

**Tackifying effect on acResin®  
[A204UV, UV3532]**

# Abstract

- When choosing a tackifier for a UV cure acrylate PSA, care must be taken to optimize compatibility, while limiting inhibition of the cure process. In this paper we will review how hydrogenation and modification of polyterpenes can produce bio-based resins compatible with UV cure acrylate systems. The impact of such resins on adhesive properties, resin stability and cure inhibition in UV acrylate systems will be reviewed.

# Introduction

- Additional better performing bio-based resins to UV cure acrylate adhesive toolbox!
  - YS Polyester TH130, UH115 (Hydrogenated terpene phenols)
  - Clearon K105, M105 (Hydrogenated, aromatic modified terpenes)
- Commonly used bio-based tackifying options are not satisfactory in UV cure acrylate adhesives (compatibility, cure inhibition)
  - Ester Gum HP (Hydrogenated rosin esters)
  - Foral AX (Hydrogenated rosins “rosin acids”)
  - Arkon M100 (Hydrogenated hydrocarbons “not bio-based”)

# Experimental Plan

- Two 100% solids, UV cure acrylate adhesives
- 10 & 20 parts loading:
  - YS Polyster TH130, UH115(Hydrogenated terpene phenols (2))
  - Clearon K105, M105 (Hydrogenated, aromatic modified terpenes (2))
  - Ester Gum HP (Hydrogenated rosin ester)
  - Foral AX (Hydrogenated rosin)
  - Arkon M100 (Hydrogenated hydrocarbon)
  - YS Polyster T130 (Non-hydrogenated terpene phenol)

# Sample Testing

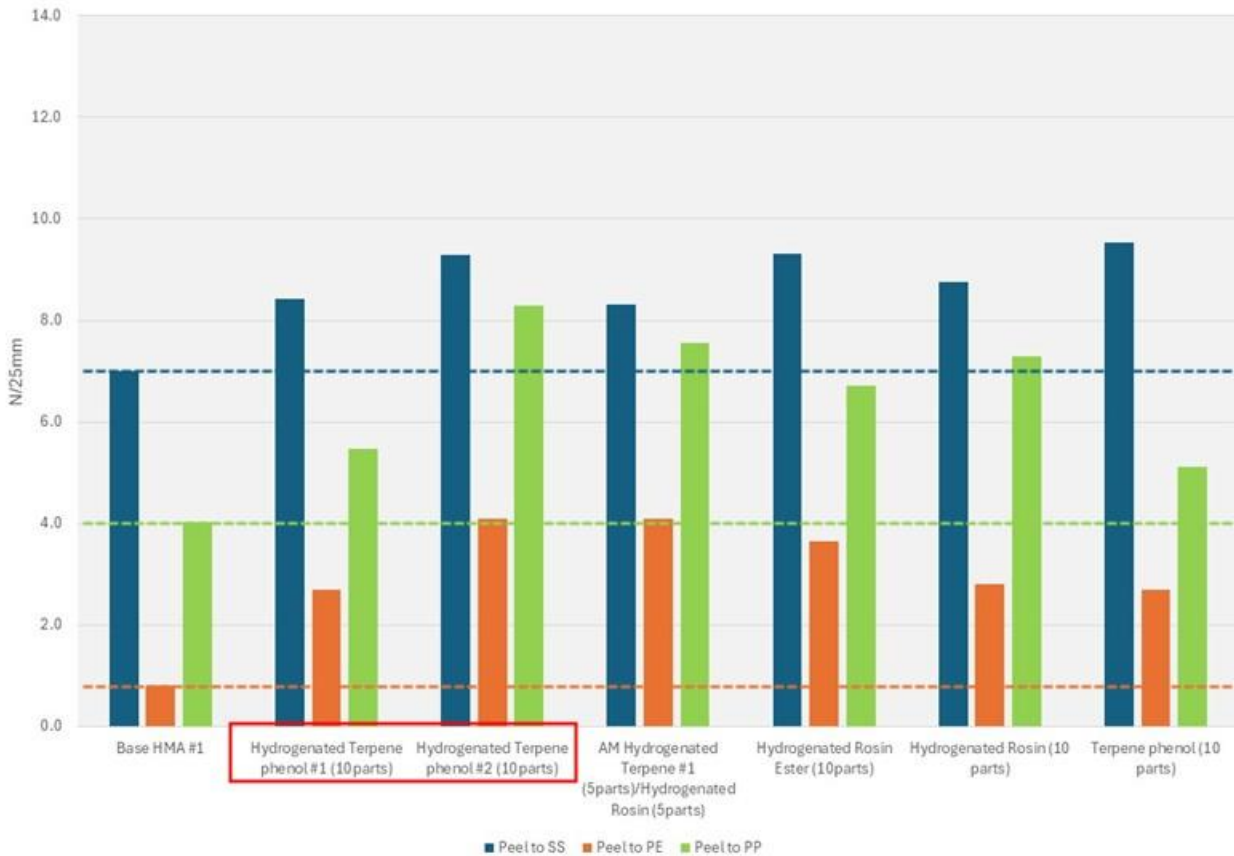
- 180° peel to steel, PE, PP at 300mm/min (ASTM D3330/PSTC 101)
- Ball Tack Test (JIS Z0237:2009 )
- 40°C & 70°C Holding Power, 25mm x 25mm area, 1 kg weight (ATSM D3665/PSTC-7)

# acResin A204UV based Formulations

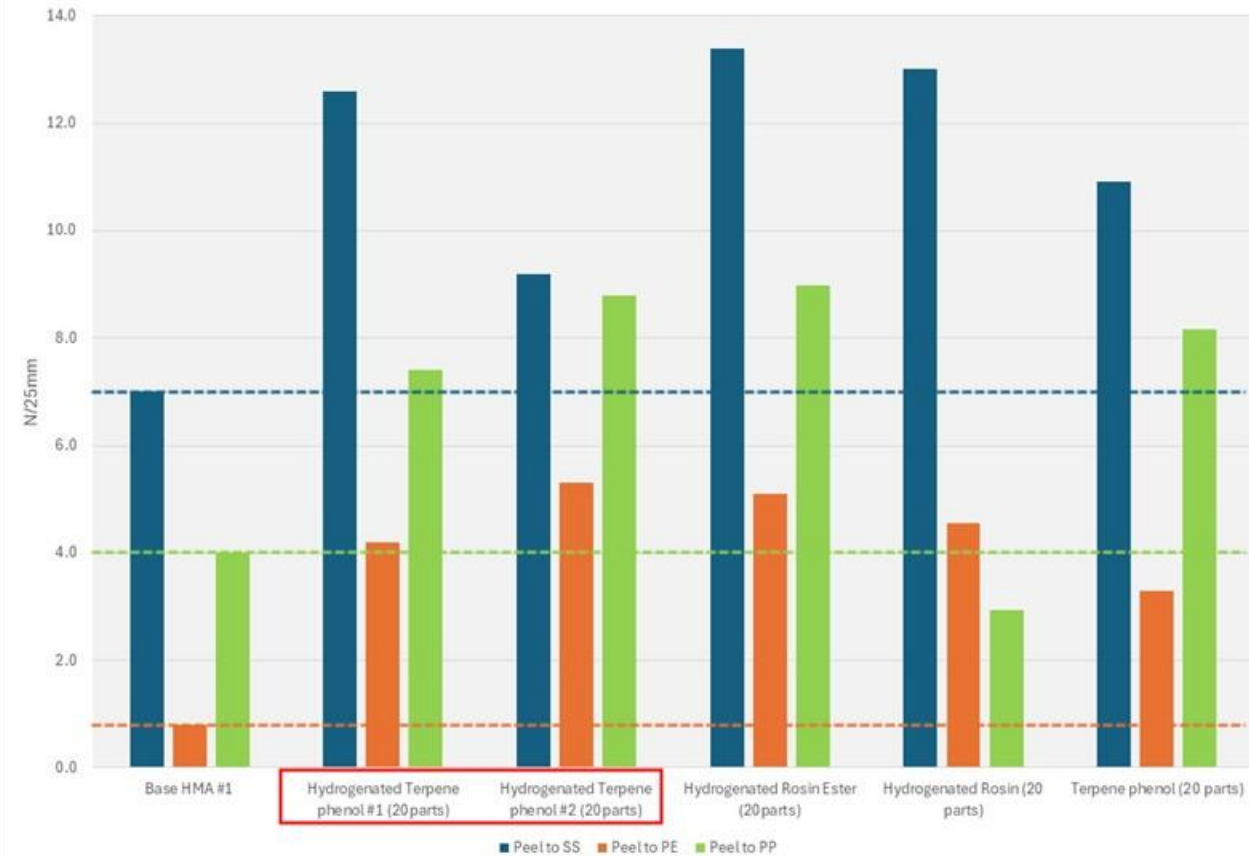
	Hot Melt Acrylate #1	Hot Melt Acrylate #2	Hydrogenated Terpene Phenol - 1	Hydrogenated Terpene Phenol - 2	Aromatic Modified, Hydrogenated Terpene -1	Aromatic Modified, Hydrogenated Terpene -2	Hydrogenated Rosin Ester	Hydrogenated Rosin	Hydrogenated Rosin	Non Hydrogenated Terpene Phenol
	(acResin® A 204 UV)	(acResin® UV 3532)	(YS Polyster TH130)	(YS Polyster UH115)	(Clearon K105)	(Clearon M105)	(Ester Gum HP)	(Foral AX®)	(Arkon M100)	(YS Polyster T130)
<b>Sample ID</b>	parts	parts	parts	parts	parts	parts	parts	parts	parts	parts
Base HMA #1	100									
Hydrogenated Terpene phenol #1 (10parts)	100		10							
Hydrogenated Terpene phenol #1 (20parts)	100		20							
Hydrogenated Terpene phenol #2 (10parts)	100			10						
Hydrogenated Terpene phenol #2 (20parts)	100			20						
AM Hydrogenated Terpene #1 (5parts)/Hydrogenated Rosin (5parts)	100				5		5			
Hydrogenated Rosin Ester (10parts)	100						10			
Hydrogenated Rosin Ester (20parts)	100						20			
Hydrogenated Rosin (10 parts)	100							10		
Hydrogenated Rosin (20 parts)	100							20		
Terpene phenol (10 parts)	100									10
Terpene phenol (20 parts)	100									20

# Peel Adhesion – acResin A204UV

Peel Adhesion: 10 parts Resin w/Hot Melt Acrylate #1



Peel Adhesion: 20 parts Resin w/Hot Melt Acrylate #1



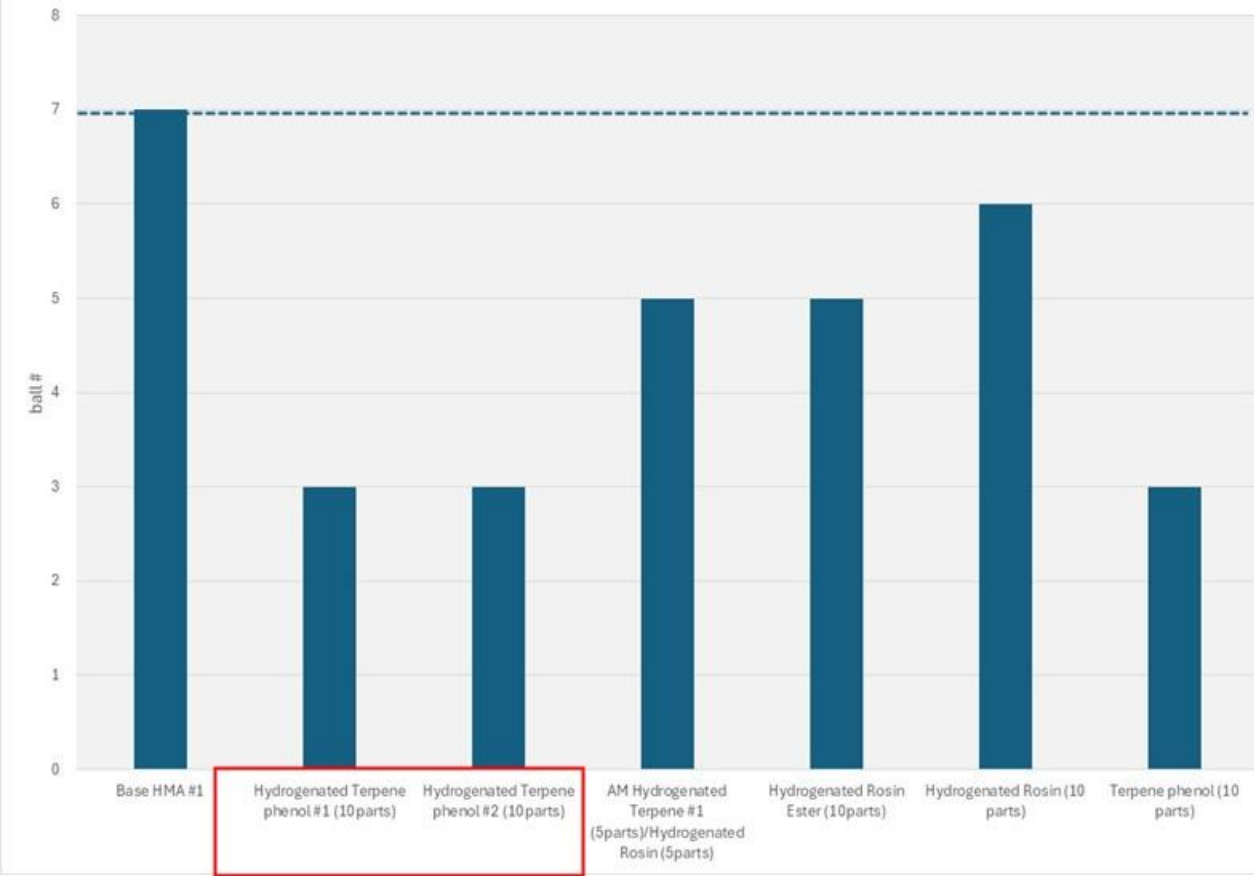
SS : Stainless steel

PE : Polyethylene

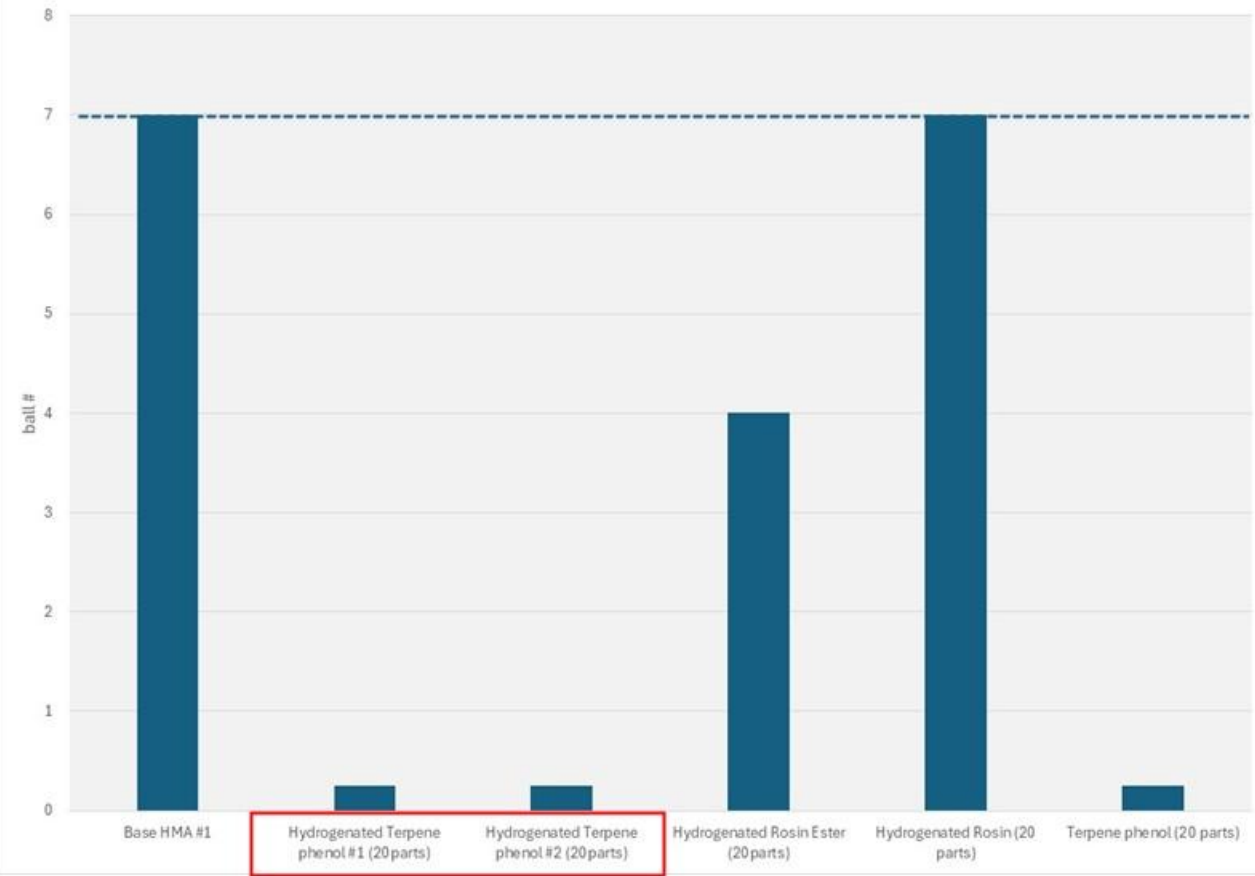
PP : Polypropylene

# Ball Tack – acResin A204UV

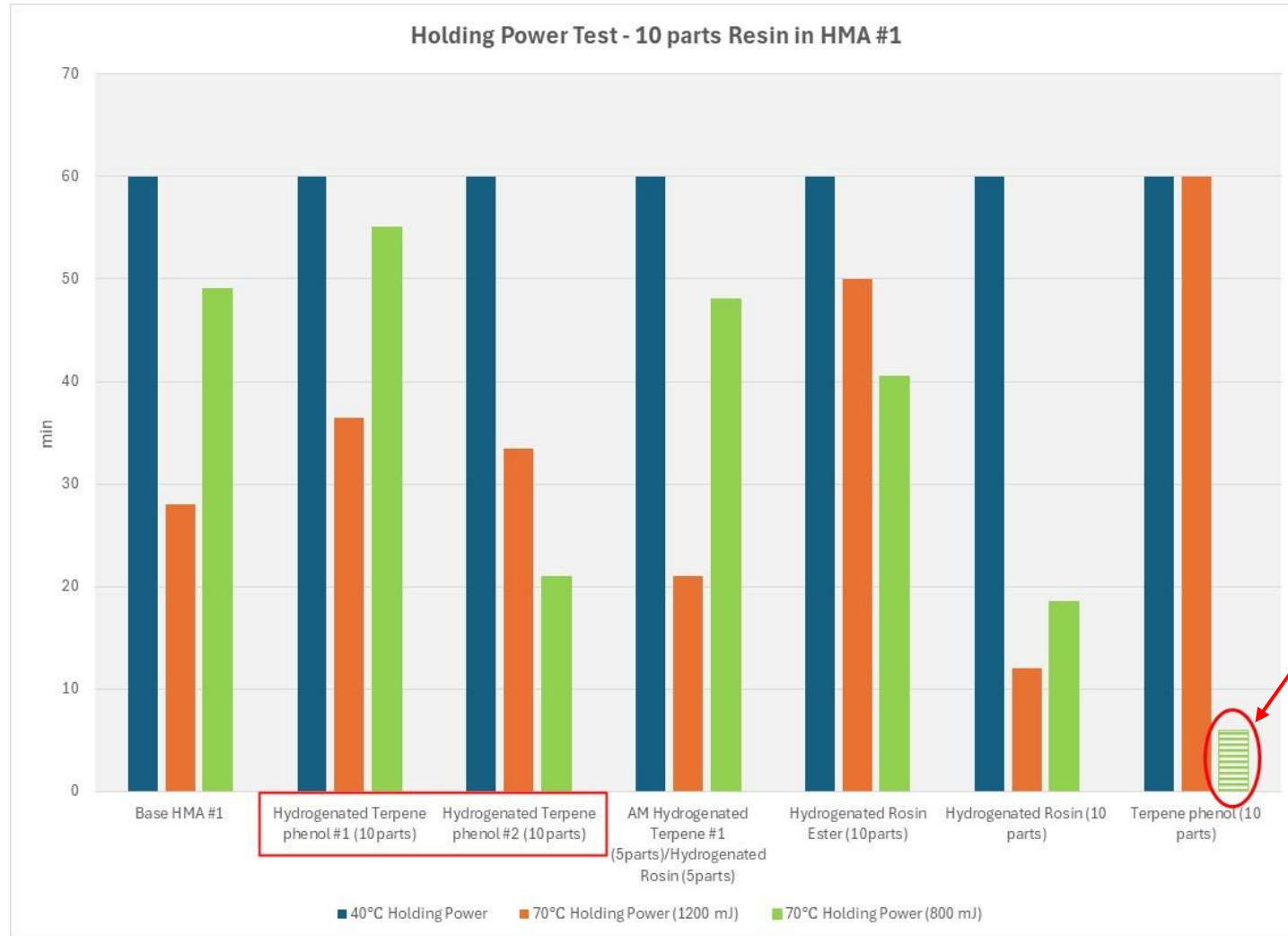
Ball Tack: 10 parts Resin w/ Hot Melt Acrylate #1



Ball Tack: 20 parts Resin w/ Hot Melt Acrylate #1



# Holding Power – acResin A204UV

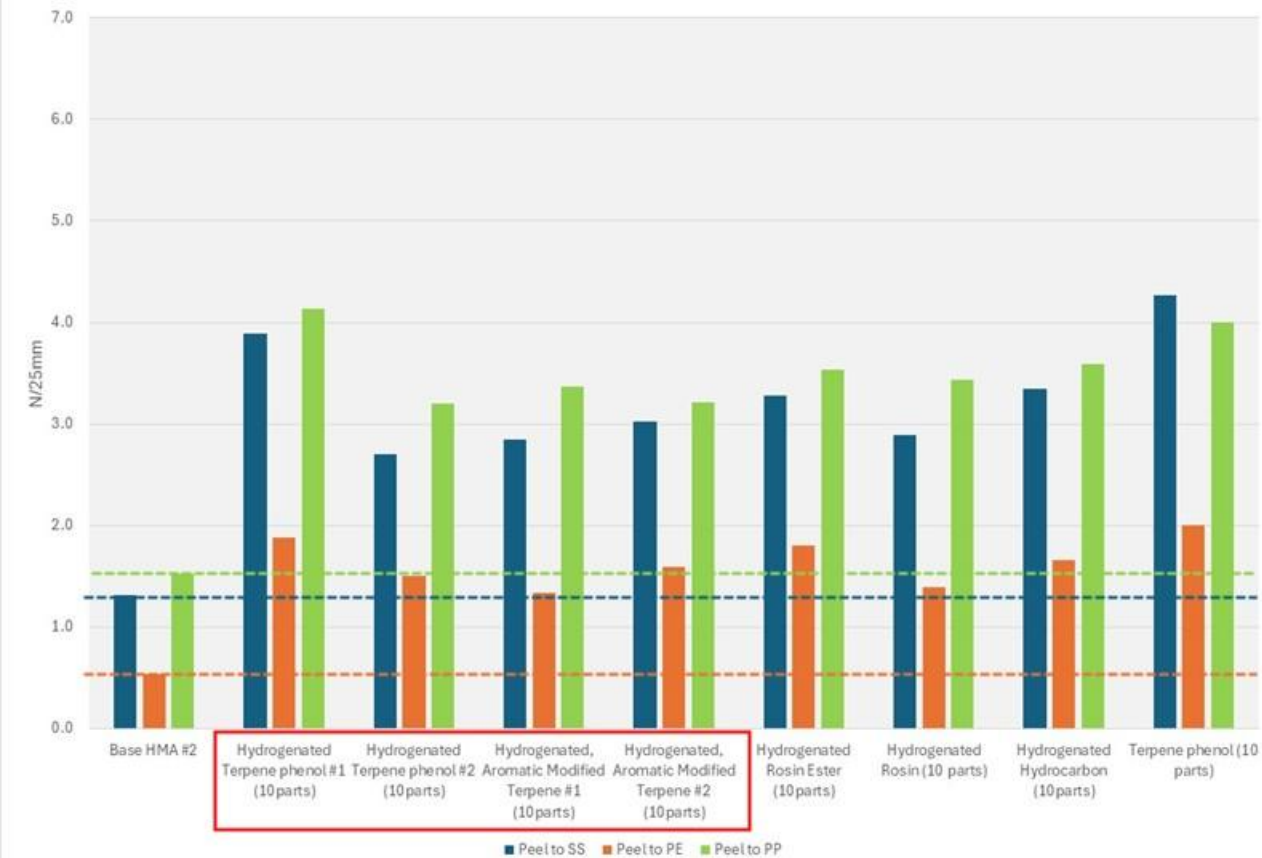


# acResin UV 3532 based Formulations

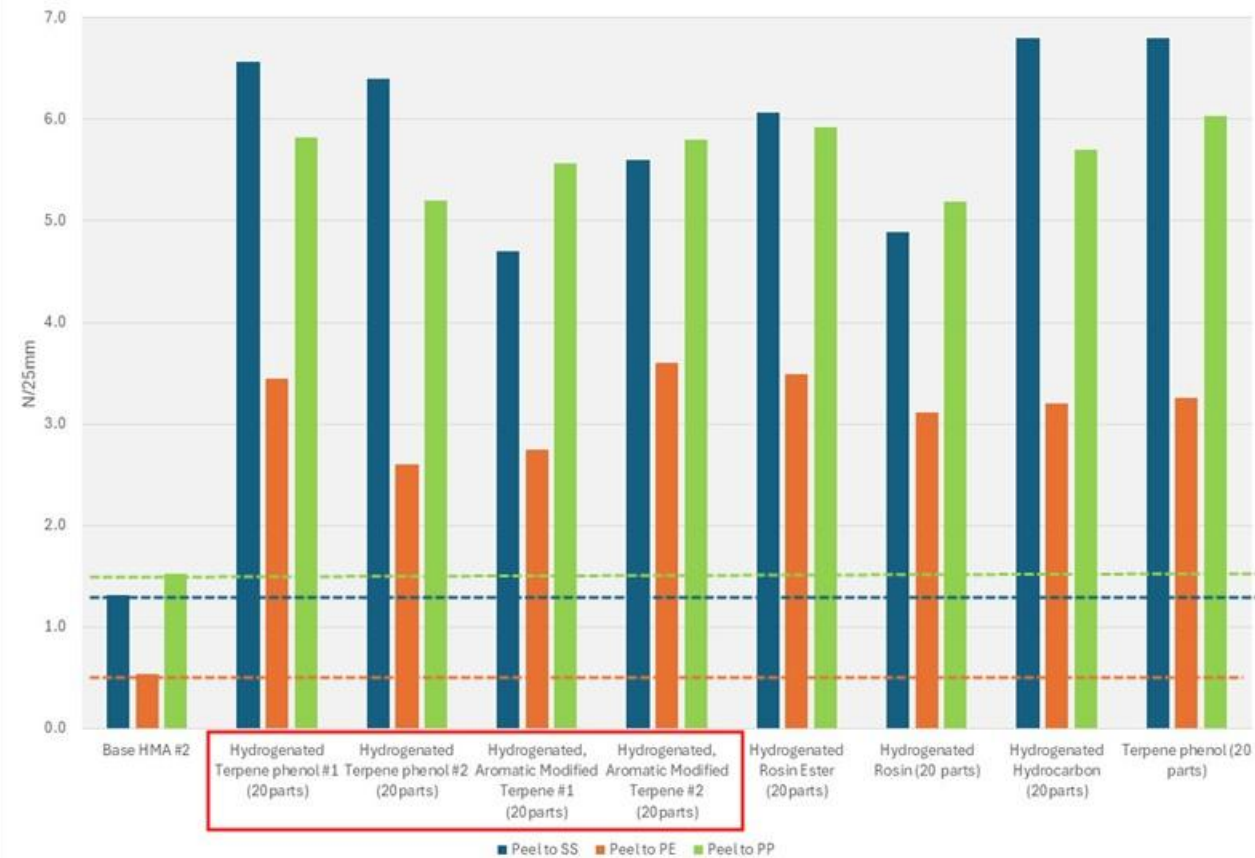
	Hot Melt Acrylate #1	Hot Melt Acrylate #2	Hydrogenated Terpene Phenol - 1	Hydrogenated Terpene Phenol - 2	Aromatic Modified, Hydrogenated Terpene - 1	Aromatic Modified, Hydrogenated Terpene - 2	Hydrogenated Rosin Ester	Hydrogenated Rosin	Hydrogenated Hydrocarbon	Non Hydrogenated Terpene Phenol
	(acResin® A 204 UV)	(acResin® UV 3532)	(YS Polyster TH130)	(YS Polyster UH115)	(Clearon K105)	(Clearon M105)	(Ester Gum HP)	(Foral AX®)	(Arkon M100)	(YS Polyster T130)
<b>Sample ID</b>	parts	parts	parts	parts	parts	parts	parts	parts	parts	parts
Base HMA #2		100								
Hydrogenated Terpene phenol #1 (10parts)		100	10							
Hydrogenated Terpene phenol #1 (20parts)		100	20							
Hydrogenated Terpene phenol #2 (10parts)		100		10						
Hydrogenated Terpene phenol #2 (20parts)		100		20						
Hydrogenated, Aromatic Modified Terpene #1 (10parts)		100			10					
Hydrogenated, Aromatic Modified Terpene #1 (20parts)		100			20					
Hydrogenated, Aromatic Modified Terpene #2 (10parts)		100				10				
Hydrogenated, Aromatic Modified Terpene #2 (20parts)		100				20				
Hydrogenated Rosin Ester (10parts)		100					10			
Hydrogenated Rosin Ester (20parts)		100					20			
Hydrogenated Rosin (10 parts)		100						10		
Hydrogenated Rosin (20 parts)		100						20		
Hydrogenated Hydrocarbon (10parts)		100							10	
Hydrogenated Hydrocarbon (20parts)		100							20	
Terpene phenol (10 parts)		100								10
Terpene phenol (20 parts)		100								20

# Peel Adhesion – acResin UV 3532

Peel Adhesion: 10 parts Resin w/ Hot Melt Acrylate #2



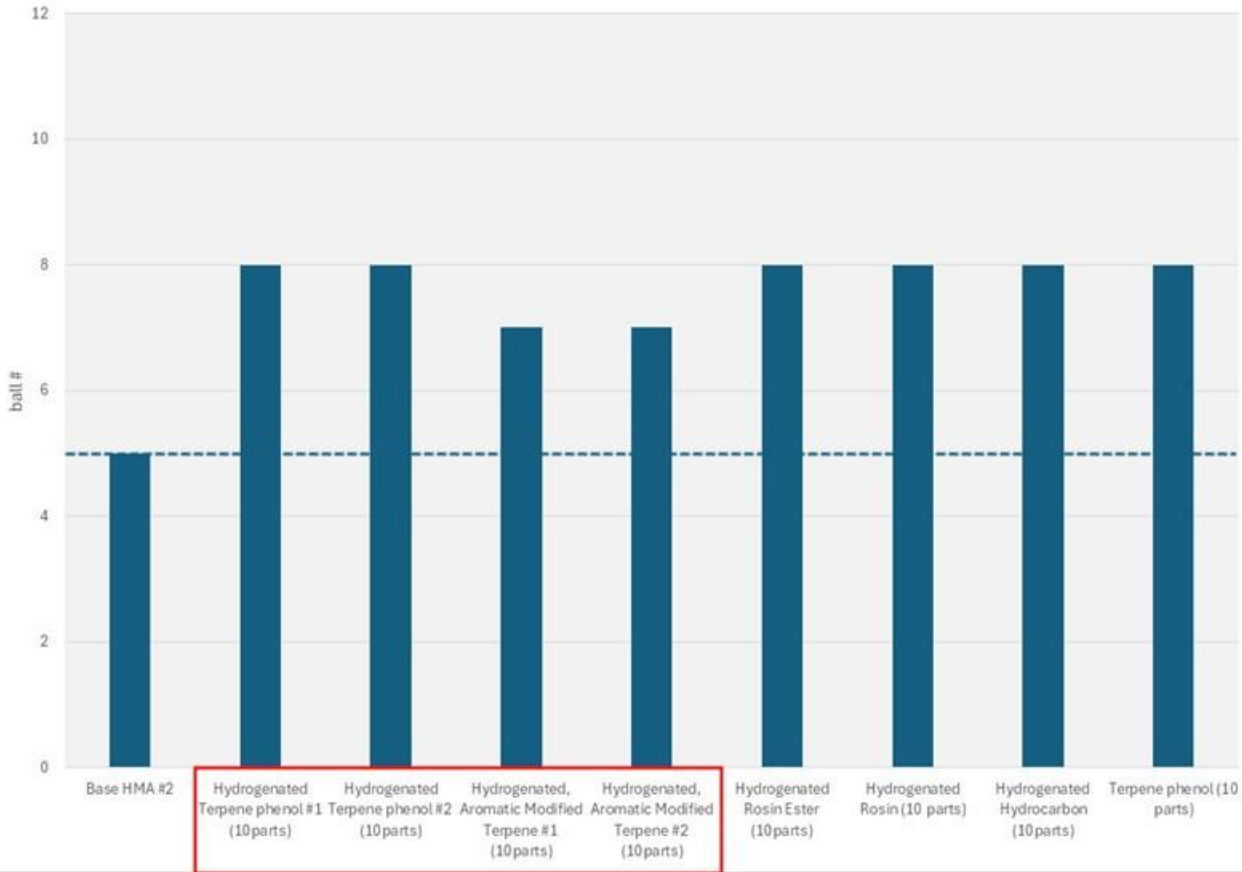
Peel Adhesion: 20 parts Resin w/ Hot Melt Acrylate #2



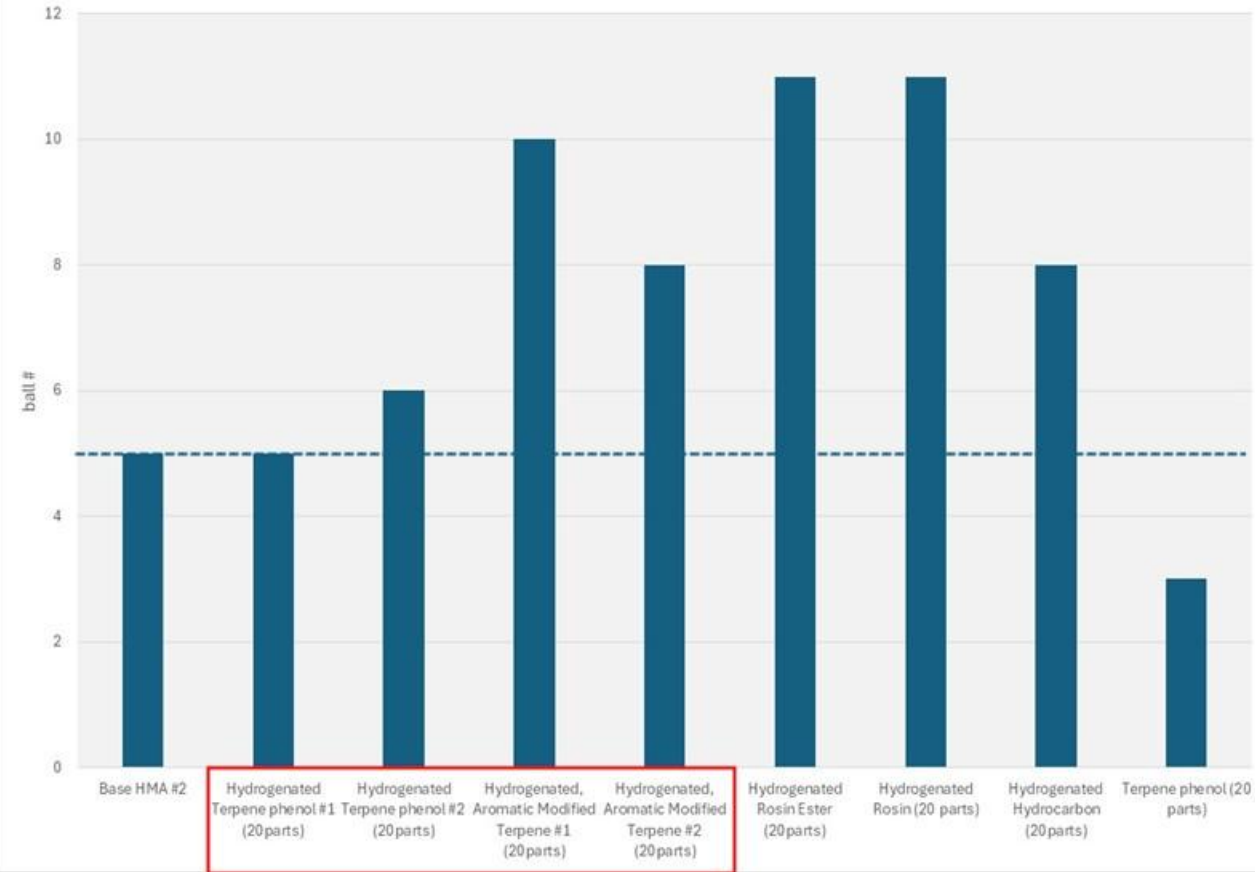
SS : Stainless steel  
 PE : Polyethylene  
 PP : Polypropylene

# Ball Tack – acResin UV 3532

Ball Tack: 10 parts Resin w/ Hot Melt Acrylate #2



Ball Tack: 20 parts Resin w/ Hot Melt Acrylate #2



## **Additional Data**

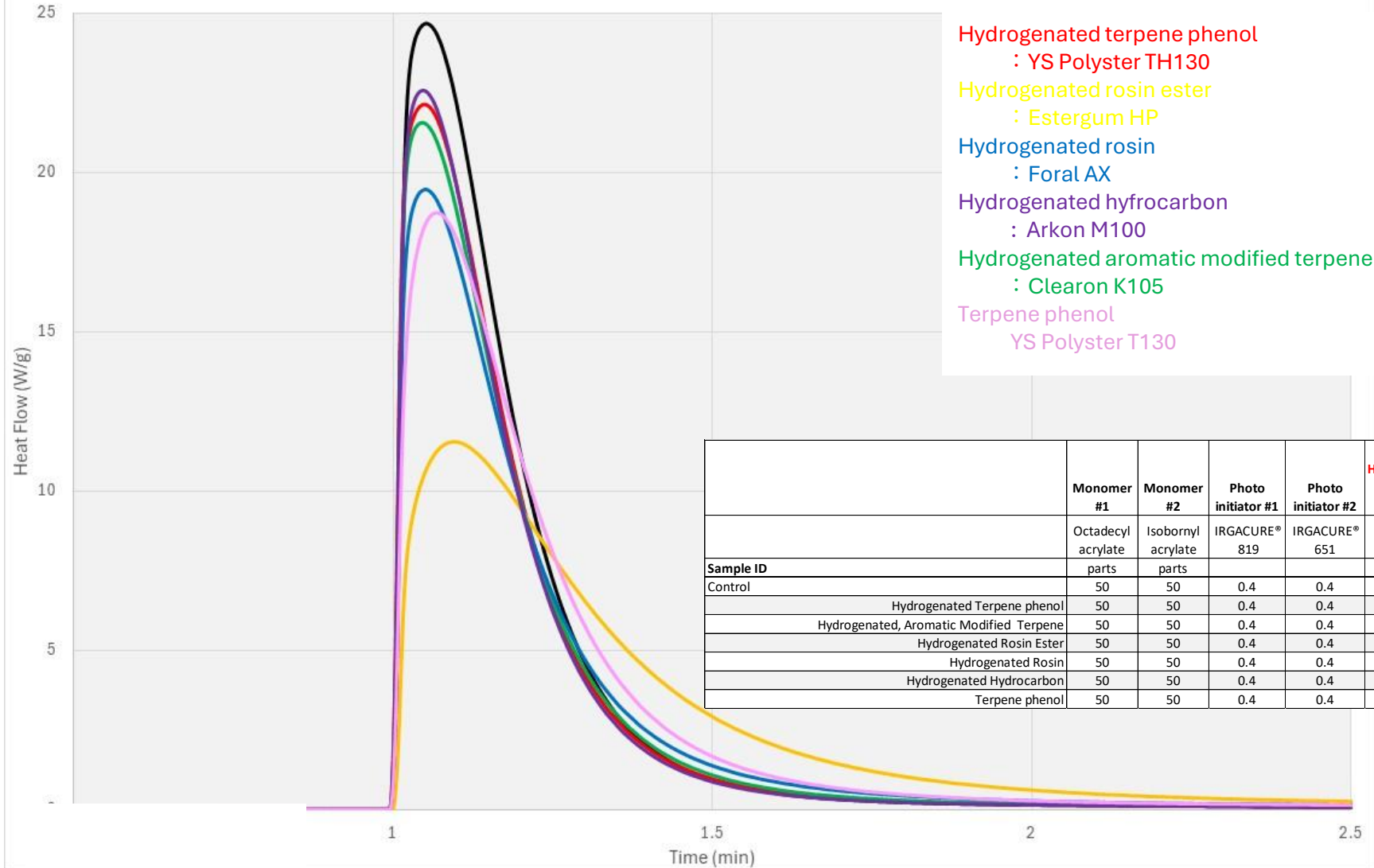
- **UV cure inhibition**
- **Color change after heating**
- **Peroxide generation after heating**

# UV Cure Inhibition

## Cure Inhibition: 10 phr resin

1/1 ODA/IBA, 0.4phr Irgacure 651, 0.4phr Irgacure 819

10mW/cm2, UV: 320~550nm

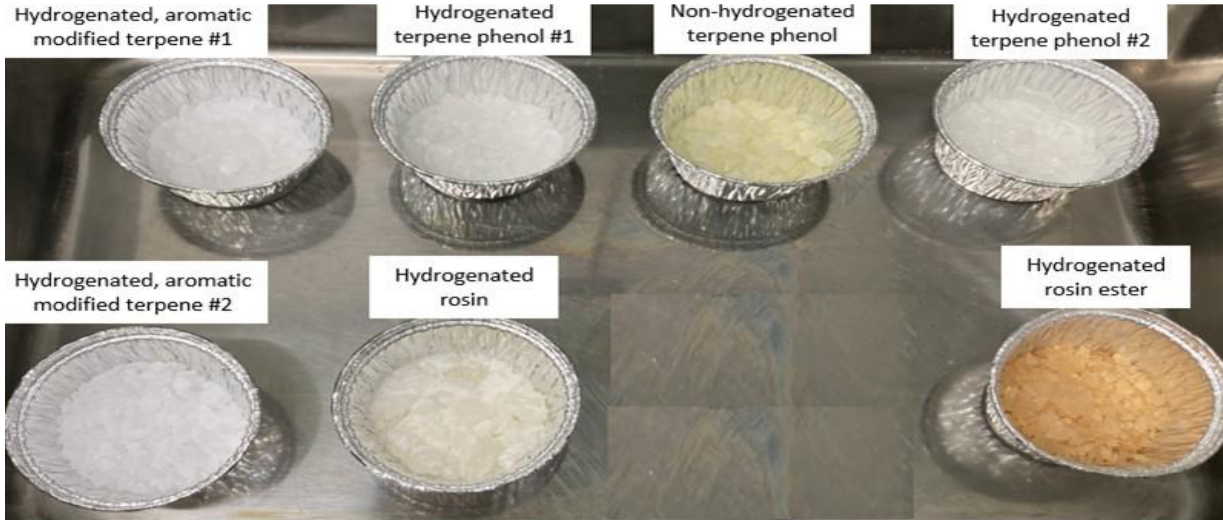


- Hydrogenated terpene phenol  
: YS Polyester TH130
- Hydrogenated rosin ester  
: Estergum HP
- Hydrogenated rosin  
: Foral AX
- Hydrogenated hydrocarbon  
: Arkon M100
- Hydrogenated aromatic modified terpene  
: Clearon K105
- Terpene phenol  
YS Polyester T130

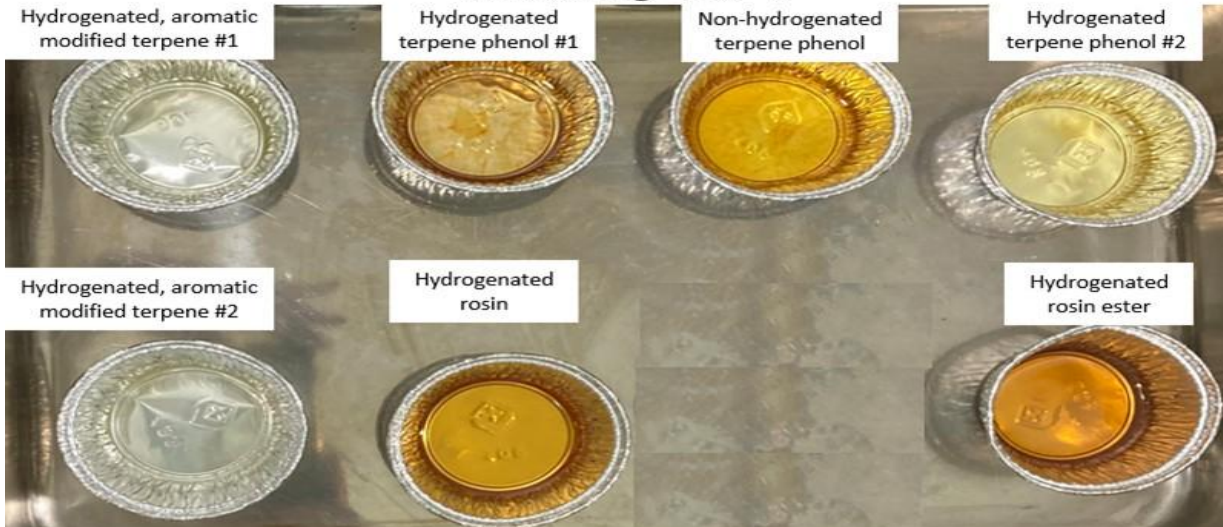
Sample ID	Monomer #1	Monomer #2	Photo initiator #1	Photo initiator #2	Hydrogenated Terpene Phenol	Aromatic Modified, Hydrogenated Terpene	Hydrogenated Rosin Ester	Hydrogenated Rosin	Hydrogenated Hydrocarbon	Non Hydrogenated Terpene Phenol
	Octadecyl acrylate	Isobornyl acrylate	IRGACURE® 819	IRGACURE® 651	YS Polyester TH130)	(Clearon K105)	(Ester Gum HP)	(Foral AX®)	(Arkon M100)	(YS Polyester T130)
Control	50	50	0.4	0.4						
Hydrogenated Terpene phenol	50	50	0.4	0.4	10					
Hydrogenated, Aromatic Modified Terpene	50	50	0.4	0.4		10				
Hydrogenated Rosin Ester	50	50	0.4	0.4			10			
Hydrogenated Rosin	50	50	0.4	0.4				10		
Hydrogenated Hydrocarbon	50	50	0.4	0.4					10	
Terpene phenol	50	50	0.4	0.4						10

# Stability – Color Change

Initial



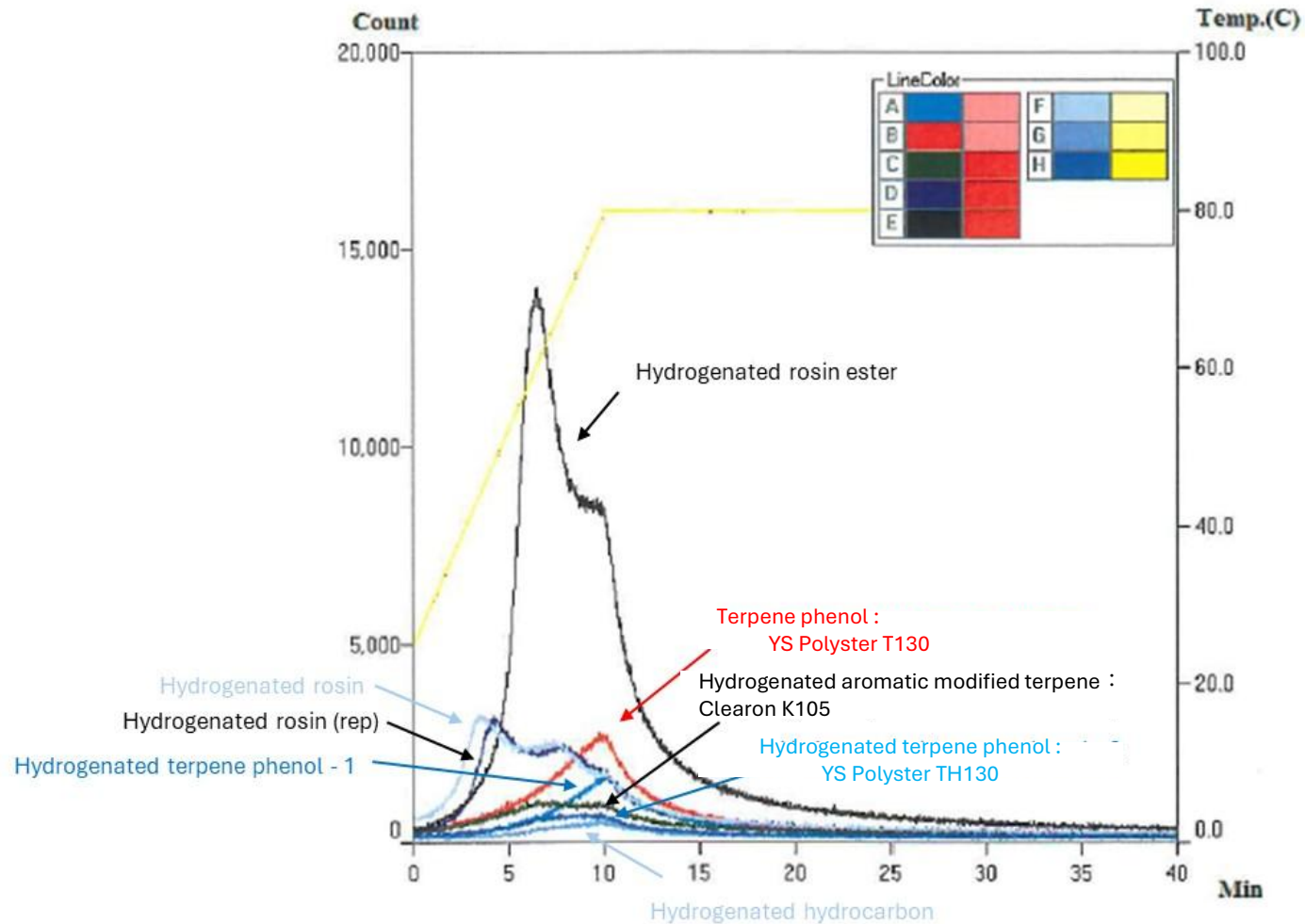
6 hours @ 180°C



	Hydrogenated Terpene Phenol #1	Hydrogenated Terpene Phenol #2	Hydrogenated, Aromatic Modified Terpene	Hydrogenated Rosin Ester	Hydrogenated Rosin	Hydrogenated Hydrocarbon	Non Hydrogenated Terpene Phenol
	(YS Polyester TH130)	(YS Polyester UH115)	(Clearon K105)	(Ester Gum HP)	(Foral AX®)	(Arkon M100)	(YS Polyester T130)
Bromine Value (measured) gBr <sub>2</sub> /100g resin	17.5	8.9	9.3	54.7	46.5	<8	23.4
Acid Value (measured) KOHmg/g	<5	<5	<5	16.5	167.8	<5	<5
OH Value (measured) KOHmg/g	33.9	16.9	40	52.4	40.6	<5	40
Initial Color (Gardner)	<1	<1	<1	7.5	<1	<1	6
6hr, 180C Color (Gardner)	5.2	3.3	<1	9.7	7.5	<1	9
Chemiluminescence (total count 10 <sup>5</sup> )	9.9	6.3	9.8	54.4	18.8	4.9	15.3

# Stability – Chemiluminescence detection

- Materials exposed 6 hours at 180°C



# Conclusion

Our bio-based hydrogenated terpene phenol resin improved adhesion to low energy surfaces like PE and PP compared to currently introduced other bio-based tackifiers such as Hydrogenated rosin and Hydrogenated rosin ester.

Our hydrogenated aromatic modified terpene resin can also enforce adhesion to low energy surfaces such as PE and PP when incorporated with Hydrogenated rosin.

Terpene resins are viable options as bio-based tackifiers for UV curable acrylic oligomers.

Additional data indicates possibility to keep line speed while long term color and adhesion stability are secured.