



# Novel Polymer Design for Radiation Curable PSAs

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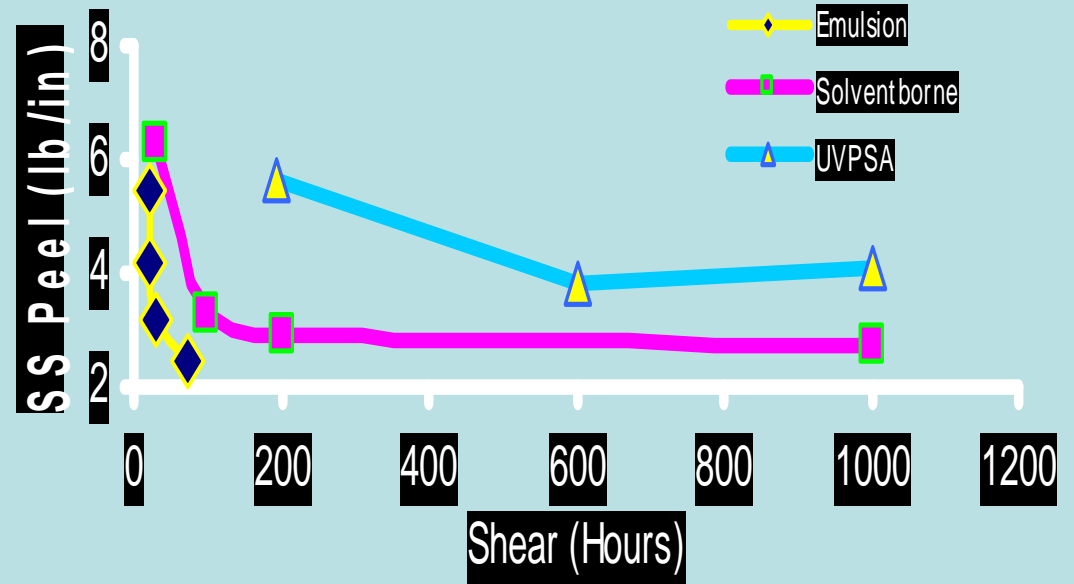
Cytec, Inc.

# Outline

- **Introduction**
- **UV PSA product design strategy**
- **UV curing process & capability**
- **Adhesion Performance**
- **Summary**

# Why UV PSA

- High performance product
- Cost effectiveness
- Environmental friendly



# Current UV-PSA Technologies

- **Acrylic Syrup**
  - Slow curing speed
  - Difficult to get 100% monomer/active components reacted
  - Nitrogen inerting required
  - Captive use in PSA market
- **Polymerizable Photoinitiator**
  - Photo-reactive groups grafted to acrylic polymer
  - Poor cohesive strength
- **Hydrogenated PB with Epoxy Functionality**
  - Cationic cure
  - Moisture sensitive
  - Post cure problem Inconsistent performance
  - Good adhesion, thermal/UV stability

# Product Design Targets

## High Performance

- Peel & shear balance
- HSE & LSE substrate adhesion
- High temperature performance
- Chemical/moisture resistance

## Greener Technology

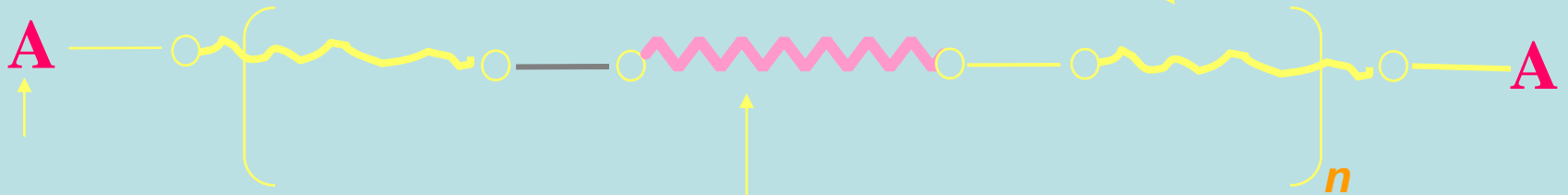
- No Solvents
- Less regulatory issues
- Lower energy usage

## Lower Total System Cost

- High line speeds
- No nitrogen inerting required
- Warm melt (110°C)
- Thick coating weights in a single pass (up to 15 mils)

# Polymer Backbone Structure

**Soft Segment** – Good adhesion to LSE substrates,  
Excellent compatibility with tackifiers

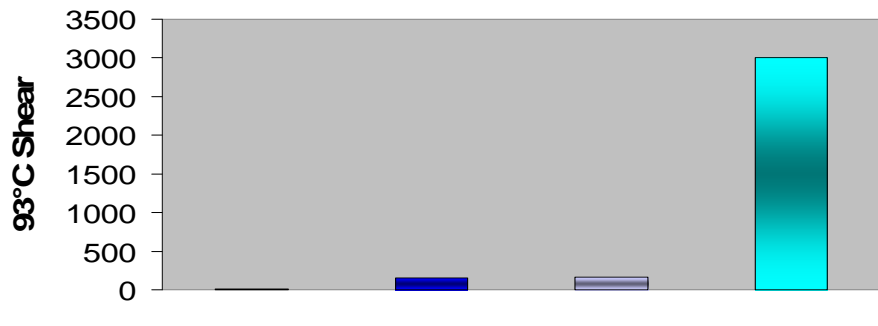


**Terminal -**  
UV-reactive site  
Curing behavior

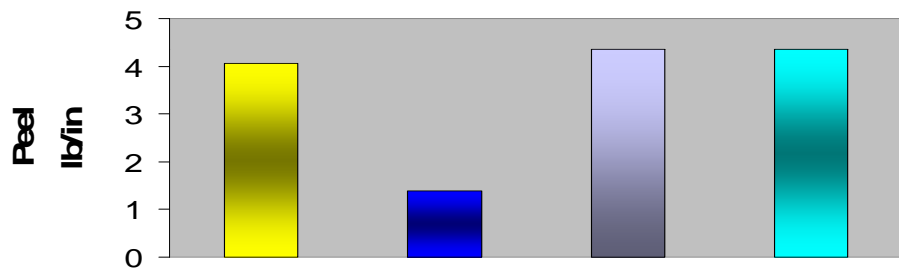
**Rigid Segment** – Reinforce adhesive for better cohesion  
and higher resistance to chemicals

Performance depends upon the polymer structure

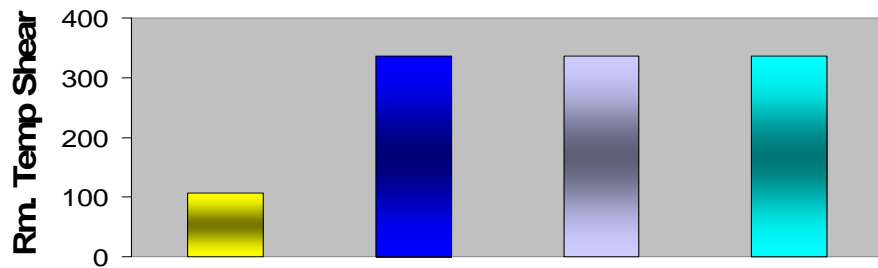
# Impacts of Polymer Structure on Adhesion



Soft Polymer    Hard Polymer    Blend of Polymers    New UV PSA



Soft Polymer    Hard Polymer    Blend of Polymers    New UV PSA



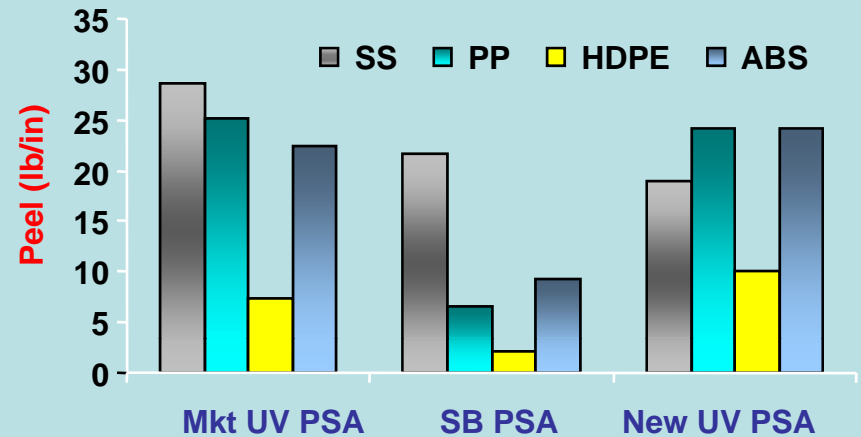
Soft Polymer    Hard Polymer    Blend of Polymers    New UV PSA

	Soft	Hard	Blend	<i>New UV PSA</i>
93 °C Shear 1Kg/in <sup>2</sup> (minutes)	9	151	166	>3000
30 min. Peel (lb/in)	4.07	1.39	4.35	4.35
RT Shear 2 Kg/in <sup>2</sup> (hours)	107	> 336	> 336	>336

# Adhesion Performance

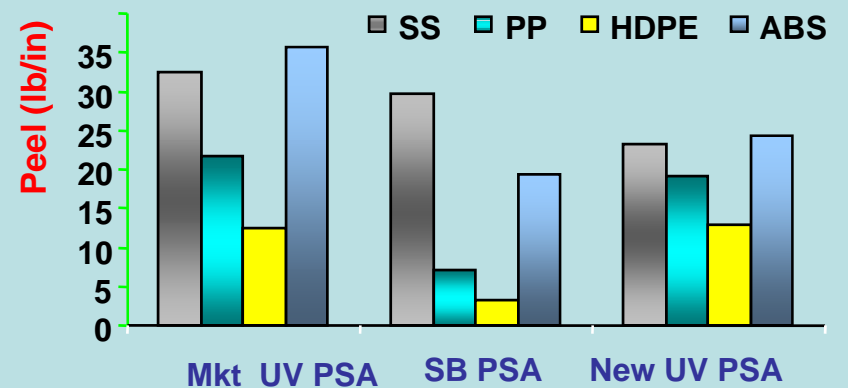
## 90° Peel – 50 GSM Coat Weight on Al foil(N/25 mm)

	Mkt UV PSA	SB PSA	New UV PSA
Stainless Steel	28.7 T/A	21.6 A	18.9 A
Polypropylene	25.1 A/2	6.6 A/Z	24.2 A
High density Polyethylene (HDPE)	7.4 A/T	2.2 A/Z	10.0 A
ABS	22.4 A/Z	9.2 A/Z	24.2 A



## 90° Peel – 125 GSM Coat Weight on Al foil (N/25mm)

	Mkt UV PSA	SB PSA	New UV PSA
Stainless Steel	35.2 T/A	29.7 A	23.3 A
Polypropylene	21.7 T/A	7.2 A	19.1 A
High Density Polyethylene (HDPE)	12.5 A/T	3.2 A	12.8 A
ABS	35.6 T/A	19.4 A	24.2 A



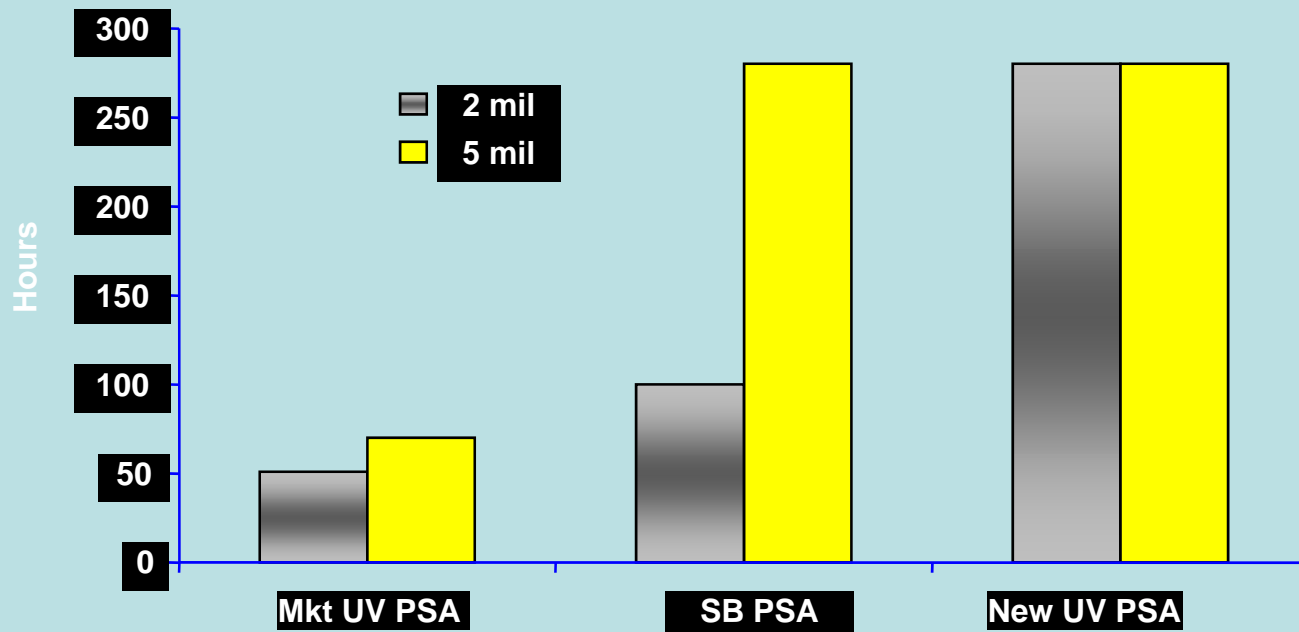
**New UV PSA has excellent adhesion to HSE & LSE substrates**



# Cohesion

Room Temperature Shear, 2Kg/in<sup>2</sup> (Hours)

	Mkt UV PSA	SB PSA	New UV PSA
2 mil	51 C	280+	280+
5 mil	70 C/T	280+	280+



# High Temperature Cohesion

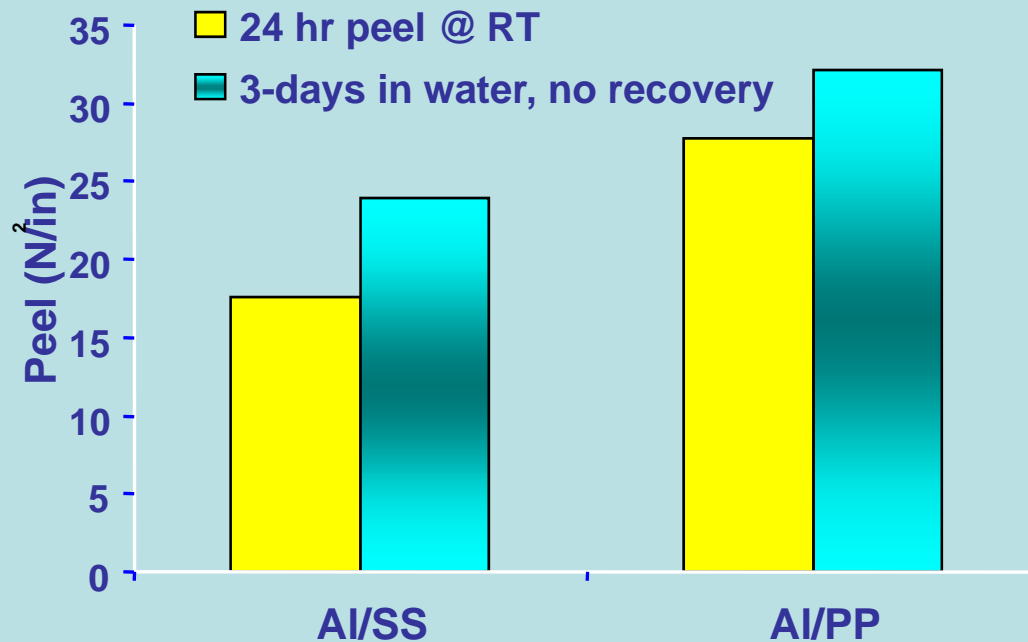
## High Temperature Shear

	Mkt UV PSA	SB PSA	New UV PSA
70°C, Kg/in <sup>2</sup> (hours)	51.2 C	167+	167+
150°C, 0.5Kg/in <sup>2</sup> (hours)	2.5 C	167+	167+

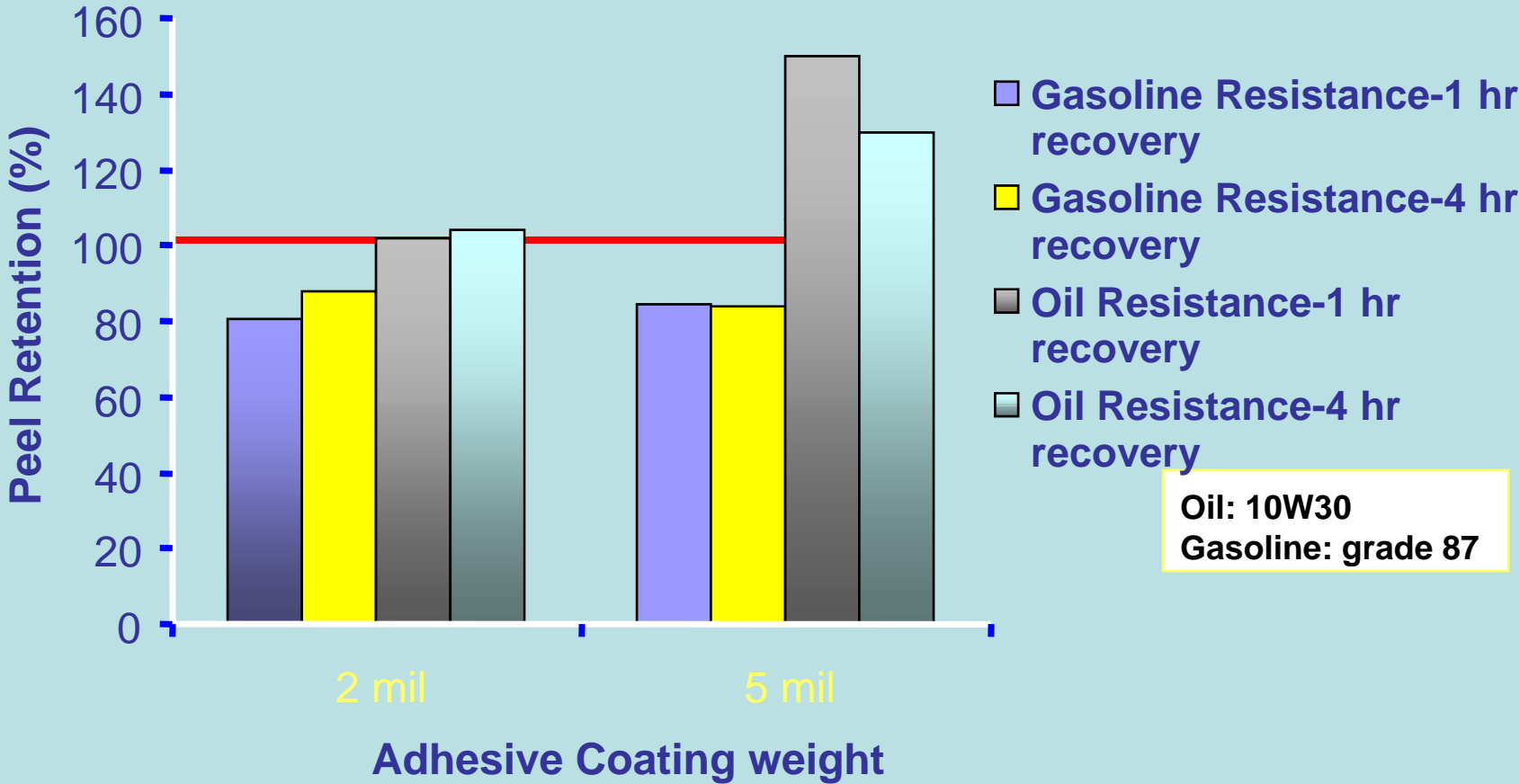
***New UV PSA showed much better cohesion at high temperature than Mkt UV PSA***

# Performance of New UV PSA

## Peel After 3-Day Water Immersion

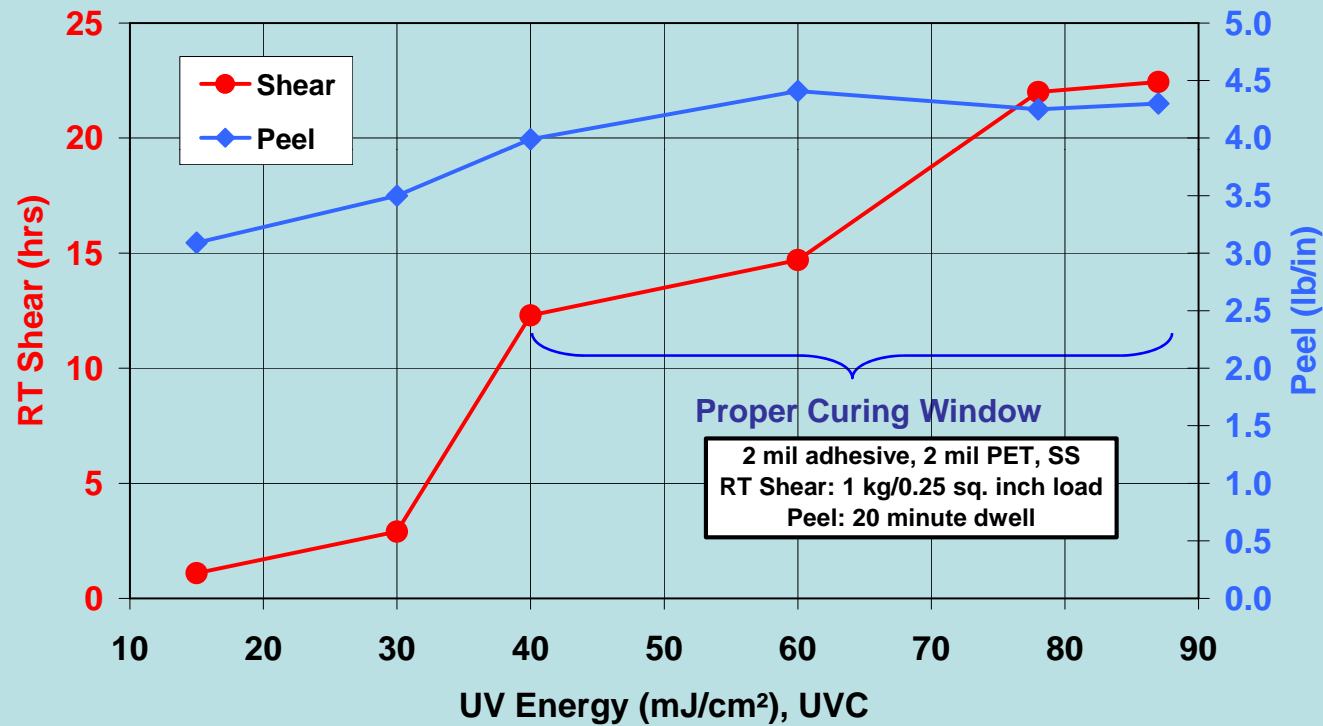


# Chemical Resistance Performance



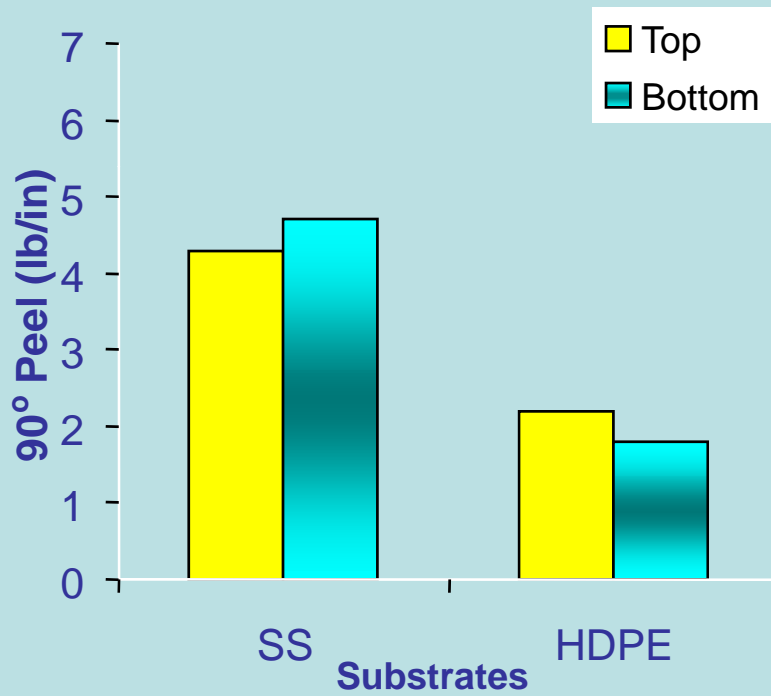
# Curing Energy vs. Performance

**New UV PSA**  
UV Energy vs. Performance

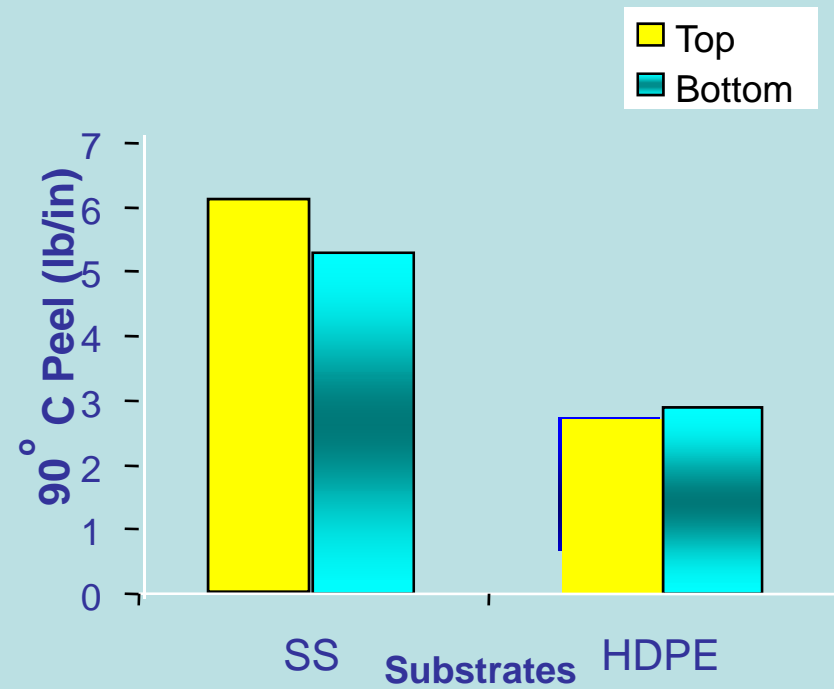


# Through Cure

2.0 mil

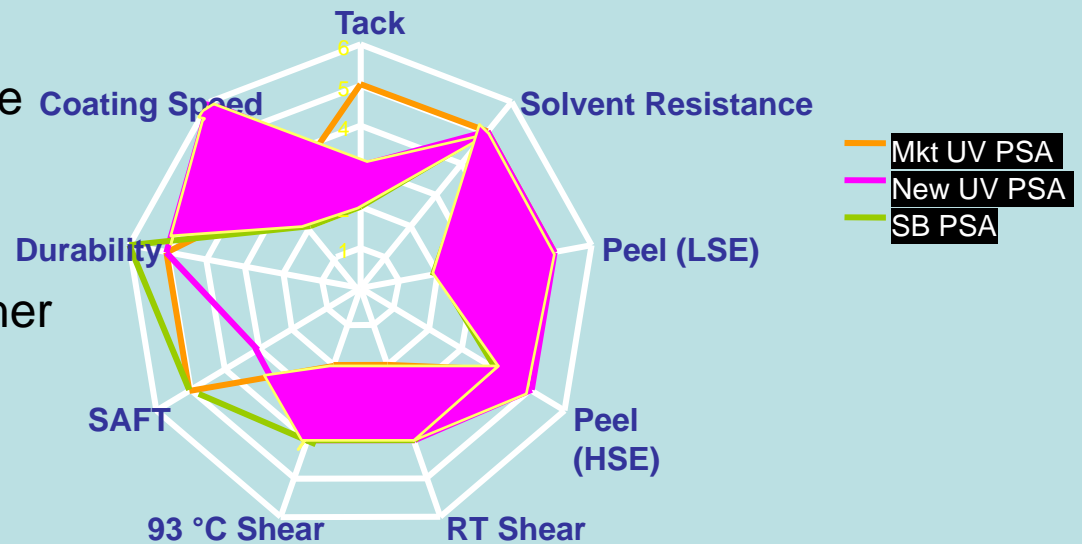
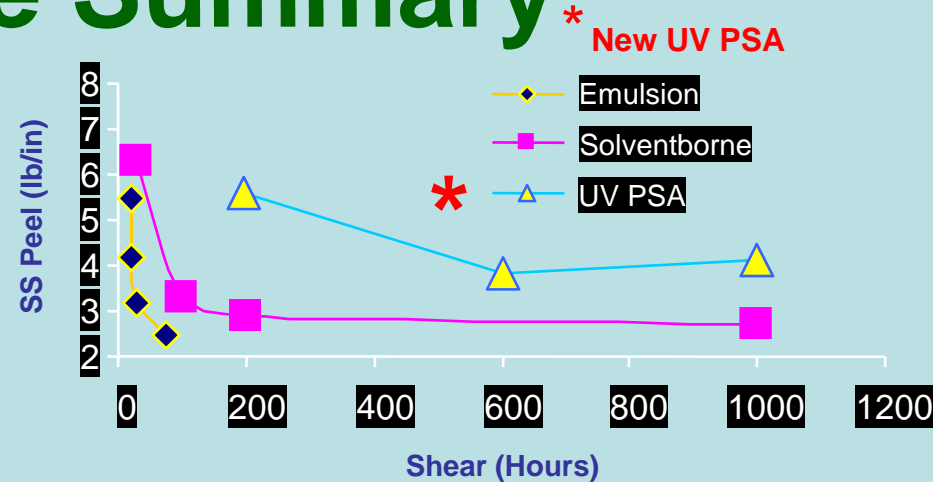


5.0 mil



# Performance Summary

- Excellent balance performance on both HSE & LSE
- Excellent room temperature shear
- Good high temperature performance
- Broad curing window
- Very good chemical resistance and water resistance
- Good heat aging performance
- Efficient through cure
- No N<sub>2</sub> inerting required
- Good compatibility to be further formulated



# Market Drivers for Warm Melt-UV PSA

- Environmental:
  - Negligible VOC's < 1%
  - Lower energy usage
- Performance:
  - Achieve unmet market needs
  - Meet/Exceed current solvent PSA performance
  - Good Peel – Shear balance on LSE and HSE surfaces
- Cost Reduction:
  - High line speeds
  - Thick depositions in single pass
  - Overall lower applied cost
    - Spreadsheet-based tool available to evaluate



# Acknowledgement

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