Introduction

The need for environmentally friendly, waterborne pressure sensitive adhesives (PSAs) continues to increase. One market segment showing significant growth is filmic label applications. These demanding applications require waterborne PSAs that are non-water-whitening and have excellent adhesion to a multitude of substrates. Eastman Chemical Company has resin dispersions that can be incorporated into filmic grade acrylic PSAs to improve peel and adhesion to low and high energy substrates while maintaining non-water whitening performance.

This technical approach requires the use of Eastman specialty adhesive products. The following test data was generated to illustrate the use of these products in a waterborne PSA formulation. The Eastman products highlighted in this work include:

- **Tacolyn 3509 Resin Dispersion** – A rosin ester-based dispersion. Tacolyn 3509 is designed for use in pressure sensitive adhesives based on acrylic polymer emulsions or carboxylated SBR polymer emulsions where it greatly enhances the tack and peel to polyethylene and corrugated board. Due to the low surface tension of Tacolyn 3509, the adhesive formulator generally does not require the post-addition of wetting agent when coating to silicone release liner.

- **Tacolyn 1070 Hydrocarbon Resin Dispersion** – Tacolyn 1070 is a hydrocarbon resin-based dispersion recommended as a tackifier for acrylic latex polymers used in label, tape, and construction adhesive applications. As a modifier for these latexes, it offers an excellent balance of adhesion, especially to polyolefins, coupled with good cohesive strength. Tacolyn 1070 resin dispersion also gives good oxidative and ultraviolet light (UV) stability in these systems.

- **Tacolyn 3280 Resin Dispersion** – Tacolyn 3280 resin dispersion is based on a highly hydrogenated rosin ester. It can be used as a tackifier resin in various types of adhesives that require an exceptional degree of color retention and oxidation resistance.

### Technical Discussion

#### Table 1: Adhesive Formulations

<table>
<thead>
<tr>
<th>Adhesive Component(^a) (Grams)(^b)</th>
<th>EHA Filmic Grade Latex</th>
<th>Tacolyn 3509</th>
<th>Tacolyn 1070</th>
<th>Tacolyn 3280</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHA Filmic grade latex</td>
<td>85.0</td>
<td>85.0</td>
<td>85.0</td>
<td>85.0</td>
</tr>
<tr>
<td>28% (\text{NH}_4\text{OH})</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Tacolyn 3509</strong>(^c)</td>
<td>–</td>
<td>15.5</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Tacolyn 1070</strong>(^c)</td>
<td>–</td>
<td>–</td>
<td>15.5</td>
<td>–</td>
</tr>
<tr>
<td><strong>Tacolyn 3280</strong>(^c)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>15.5</td>
</tr>
<tr>
<td>67% Surfynol PSA 336(^d)</td>
<td>0.6</td>
<td>–</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>20% Polyphobe 104(^e)</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>

\(^a\)Adhesive components were added in the order listed necessary in order to maintain stability of the latex and prevent coagulation or grit formation, \(^b\)On a dry weight basis, \(^c\)Eastman Chemical Company, \(^d\)Surfactant - Air Products and Chemicals, Inc., \(^e\)Rheology modifier - The Dow Chemical Company
**Resin Dispersions for Filmic Label Applications (TT-66A)**

### Peel and Loop Tack Performance

**Figure 1: 180° Peel Test Results**

![180° Peel Test Results](image1)

**Figure 2: Loop Tack Test Results**

![Loop Tack Test Results](image2)

*Note: Labels consisted of 21 g/m² dry adhesive between 100 gauge corona treated oriented polypropylene and siliconized release liner. 180° peel adhesion was determined in accordance with test method PSTC-1 with a five-minute dwell time. All tests were performed @ 23°C, 50% relative humidity. Test data was reported as an average five specimens.*

Figure 1 illustrates that peel performance of the filmic latex is enhanced by incorporating a resin dispersion. In addition, adhesion to low and high energy substrates is substantially improved. Relative to the control, Tacolyn 3280 is particularly effective in improving peel properties on low energy surfaces. Tacolyn 3509 is the most effective on high energy surfaces, while Tacolyn 1070 offers a good balance of peel on both types of substrates. Based on the data shown in Figure 2, loop tack performance of the PSA is not adversely affected by incorporation of the resin dispersion.

### Shear Performance

**Figure 3: 178°C ¾" x ¾" Shear Results**

1 kg weight

![178°C ¾" x ¾" Shear Results](image3)

**Figure 4: 178°C 1" x 1" Shear Results**

1 kg weight

![178°C 1" x 1" Shear Results](image4)

*Note: All tests were performed at 23°C, 50% relative humidity. Test data was reported as an average five specimens.*

Shear performance results, as shown in Figures 3 and 4, illustrate that cohesion of the filmic latex is maintained when a resin dispersion is incorporated. Within experimental error, the use of each resin dispersion in the filmic latex, respectively, results in similar shear values.
Water Resistance

To evaluate water resistance, several PSAs were prepared using competitive resin dispersions. Panels were placed in room temperature deionized water and soaked for 24 hours. Testing on the PSAs with competitive resins was discontinued because the color of the labels appeared white after drying.

Whitening was due to the large particle size of the competitive dispersions, which was greater than the wavelength of visible light (400-800 nm). Light is reflected when visible light passes through an adhesive film containing large particles. This phenomenon does not occur when particles are smaller than the wavelength of light. The small particle size of Eastman’s Tacolyn resin dispersions make them ideal for applications where clarity is a critical concern.

Figure 5: Water Resistance Testing

180° Peel After 24 Hour Water Soak

Note: Panels were placed in room temperature deionized water and soaked for 24 hours. Labels were observed for whitening. Panels were removed from the water bath, gently wiped dry and immediately subjected to 180° peel test. 80° peel adhesion was determined in accordance with test method PSTC-1 with a five-minute dwell time. Test data was reported as an average five specimens.

As illustrated in Figure 5, the non-water whitening performance of PSAs containing Tacolyn resin dispersions is comparable to the control filmic latex. Within experimental error, there are no significant differences based on the type of resin dispersion used.

Conclusion

In this study, the control formula consisted of a filmic grade acrylic latex with no added resin dispersion. Various resin dispersions were added to the filmic grade latex in order to improve adhesive performance. Based on the results of this study, it may be possible to improve the peel and adhesion of a filmic latex by incorporating a Tacolyn resin dispersion. This improvement in adhesive performance is seen from 180° peel values on both low and high energy substrates. In addition, as evidenced by shear results on stainless steel, the use of Tacolyn resin dispersions help maintain cohesive properties of filmic latex. Using Tacolyn resin dispersions in a filmic latex also provides good non water-whitening performance in pressure sensitive adhesive applications.

PSA filmic label makers are being challenged to reduce costs without sacrificing performance or the environment. Eastman’s family of Tacolyn resin dispersions helps meet these challenges by providing improved specific adhesion to polyolefins coupled with excellent moisture resistance.

For more information on formulation strategies using tackifiers from Eastman, contact us at 1-800-EASTMAN or through the internet at www.tackifier.com.
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