Transdermal Drug Delivery Solutions

Dow Corning® brand SilAc Hybrid Pressure Sensitive Adhesives

Efficacy. Compliance.

To efficiently treat diseases and meet unmet medical needs, transdermal drug delivery systems are designed to provide an alternative delivery route to oral dosage forms by effectively delivering a consistent therapeutic amount of drug across patient skin. Transdermal patches offer the advantage of controlled drug release systems with the avoidance of first-pass metabolism by the liver and reduced side effects associated with orally delivered drugs. The transdermal route of drug administration is recognized to improve patient compliance, allowing daily or multiple-day treatment and easy interruption by patch removal if adverse effects occur.

Transdermal patches typically use a pressure sensitive adhesive (PSA) – traditionally silicone, acrylic or polyisobutylene (PIB) – as a patch fixation system and/or drug matrix. Dow Corning® brand BIO-PSA silicone adhesives have been widely used for certain classes of active pharmaceutical ingredients (API), while other delivery systems have been used in combination with other chemistries; this is generally related to the drug solubility profile in the adhesive matrix or system. While silicone adhesives are often used because they are “kind” to the skin, chemically stable and highly permeable, silicone-based patches are also considered when the drug depletion rate needs to be high.

As a market leader in transdermal silicone adhesive systems, Dow Corning developed Dow Corning® brand SilAc Hybrid Pressure Sensitive Adhesives to provide an innovative single-technology solution that addresses multiple needs for patch formulators and pharmaceutical companies. The Dow Corning® SilAc Hybrid PSA product line complements Dow Corning’s existing range of BIO-PSA adhesives. It is a flexible, innovative and patented hybrid system with effective drug-loading and release properties, a good adhesion profile, and rheological behavior that leads to good coating homogeneity in manufacturing.

Combining currently used technologies for improved performance

Bringing together the best of known silicone and acrylic polymers in one hybrid system delivers the advantages of each chemistry: respectively high drug diffusion and solubility while retaining good chemical and physical stability. Blends of silicone and acrylic systems have been described as providing improved wear adhesion and drug release properties. Dow Corning® SilAc Hybrid PSA also provides better stability and increased versatility to achieve suitable tack, peel adhesion and lower cold-flow.
Chemistry

Dow Corning® SilAc Hybrid PSA is a silicone-acrylate hybrid PSA. The acrylate copolymer is designed to provide a suitable balance of adhesive and drug release performances to the hybrid adhesive. The resulting hybrid structure combines polyacrylate and silicone PSA molecular structures in a stable semi-interpenetrated network (see Figure 1).

Like other pressure sensitive adhesive technologies, Dow Corning® SilAc Hybrid PSAs are viscoelastic compounds characterized by an effective balance of adhesion and cohesion performances. They are typically evaluated by the dynamic rheology "oscillation test" method. The rheological parameters, viscous modulus ($G'$), elastic modulus ($G''$) and complex viscosity ($\eta^*$) are scrutinized for performance comparison. Indeed, good initial adhesive performance (tack) is obtained when $G'$ values are low (possibly lower than $G''$) at low frequency rates (e.g., 0.01 rad/s) corresponding to the patch application step. Nevertheless, the swift increase in $G'$ values (preferably higher than $G''$) as the frequency is increased exhibits the optimum creep-resistance behavior, which is favorable to cold-flow resistance and long wear time. As shown in Figure 2, the typical rheological profiles for Dow Corning® SilAc Hybrid PSAs meet the PSA requirements and confirm their suitability as efficient skin adhesives.

Table 1. Comparative performance of selected adhesive matrices for transdermal applications.

<table>
<thead>
<tr>
<th>Adhesive Matrix</th>
<th>Instant Patch Adhesion (Tack)</th>
<th>Drug Load</th>
<th>Drug Diffusion</th>
<th>Cold-Flow Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicone PSAs</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Acrylic PSAs</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Silicone/Acrylic PSA Blend</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Dow Corning® SilAc Hybrid PSA</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
</tbody>
</table>


1The performance of a transdermal patch is design- and formulation-dependent; the adhesive plays a critical but only partial role as part of the formulation.

Table 2. Typical properties of Dow Corning® SilAc Hybrid PSAs.

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>CTM¹</th>
<th>Dow Corning® 7-6102 SilAc Hybrid PSA</th>
<th>Dow Corning® 7-6302 SilAc Hybrid PSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicone/Acrylic Ratio</td>
<td></td>
<td>50/50</td>
<td>50/50</td>
<td>50/50</td>
</tr>
<tr>
<td>Solvent</td>
<td></td>
<td>Ethyl Acetate</td>
<td>Ethyl Acetate</td>
<td>Ethyl Acetate</td>
</tr>
<tr>
<td>Volatile Content %</td>
<td></td>
<td>0086</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Viscosity, 25°C cP</td>
<td></td>
<td>0050</td>
<td>2,500</td>
<td>1,500</td>
</tr>
<tr>
<td>$\eta^*$, 30°C, 0.1 rad/s</td>
<td></td>
<td>1098</td>
<td>1.0e7</td>
<td>4.0e6</td>
</tr>
<tr>
<td>Characteristics</td>
<td></td>
<td>High shear</td>
<td>High tack</td>
<td>High tack</td>
</tr>
</tbody>
</table>

¹CTM: Corporate Test Method. Copies of CTMs are available on request.

Specification Writers: These values are not intended for use in preparing specifications. Please contact your local Dow Corning sales office or your Dow Corning Connection before writing specifications on this product.

Figure 1. Comparison of Dow Corning® BIO-PSA Silicone Adhesive and Dow Corning® SilAc Hybrid PSA.

Figure 2. Typical rheological profiles for Dow Corning® SilAc Hybrid PSAs; measured at 30°C on dried adhesive solids.

The performances of a transdermal patch are design- and formulation-dependent. The adhesive plays a critical role, but the performance also is influenced by the formulation. Compared with other adhesive matrices for transdermal applications, Dow Corning® SilAc Hybrid PSAs provide a wide formulation space, allowing for good patch adhesion, efficient drug load and drug diffusion, suitable water permeability, and cold-flow resistance. Dow Corning® SilAc Hybrid PSAs offer the performance of silicone acrylic blends while ensuring phase stability and formulation flexibility.
Make Dow Corning your innovation leader

With more than 60 years of healthcare market experience in the design of silicone-based systems, you can rely on Dow Corning for:

- A reliable global supply of reputable silicone-based adhesives specifically for healthcare applications
- Regulatory and product development expertise and support
- A regulatory documentation aligned with the requirements of the pharmaceutical market

Regulatory summary

A Drug Master File for Dow Corning® SilAc Hybrid Pressure Sensitive Adhesives is on file with the United States Food and Drug Administration.

For additional information

For product data sheets and product samples, contact your Dow Corning technical representative.

Contact Dow Corning

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