EASTMAN

Pure monomer resins

Extending hydrogenated hydrocarbon resins with pure monomer resins in olefin block copolymer-based diaper construction adhesives

Technical tip

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Extending hydrogenated hydrocarbon resins with pure monomer resins in olefin block copolymer-based diaper construction adhesives

Introduction

Pure monomer resins (PMRs) are traditionally used in adhesive formulations based on styrenic block copolymers due to their compatibility, thermal stability, and high-temperature properties. With the introduction of Dow INFUSE™ olefinic block copolymer (OBC) technology, adhesive manufacturers have a new polymer that can be utilized in diaper construction adhesives. Eastman tested OBC-based nonwoven pressure sensitive adhesive formulations containing Eastotac™ H100W extended with PMRs. The results indicate adhesive formulations utilizing hydrogenated hydrocarbons can be extended with PMRs up to 10% by resin volume without negatively affecting the adhesive performance and thermal aging properties.

Data

Typical properties of selected hydrogenated hydrocarbon resins and PMRs are given in Table 1. Values shown are an average of typical samples and should not be interpreted as product specifications.

Table 1. Typical properties of selected hydrogenated hydrocarbon resins and PMRs[a]

Resins	Type	Ring & ball softening point (°C)	Mn/Mw/Mz (Daltons)	T_g (°C)	Gardner color/YID[b]
Eastotac™ H-100W	Hydrogenated hydrocarbon resin	100	450/1000/2150	41	<1/8
Kristalex™ 3085	PMR	85	650/1150/1900	41	<1/4
Piccotex™ LC	PMR	91	750/1350/2200	46	<1/8
Piccolastic™ A75	PMR	74	700/1300/2250	35	1/-

[a] *Obtained from Eastman publication WA-86A,* Spectrum of Hydrocarbon Resins; *WA133,* Eastman Hydrocarbon resins

[b] *YID = Yellowness Index*

An OBC-based disposable diaper construction adhesive formulation was prepared with Eastotac™ H-100W hydrogenated hydrocarbon resin as the control. Effects of three different PMRs (Kristalex™ 3085, Piccotex™ LC, and Piccolastic™ A75) as extenders for Eastotac H-100W were evaluated at 6% by weight (in formulation), which equates to a 10% extension with respect to total hydrogenated hydrocarbon resin content. Study formulations are shown in Table 2.

Table 2. Disposable diaper construction adhesive formulations with PMRs

Formulation ingredients	Eastotac™ H-100W control	Kristalex™ 3085	Piccotex™ LC	Piccolastic™ A75
		90:10 H100W:3085	90:10 H100W:LC	90:10 H100W:A75
INFUSE™ 9807[a]	20	20	20	20
Eastotac™ H-100W[b]	59.5	53.5	53.5	53.5
Kristalex™ 3085[b]	-	6	-	-
Piccotex™ LC[b]	-	-	6	-
Piccolastic™ A75[b]	-	-	-	6
Calsol™ 5550[c]	20	20	20	20
Irganox™ 1010[d]	0.5	0.5	0.5	0.5

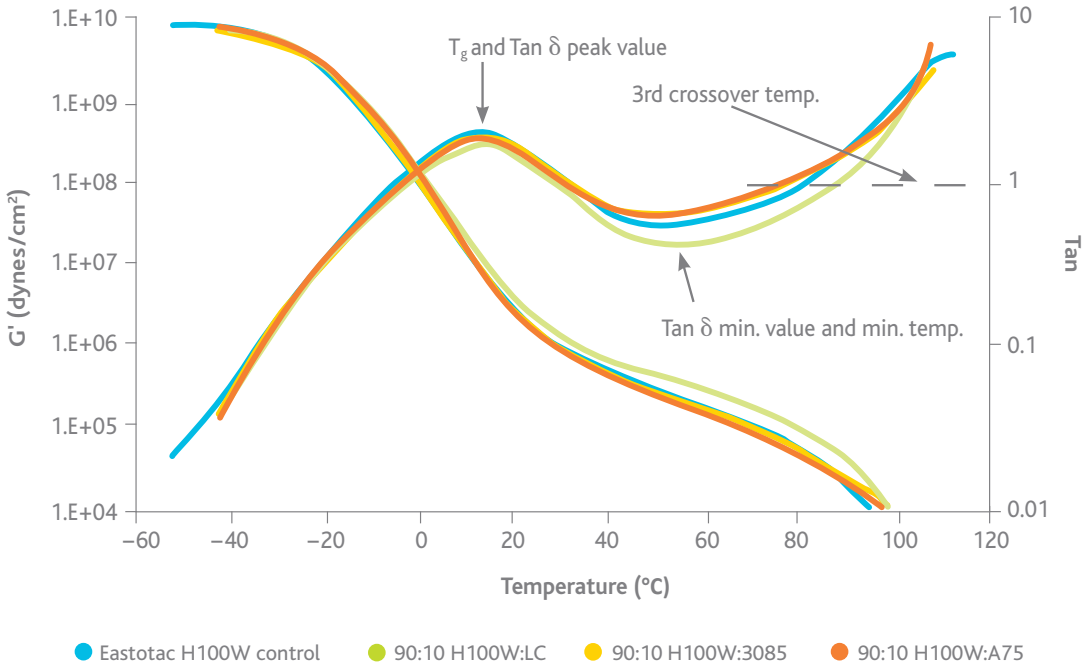
[a] *DOW Chemical Company (polymer)*
[b] *Eastman Chemical Company (resins)*
[c] *Calumet Specialty Products (naphthenic oil)*
[d] *BASF (antioxidant)*

Study formulations were prepared using an in-can mixer and subsequently evaluated for the following:

- Viscoelastic properties—Using Dynamic Mechanical Analysis (DMA)
- Viscosity profiles at varying temperatures (before and after aging [177°C for 72 h])—Brookfield Viscometer
- Adhesive property evaluation—1-mil-thick adhesive coating on Mylar™
  - 180 degree peel on stainless steel substrate (peel rate @ 4 inches/min)
  - Loop tack on stainless steel substrate

The viscoelastic performance analysis of the PMR extended formulations along with the control is shown in Figure 1.

Figure 1. Viscoelastic properties of formulations extended with PMRs



As can be seen in Figure 1, the T_g and elastic modulus are not significantly affected (with the exception of Piccotex™ LC) by the addition of PMRs into the formulation, with most showing similar viscoelastic characteristics to the control.

Figure 2 shows the absolute values of T_g, Tan δ minimum value at Tan δ minimum temperature (an indication of cohesive property), 3rd crossover temperature (indication of melting temperature), and Tan δ peak value at T_g (indication of tack). With the exception of Piccotex™ LC, all other PMR extended formulations are comparable to the control formulation.

Figure 2. Viscoelastic property comparison values from DMA.

Figures 3 and 4 summarize the adhesive property evaluation results, which were performed with 0.9–1-mil-thick Mylar™-coated films on a stainless steel substrate. Eastotac™ H100W resins extended with PMRs exhibit similar adhesive performance compared to the control formulation.

Notably, the formulation containing Piccolastic™ A75 exhibited improved loop tack, which can be attributed to the slightly lower softening point of the resin.

Figure 3. 180 degree peel on stainless steel (peel rate at 4 inches/min)

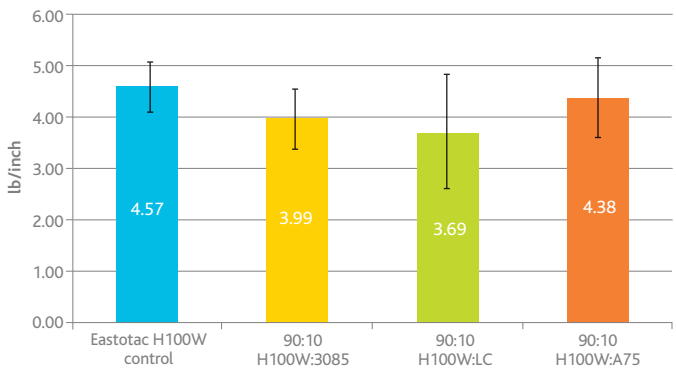


Figure 4. Loop tack on stainless steel

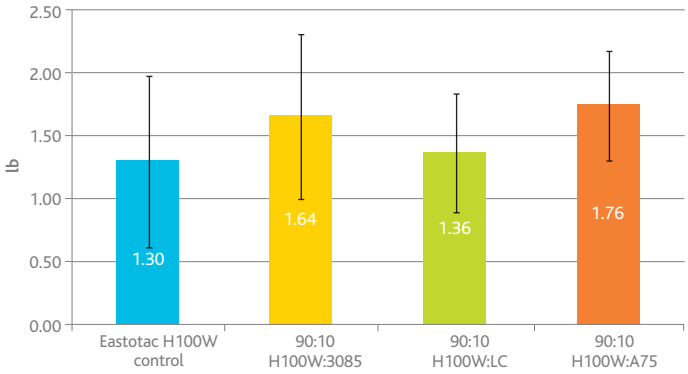


Figure 5 illustrates the viscosity profiles at 5 different temperatures. All formulations are similar to the control, even after aging at 177°C for 72 h.

Figure 5. Initial (before aging) and aged Brookfield viscosity (cps) profiles of formulations at different temperatures

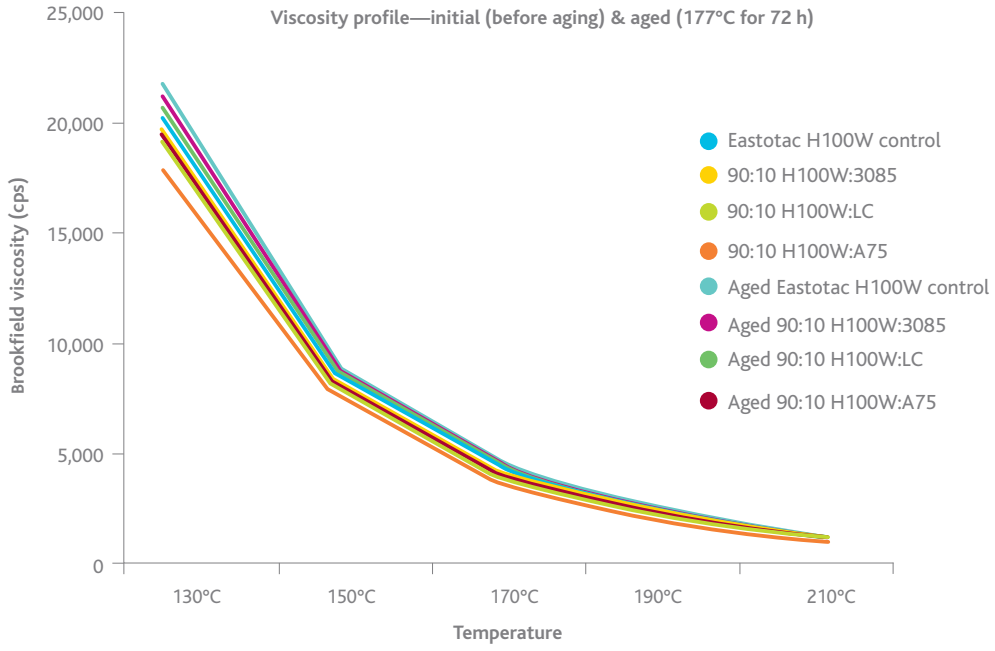


Figure 6. Aging studies of the formulations at 177°C for 72 h.

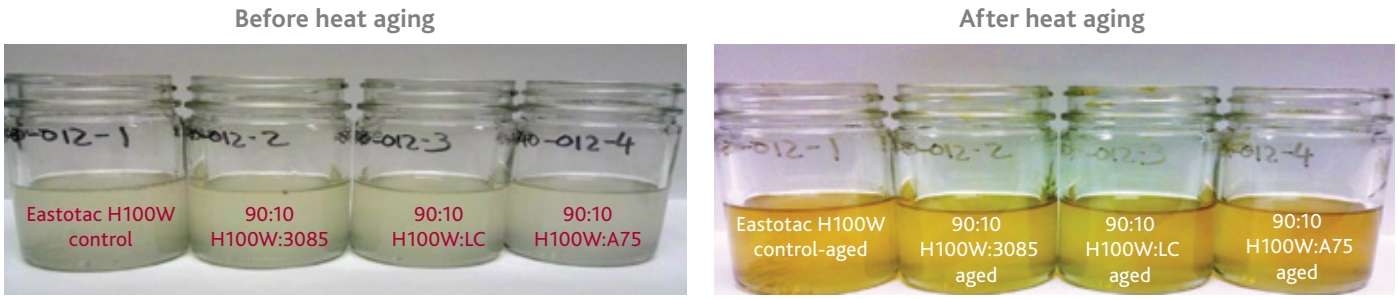


Figure 6 demonstrates the excellent thermal stability characteristics of OBC-based formulations both before and after aging (at 177°C for 72 h). The addition of PMRs does not have a detrimental effect on aging characteristics.

Conclusion

Adhesives utilizing hydrogenated hydrocarbon resins such as Eastotac™ H100W can be extended with pure monomer resins by up to 10% in an OBC-based nonwoven PSA formulation without affecting the adhesive performance and thermal aging properties.

- Piccolastic A75 containing formulation exhibited best overall properties:
  - Adhesive performance—improved tack and similar peel
  - Good thermal stability on aging, both color and viscosity

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