Navigating Adhesive Formulation Challenges with Waterborne Acrylic Polymers

Robert Sandoval, Ph.D.
R&D Technical Director

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Agenda

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Adhesives Overview - Chemistries, types, and market landscape


Vinyl Flooring Adhesives – Challenges and Technical Solutions


Permanent and Removable – Challenges and Technical Solutions

Low Surface Energy Substrates – Challenges and Technical Solutions


Tapes and Labels - Challenges and Technical Solutions


Sealants - Challenges and Technical Solutions


EPS Portfolio

Engineered Polymer Solutions

One of **the largest water-based acrylic polymer manufacturers** in North America

Access to **broad range of polymers and product performance** attributes

Proven ability to swiftly **customize and engineer** polymers for customer & market driven opportunities

Adhesives market segment is **Strategic** to EPS

Latex Manufacturing Location

Colorants Manufacturing Location

Enhanced technological expertise

Exceptional formulation support

Application testing: Real-time exposure data accelerates downstream development

Responsive to emerging market needs

World-class acrylic emulsion manufacture

Commitment to quality and technical service

Global Manufacturing Grid

Eight strategically located plants in the US and one in The Netherlands

- Los Angeles, CA
- Woodburn, OR
- Garland, TX
- Rockford, IL
- South Holland, IL
- Marengo, IL
- Chester, SC
- Hagerstown, MD
- Ambacht, NL

Pressure Sensitive Adhesive Chemistries

PSA Definition
A material that holds two surfaces together solely by surface contact, which is achieved by slight external pressure.

Pressure Sensitive Adhesive	Advantages	Disadvantages
Rubber/Resin	• High tack/High peel • Ability to bond to variety of substrates including non-polar low-surface energy substrates • Economical	• Poor UV resistance • Poor heat resistance • Poor solvent resistance • Poor plasticizer resistance
Acrylic	• Excellent temperature resistance • Excellent UV resistance • Good clarity • Good color stability • Bonds well to polar substrates	• Poor adhesion to low surface energy substrates
Silicone	• Adhesion to silicone and other hard to adhere substrates • Excellent temperature resistance	• Overall low adhesive strength • Expensive

Acrylic PSA Types

Solvent based	Water-based	Hot Melt
Advantages		
Quick drying	Easy cleaning	Very fast setting
Good adhesion to non-polar substrates	Good adhesion to polar substrates	No solvent waste
Good bond to plastics	High solids	100% active
Disadvantages		
Flammability	Slower drying	High equipment costs
VOC	Requires heat to dry	Requires heat
Low solids content	Poor adhesion to non-polar substrates	Thermal degradation possible
Less easy to clean		Difficult to clean
		Temperatures can affect substrate

Adhesives Market Overview

Demand Drivers

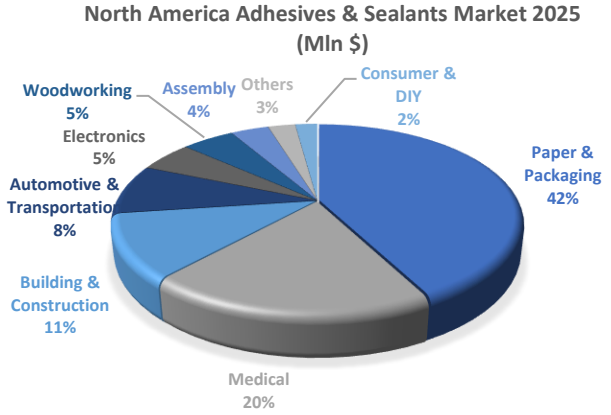
- Bonding the New Method of Choice - switching away from traditional fasteners
- Lightweight / Downgauging
- Multi-substrate adhesion
- Flexible product design & aesthetic improvements

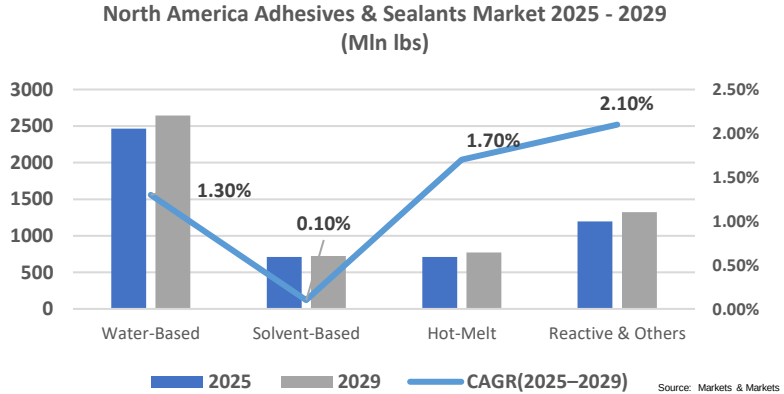
High Growth Market Segments

- E-commerce - Packaging
- Modular Construction
- Automotive - EVs
- Electronics and Consumer Goods

Key Opportunities

- Packaging / Sealing / Harnessing Tapes
- PSA Labels
- Masking / Barrier / Protective Films





Source: Markets & Markets

Vinyl Flooring Adhesives Challenges

Plasticizer
Migration

Adhesive Failure
Due to Substrate Conditions – Moisture, Dust, Uneven Surfaces

Temperature
Sensitivity

Workability

Compatibility with Vinyl and Additives

Vinyl Flooring Adhesives Technical Solutions

EPS® 2133 delivers exceptional resistance to plasticizer migration and water exposure, making it the ideal adhesive solution for vinyl and rubber flooring.

It ensures long-lasting durability, even in moisture-prone environments, helping maintain bond integrity and reduce maintenance over time

Property	EPS® 2133
Solids %	57
pH	7.0 - 8.0
Density lbs/gal	8.7
Tg °C	-34

Sample	180° Peel 30 min dwell @ RT	180° Peel 24hr dwell @ 50C	Probe Tack	Static Shear 1"x1"x1Kg
EPS® 2133	43.1 oz/in	71.1 oz/in	485 g/cm	> 10,000 minutes
Facestock - 2mil PET		Substrate - PSTC Polished Stainless Steel		Coating Weight - ~16-17 lbs/ream

This polymer is not FDA-approved.

Vinyl Flooring Adhesives
Plasticizer Resistance

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LAP SHEAR - WET LAY-IN

Sample	Vinyl Flooring (LVT)	
	7 days @ RT dwell	7 days @ 60°C
Competitive Polymer	36.5 psi	29 psi
EPS® 2133	27.3 psi	31.3 psi

Substrate - Plywood
Pull Rate - 0.5 inches/minute
1/16" spreader

Lap Shear Dry Lay-in

Sample	Vinyl Flooring (LVT)	
	7 days @ RT	7 days @ 60°C
Competitive Polymer	45.6 psi	68.9 psi
EPS 2133	27.7 psi	40.6 psi

Substrate - plywood
Pull Rate 0.50 inches/min
Dry Time - 6 hours @ RT

Maintains adhesion at high temperature dwell

Vinyl Flooring Adhesives
Water Resistance

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Before

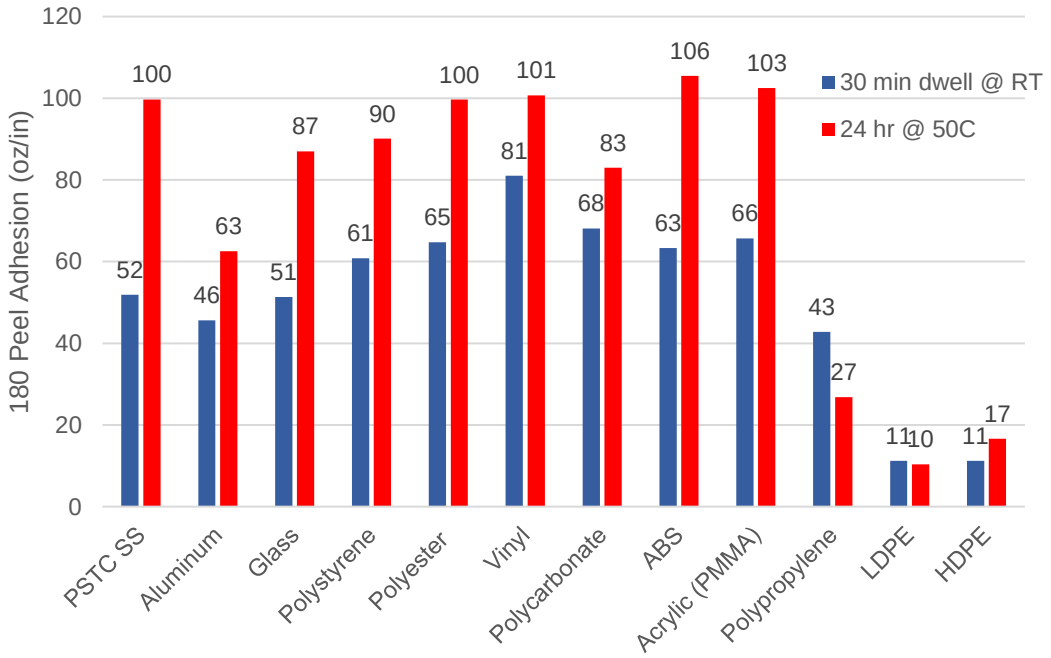
EPS® 2133 | Competitive Polymer

2-Week DI Water Immersion

EPS® 2133 | Competitive Polymer

Vinyl Flooring Adhesives Technical Solutions

Substrate	Failure Mode
PSTC SS	Adhesive
Aluminum	Adhesive
Glass	Adhesive
Polystyrene	Cohesive
Polyester	Cohesive
Vinyl	Cohesive
Polycarbonate	Cohesive
ABS	Cohesive
Acrylic (PMMA)	Cohesive
Polypropylene	Slipstick
LDPE	Adhesive
HDPE	Adhesive



Pressure Sensitive Adhesives

Permanent
Adhesives that cannot be removed once applied without causing damage to the substrate.

Peelable/Removable
Adhesive can be removed without damage to the substrate. Can still be difficult to remove because of strong adhesion.

Ultra-Peelable
Easy to remove and do not leave any residue. Typically used on glass and other substrates where residue is undesirable.

Tapes and Labels Challenges

Tapes and Labels Technical Solutions

EPS® 2127D is a high-solids acrylic copolymer emulsion designed for **pressure-sensitive adhesive tape and label applications.**

It delivers an exceptional balance of adhesive properties, making it suitable for use in both tackified and non-tackified formulations.

Property	EPS® 2127D
Solids %	60
pH	8.0 - 9.0
Density lbs/gal	8.45
Tg °C	-34

Sample	180° Peel 30 min dwell @ RT	180° Peel 24hr dwell @ 50C	Probe Tack	Static Shear 1"x1"x1Kg
EPS® 2127D	42 oz/in	50-75 oz/in	430 g/cm	> 2,500 minutes
Facestock - 2mil PET		Substrate - PSTC Polished Stainless Steel		Coating Weight - ~16-17 lbs/ream

Tapes and Labels Technical Solutions

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Sample	180° Peel 30 min dwell @ RT	180° Peel 24hr dwell @ 50C	Probe Tack	Static Shear 1"x1"x1Kg
Competitive Polymer A	37.7 oz/in	79.3 oz/in	350 g/cm	3700 minutes
Competitive Polymer B	52.6 oz/in	84.2 oz/in	570 g/cm	2800 minutes
EPS 2127D	71.3 oz/in	83.3 oz/in	372 g/cm	2000 minutes
EPS 2133	43.1 oz/in	71.1 oz/in	485 g/cm	> 10,000 minutes

Facestock - 2mil PET
Substrate - PSTC Polished Stainless Steel
Coating Weight - ~16-17 lbs/ream

Tapes and Labels
Technical Solutions

X-Linker Level	180 ° Peel Adhesion - 30 min @ RT Dwell			
	Competitive Polymer A	Competitive Polymer B	2133	2127D
0%	24.5 oz/in	30.1 oz/in	27.4 oz/in	29.0 oz/in
0.10%	15.9 oz/in	22.1 oz/in	24.1 oz/in	22.1 oz/in
0.25%	14.8 oz/in	19.7 oz/in	22.1 oz/in	18.8 oz/in
0.50%	13.6 oz/in	17.7 oz/in	17.2 oz/in	15.3 oz/in

X-Linker Level	24hr dwell @ RT			
	Competitive Polymer A	Competitive Polymer B	2133	2127D
0%	26.3 oz/in	51.7 oz/in C	32.6 oz/in	49.4 oz/in
0.10%	18.4 oz/in	22.1 oz/in	28.8 oz/in	27.6 oz/in
0.25%	14.8 oz/in	20.3 oz/in	23.8 oz/in	25.1 oz/in
0.50%	11.9 oz/in	16.9 oz/in	19.3 oz/in	17.3 oz/in

Facestock - 2 mil LDPE
Substrate - PSTC Stainless Steel
Coating Weight - 6.5-7 lbs/ream

Tapes and Labels
Technical Solutions

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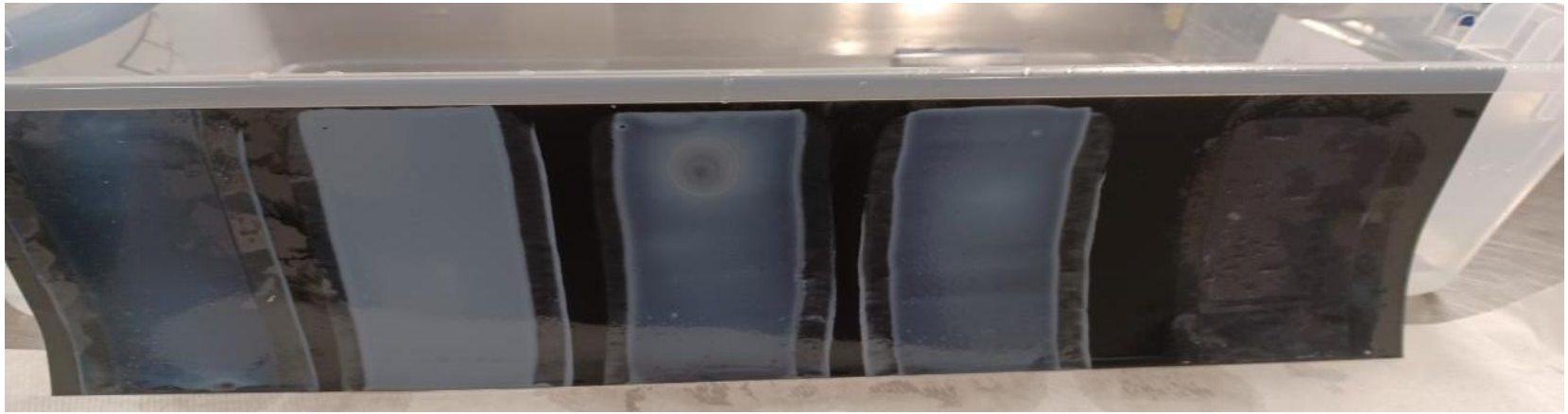
24 hr. water immersion



Competitive Polymers

EPS® 2127D

Removable Adhesives Challenges

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Adhesion to **Low Surface Energy** (LSE) Substrates

Balancing **Tack, Peel, and Shear**

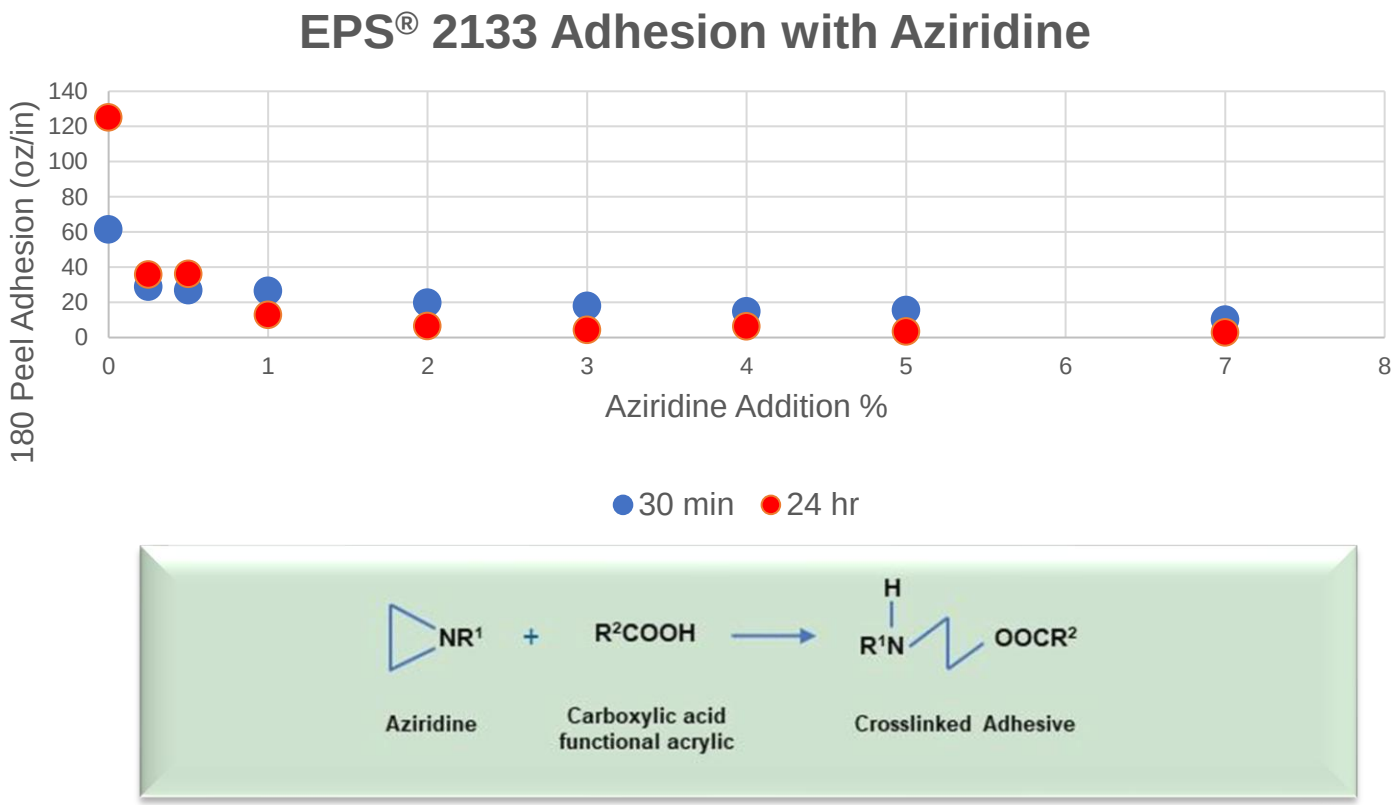
Durability and Aging: thermal cycling, humidity and chemical exposure

Optical Clarity and Aesthetics

Adhesive Residue – Over Anchoring

Adhesion to **Contaminated or Textured Surfaces**

Removable Adhesives Technical Solutions



Removable Adhesives Technical Solutions

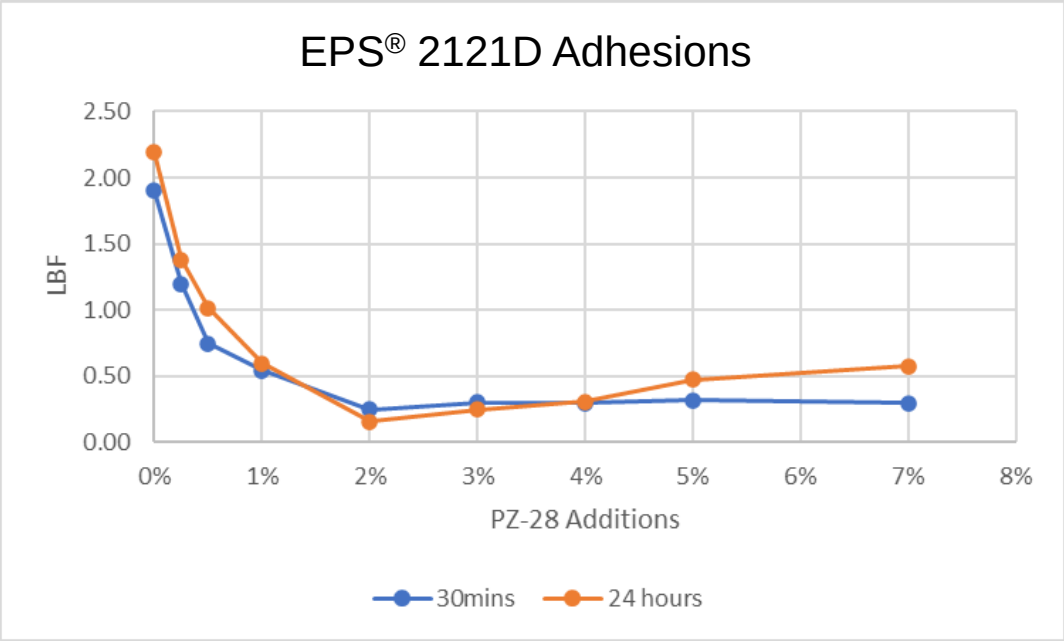
EPS® 2121D is a general-purpose all-acrylic emulsion for removable applications.

Exhibits low peel, moderate tack, and high shear values.

Property	EPS® 2121D
Solids %	50
pH	7.0 - 8.0
Density lbs/gal	8.5
Tg °C	-32

Sample	180 Peel (PSTC-101)	Loop Tack (PSTC-16)	Static Shear (1” x 1” x 1 kg)
EPS 2121D	22.4 oz/in	36.8 oz/in	> 10,000 min

Removable Adhesives Technical Solutions

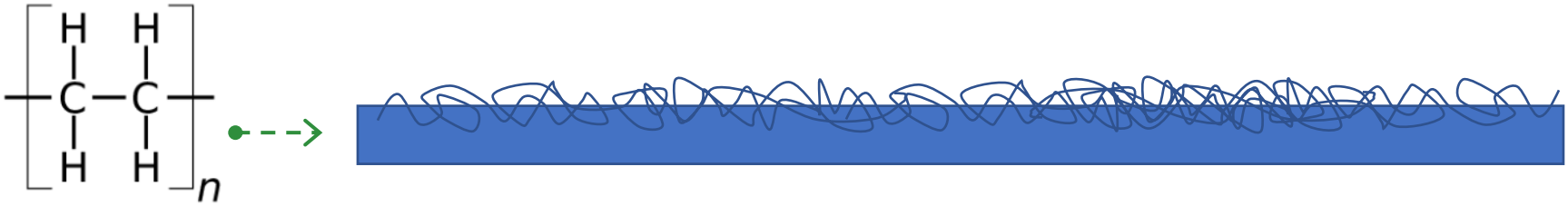


- Removable adhesive resin with inherently lower starting peels
- No adhesive residue upon weathering

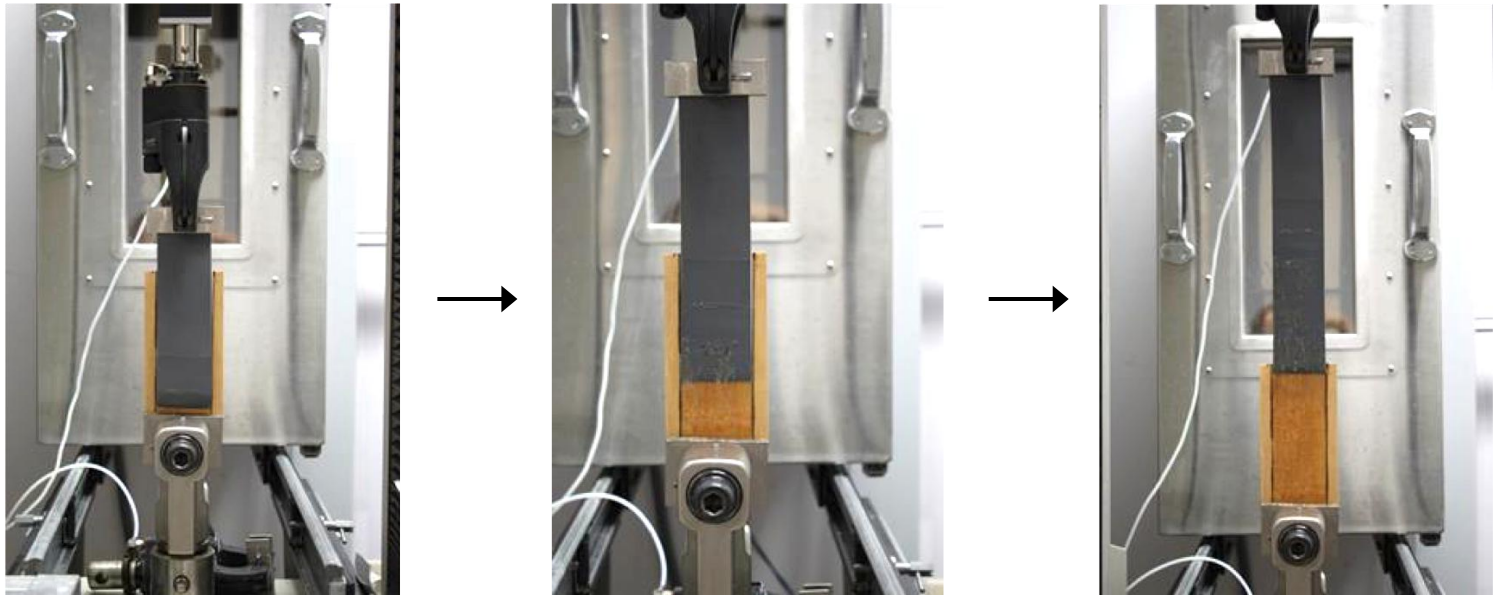
Low Surface Energy Challenges

Low Surface Energy Challenges

- Unlike metal substrates, TPOs have no functionality that can be used to improve adhesion (i.e., acids, amines, hydroxyls, etc.)
- TPO membranes have other ingredients such as TiO_2, flame retardants, UV absorbers/stabilizers, processing aids



Low Surface Energy Technical Solutions



Low Surface Energy Technical Solutions

EPS® 2252 is a high-solids acrylic emulsion designed to provide excellent adhesion to TPO and EPDM.

EPS® 2252 provides the capability to formulate coatings at <50 g/L VOC.

Property	EPS® 2252
Solids %	60
pH	8.0 - 9.0
Density lbs/gal	8.55
Tg °C	-32

Low Surface Energy Technical Solutions

Competitive Benchmark - 180° Peel Adhesion				
Sample	**24hr dwell @ RT**	**Mode of failure**	**7-day dwell @ RT**	**Mode of failure**
WB Commercial Sample 1	4.1 pli	Adhesive	3.8 pli	Adhesive
WB Commercial Sample 2	6.9 pli	Adhesive	4.5 pli	Adhesive
WB Commercial Sample 3	5.3 pli	Cohesive	9.3 pli	Cohesive
EPS 2252	**9.5 pli**	**Cohesive**	**15.5 pli**	**Cohesive**
Solvent-based Commercial Sample 1	2.2 pli	Cohesive	8.5 pli	Cohesive
Solvent-based Commercial Sample 2	2.5 pli	Cohesive	8.1 pli	Cohesive
Solvent-based Commercial Sample 3	1.9 pli	Cohesive	10.3 pli	Cohesive

Testing Conditions - 180° Peel Adhesion-Crosshead Speed 2 inches/minute
Spread Rate - 9 lbs/100ft^2
45 mil new TPO
Substrate - Plywood

Adhesion of TPO to plywood

Sealants Challenges

Limited **Elasticity** and **Movement** Capability

Water Resistance

UV and Weathering Limitations

Shrinkage During Cure

Adhesion Limitations on **Non-Porous or LSE surfaces**

Sealants - Technical Solutions

ASTM Test	Condition	Standard	EPS® 2133 Result
C661 Shore Hardness	7 days @ 72°F/50% RH, 7 days @ 100°F, 7 days @ 72°F/50% RH	15 Shore A minimum	28 Shore A
C732-Aging Effects of Artificial Weathering	7 days @ 72°F/50% RH, 500 hours QUV-A	Wash Out - none Slump – none Cracking – none Discoloration - as acceptable Adhesion Loss - 25% max	Pass
C734 - Low-Temperature Flexibility after Weathering	2 days @ 72°F/50% RH, 500 hours QUV-A, 90° Bend over 1" mandrel at 0°C	No cracking through to substrate or adhesion loss	Pass
C736 Extension and Recovery	7 days @ 73°F/50% RH, 7 days @ 50°C	Recovery - 75% min Adhesionh Loss - 25% max	0% Adhesion Loss/100% Recovery
C793-Effects of Accelerated weathering	21 days @ 72°F/50% RH, 250 hours QUV-A, 180° Bend over a 0.5" mandrel @ -26°C	No cracking through to substrate	Pass
C794 -Adhesion in Peel	7 days @ 72°F/50% RH, 7 days @ 100°F, 7 days @ 72°F/50% RH followed by 7-day DI Water Immersion	5 lbs/inch minimum	Mortar - 11.9 pli Aluminum - 10.5 pli, Glass - 12.1 pli
C1183 Extrusion	5 Freeze Thaw Cycles (16hrs@0°F/8hrs@73°F), 7days@50°C	2 g/s minimum	13.3 grams/sec
D2202 Slump	30 minutes @ 50°C	no greater than 0.15 inches	0.10 inches

P:B - 1.5

EPS Adhesives Portfolio

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Product	Chemistry	Application						Performance			Properties		
		Permanent PSAs	Removable PSAs	Tape and Labels	Protective Masking	Vinyl Flooring Adhesive	Caulks and Sealants	Peel	Shear	Tack	Solids (%)	pH	Tg (°C)
EPS® 2121D	All-Acrylic		•	•	•			Low	High	Moderate	50	7.0-8.0	-32
EPS® 2123D	Styrenated Acrylic		•	•	•			Low	High	Moderate	52	7.0-9.0	-34
EPS® 2127D	All-Acrylic	•		•	•		•	High	Moderate	High	60	8.0-9.0	-45
EPS® 2133	All-Acrylic	•	•	•	•	•	•	Moderate	High	High	57	7.0-8.0	-34
EPS® 2156D	All-Acrylic		•	•	•			Low	High	Moderate	55	7.0-9.0	-41
EPS® 2157D	All-Acrylic		•	•	•			Moderate	High	Moderate	52	6.0-8.0	-40
EPS® 2252*	All-Acrylic	•						High	Low	High	60	8.0-9.0	-32

D = Low foaming

*Adhesion to low energy substrates

Summary

- The landscape of waterborne acrylic polymers for adhesives and sealants is rapidly evolving.
- Application-specific challenges across markets demand tailored solutions.
- Polymer selection is critical, as it directly influences the performance of the finished product.
- Through smart formulation, polymers can be customized to meet customers' unique needs, driving innovation and value.

Elevate your adhesives with innovative EPS polymers to boost performance

QUESTIONS

Robert Sandoval, Ph.D.
R&D Technical Director
robert.sandoval@eps-materials.com

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