

Transdermal drug delivery solutions

Combining currently used technologies for improved performance



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.

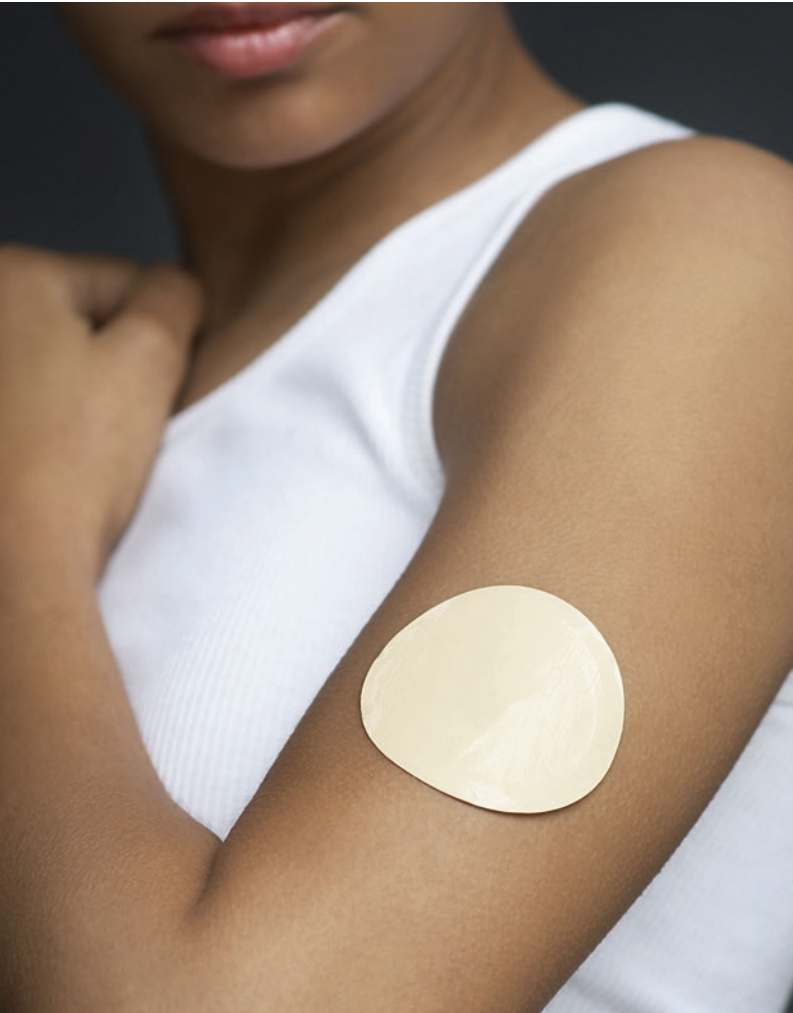
Transdermal patches typically use a pressure sensitive adhesive (PSA)—traditionally silicone, acrylic or polyisobutylene (PIB)—as a patch fixation system and/or drug matrix. Liveo™ BIO-PSA silicone adhesives have been widely used for certain classes of active pharmaceutical ingredients (API), while other 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, DuPont developed Liveo™ SilAc Hybrid Pressure Sensitive Adhesives to provide an innovative single-technology solution that addresses multiple needs for patch formulators and pharmaceutical companies. The Liveo™ SilAc Hybrid PSA product line complements DuPont’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.

DuPont™ Liveo™ SilAc Hybrid Pressure Sensitive Adhesives

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. Liveo™ SilAc Hybrid PSA also provides better stability and increased versatility to achieve suitable tack, peel adhesion and lower cold-flow.

*SilAc technology is not fully commercial



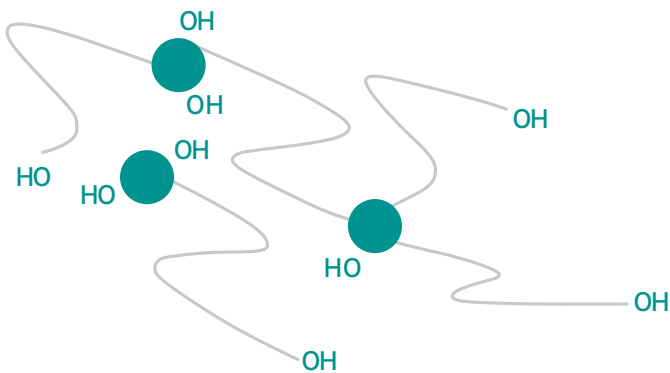
Chemistry

Liveo™ 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, Liveo™ 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 Liveo™ SilAc Hybrid PSAs meet the PSA requirements and confirm their suitability as efficient skin adhesives.

Figure 1: Comparison of Liveo™ BIO-PSA Silicone Adhesive and Liveo™ SilAc Hybrid PSA

Liveo™ BIO-PSA Silicone Adhesive



Liveo™ SilAc Hybrid PSA

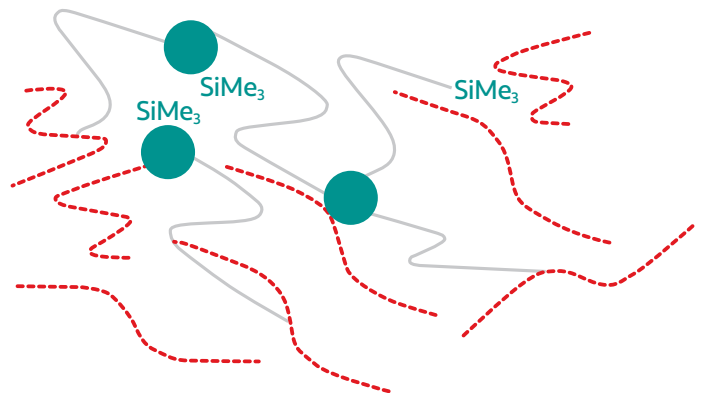


Table 1: Comparative performance of selected adhesive matrices for transdermal applications¹

Adhesive Matrix	Instant Patch Adhesion (Tack)	Drug Load	Drug Diffusion	Cold-Flow Resistance
Silicone PSAs				
Acrylic PSAs				
Silicone/Acrylic PSA Blend				
Liveo™ SilAc Hybrid PSA				

Compared with other adhesive matrices for transdermal applications, Liveo™ 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. Liveo™ SilAc Hybrid PSAs offer the performance of silicone acrylic blends while ensuring phase stability and formulation flexibility.

Theoretical performance with indicating maximum performance and indicating minimum performance. Theoretical performance based on literature reviews and internal knowledge.

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.

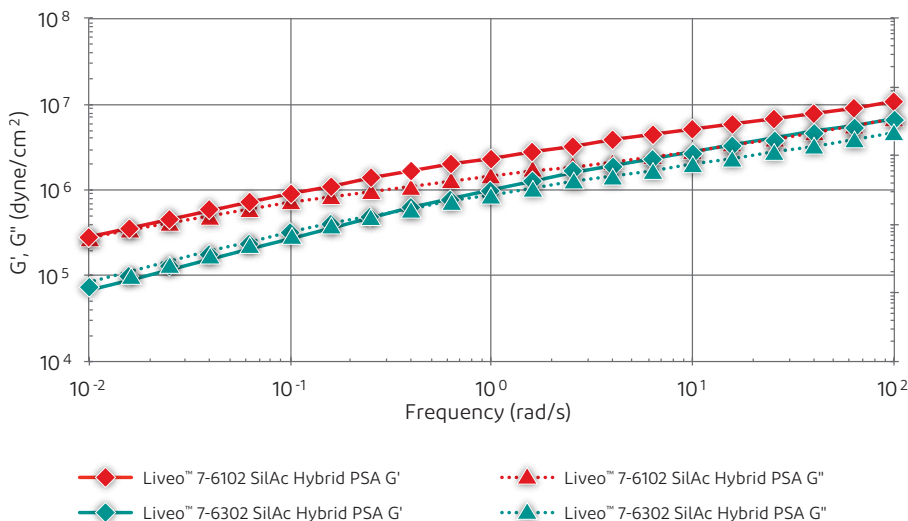
Table 2: Typical properties of Liveo™ SilAc Hybrid PSAs

Property	Unit	CTM ²	Liveo™ 7-6101 SilAc Hybrid PSA	Liveo™ 7-6102 SilAc Hybrid PSA	Liveo™ 7-6301 SilAc Hybrid PSA	Liveo™ 7-6302 SilAc Hybrid PSA
Silicone/Acrylate Ratio			50/50	50/50	50/50	50/50
Solvent			Heptane	Ethyl Acetate	Heptane	Ethyl Acetate
Volatile Content	%	0086	40	50	40	50
Viscosity, 25°C	cP	0050	1,500	2,500	2,000	1,500
Eta*, 30°C, 0.1 rad/s	P	1098	5.0e7	1.0e7	4.0e7	4.0e6
Characteristics				High shear		High tack

²CTM: 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 DuPont sales office before writing specifications on this product.

Figure 2: Typical rheological profiles for Liveo™ SilAc Hybrid PSAs; measured at 30°C on dried adhesive solids





Make DuPont your innovation leader

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



To learn more about DuPont's healthcare solutions visit:
www.dupont.com/healthcare.html

For country-level information, visit:
www.dupont.com/corporate-functions/our-company/global-locations.html



CAUTION: DO NOT USE DUPONT MATERIALS IN MEDICAL APPLICATIONS INVOLVING PERMANENT IMPLANTATION IN THE HUMAN BODY OR PERMANENT CONTACT WITH INTERNAL BODILY FLUIDS OR TISSUES. DO NOT USE DUPONT MATERIALS IN MEDICAL APPLICATIONS INVOLVING BRIEF OR TEMPORARY IMPLANTATION IN THE HUMAN BODY OR PERMANENT CONTACT WITH INTERNAL BODILY FLUIDS OR TISSUES UNLESS THE MATERIAL HAS BEEN PROVIDED DIRECTLY BY DUPONT UNDER A CONTRACT THAT EXPRESSLY ACKNOWLEDGES THE CONTEMPLATED USE.

The information, suggestions and data contained herein are intended only as an informational guide to assist you in making preliminary selections of materials and are not intended to be all-inclusive or final. Because DuPont cannot anticipate or control the many different conditions under which this information, data, suggestions or materials may be used, DuPont does not guarantee the applicability or the accuracy of this information or the suitability of the information, data, suggestions, or materials in any given situation. The information, data, or suggestions are not intended to substitute for any testing you may need to conduct to determine for yourself the suitability of a particular material for a particular purpose. DuPont makes no guarantee of results and assumes no obligation or liability whatsoever in connection with this information. Such information, data or suggestions are to be used and relied upon at user's own discretion and risk. DuPont makes no warranties, express or implied, and disclaims any and all direct and indirect liability for damages or losses resulting from or relating to the use of any information, suggestion, data, or materials described herein. Statements concerning the use of the products or formulations described herein are not to be construed as recommending the infringement of any patent, copyright, designs or other intellectual property and no liability for infringement arising out of such use is assumed by DuPont. None of this information is to be considered as a license to operate under, or recommendation to infringe, any patents.

DuPont reserves the right not to sell Special Control and Premium Control products for selected applications.

Although these products are tested against certain USP Class VI and ISO 10993 standards, DuPont makes no representation or warranty of suitability of its products for particular healthcare or medical applications or any other representations or warranties based on such testing.

The information set forth herein is furnished free of charge and is based on technical data that DuPont believes to be reliable. It is intended for use by persons having technical skill at their own discretion and risk. DuPont makes no warranties, express or implied, and assumes no liability in connection with any use of this information.

DuPont™, the DuPont Oval Logo, and all products, unless otherwise noted, denoted with ™, SM or © are trademarks, service marks or registered trademarks of affiliates of DuPont de Nemours, Inc.

© 2020 DuPont de Nemours, Inc. All rights reserved.

Form Number: 001-20450-CDP0820