Adhesion to paper

- Coatings on Paper and Board
 - » Moisture resistance/barrier
 - » Oil and grease barrier
 - » Heat sealability
- Adhesion promoter
 - » Paper to paper
 - » Paper to plastic
 - » Plastic to plastic (PP to PET)
- Flexibility – crack and fold
- Anti-skid coatings
- Wet end addition



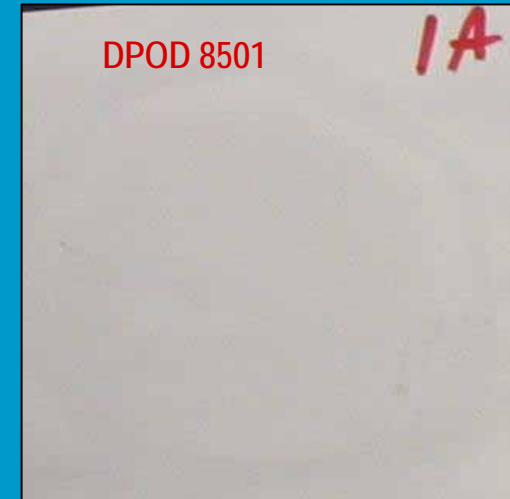
Frothed Polyolefin Foam Coatings



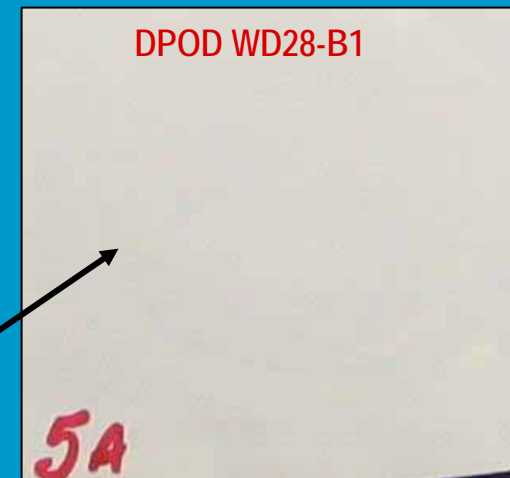
- Foam directly onto various substrates
- Open cell structure
 - » Moisture adsorption & wicking
- High elasticity & soft, luxuriant feel
- Biocompatibility
- High filler acceptance
- Embossable

PODS: Barrier Performance Example

	DPOD 8501	EXP (WD28-B1)
OGR		
3M Kit, Fold	12	12
3M Kit, Flat	12	12
Stain Resistance	Pass	Pass
Corn Oil DeltaY	0.96	1.02
Oleic DeltaY	25.5	27.3
Blocking		
Rating	5	4
Fiber Tear, %	10	0
Humidity		
MVTR, g/m**2, Jungle Cond.	427	56
Direct Water Resistance		
Cobb, g/sq m, 10 min	12	0.2



24 hr stain, Corn Oil, 140F



Observation on back side, oil applied on barrier side

Summary

- Attributes of polyolefins are available in a water-borne dispersion
- PODs provide unique properties
 - » Adhesion to polyolefins
 - » Heat sealability
 - » Barrier properties
- PODs create opportunities for innovations which improve existing and build novel structures
 - » Paper
 - » Films
 - » Foams
 - » Textiles
 - » Many Others

Overall Summary

- There is a market need for new alternative barrier coating
 - » Sustainability, FC and Wax replacement – Replupable
- There is an alternative offering
 - » Formulated latex based coating
 - » Polyolefin Dispersions
 - » Good OGR + MAVTr performance
- Initial results from the filed are positive
 - » further development continues

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Thank You

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