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An Instant Bond: Silicone Reactive Hot Melt for Plastics

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What We'll Discuss

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1. 100% Silicone Reactive Hot Melt
   - Mechanical properties
     - Instant bonding
     - Energy dissipation
     - Low VOC
     - Stress strain
     - Elastic recovery
   - Features and benefits
     - Unprimed adhesion
     - Temperature resistance
     - Weather resistance / durability
2. Cost Savings
   - Manufacturing efficiency
   - Reduced material waste
   - Extended performance life
3. Expanding Applications
   - Plastic bonding applications
   - Replacement for mechanical fasteners

100% Silicone* Reactive Hot Melt

* Silicone is a non-organic (carbon-based) polymer backbone

Comparison of Bonding Techniques

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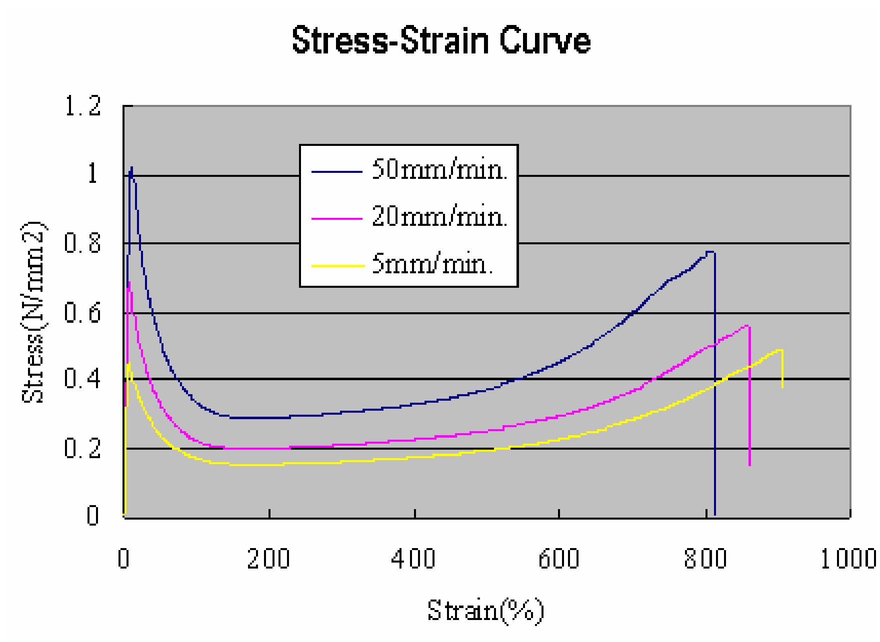
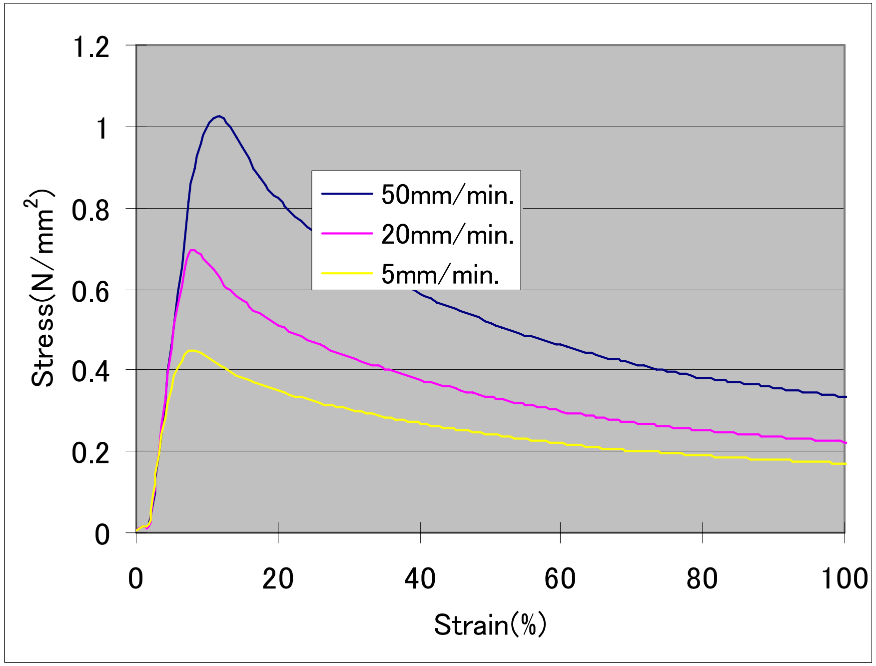
	Advantages	Disadvantages
Tape	• Inexpensive • No equipment necessary	• Labor intensive • No automated application • Application consistency (manual) • Primer often needed on low surface energy plastics
Traditional Sealants	• Moderate-to-superior performance & reliability • Low cost application equipment	• Poor green strength • Material squeeze-out • Surface contamination
Mechanical Fasteners	• Long term bond	• Drilled holes weaken material and can lead to stress points • Temperature variations induce high stress at screw points
Silicone Reactive Hot Melt	• Instant bonding • Accelerated production process • Lowers labor costs • Design flexibility • Strong adhesion to plastics	• Initial equipment investment • Higher material costs

Mechanical Properties

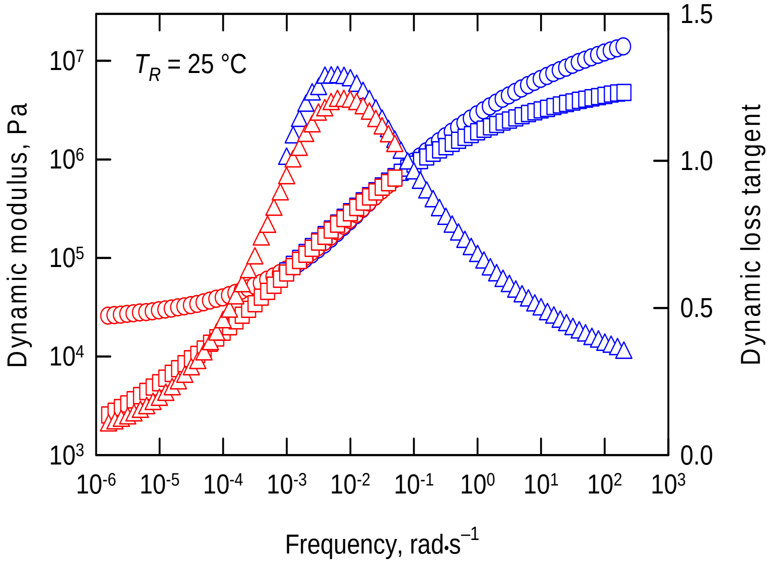
Stress Strain

- Behaves like a high modulus elastomer at low temperature or high strain rate
- Behaves like a low modulus elastomer at high temperature or under constant load





Mechanical Properties



High temperature behavior
Long-term (slow rate) properties

Low temperature behavior
Short-term (high rate) properties

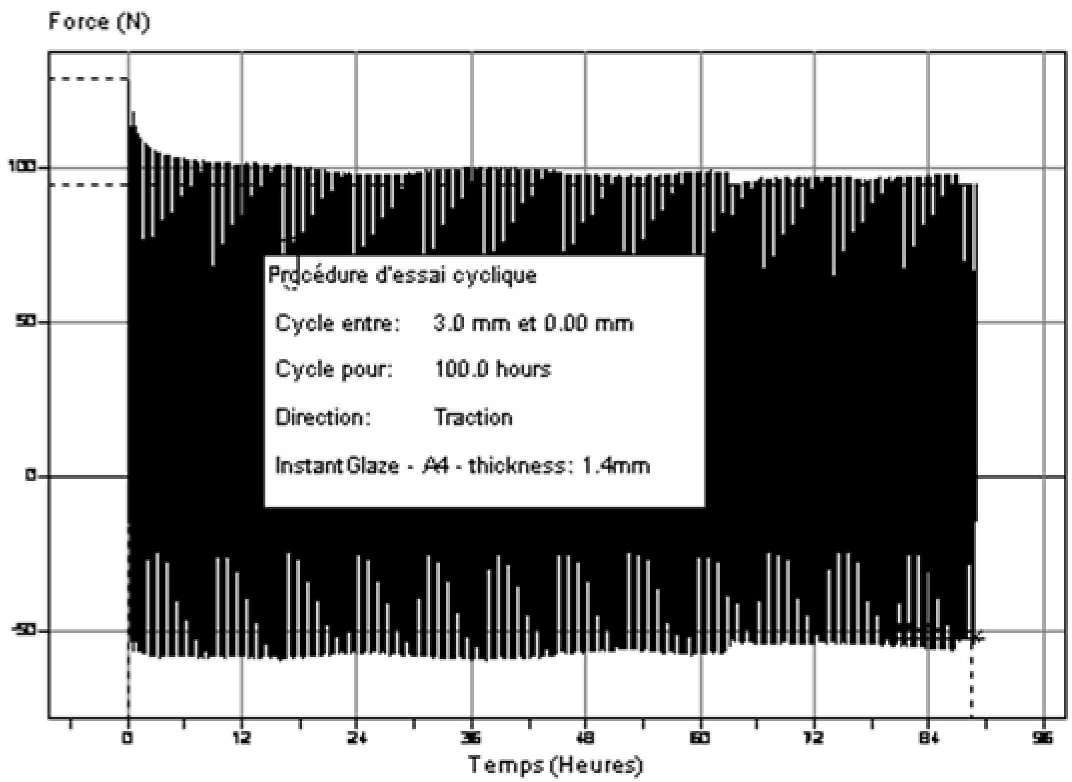
T, °C 90	25	Viscoelastic function
○	○	Storage modulus *G'*; elastic component
□	□	Loss modulus *G"*, loss/viscous component
△	△	Loss tangent, tan δ (*G"*/*G'*)

- The elastic component *G'* is a measure of the ability to store energy and to recover when deformation ceases
- The viscous component *G"* is a measure of the ability to dissipate the energy being applied
- The dynamic loss tangent, tan *d*, is the ratio of *G"* to *G'*. The breadth and magnitude of tan *d* is responsible for the adhesive performance over a wide range of frequencies and temperatures; balancing energy dissipation (adhesive) and energy storing (strength) capabilities.

Mechanical Properties

Elastic Recovery

- The cycling under a constant deformation shows that an elastic recovery greater than 90% is retained over more than 3 days thereby providing this hot melt with excellent movement capability resulting in less stress buildup



Features and Benefits

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Unprimed Adhesion

- Very low surface tension → excellent wetting characteristics even on non polar substrates such as polyethylene or polypropylene
- Low elastic modulus → a material of choice for sealing plastics to materials with different CTEs such as glass, plastics and metals

Temperature Resistance

- Chemical bond unaffected by typical high and low temperature conditions
- Service temperatures of -50°F (-45°C) to 300°F (150°C)

Weather Resistance / Durability

- Unaffected by long term direct and indirect UV exposure
- The silicone reactive hot melt is resistance to water

Cost Savings

Manufacturing Efficiency

- Fast bonding
  - Rapid rise in viscosity
  - Pressure sensitive adhesive (PSA) character of the material
- No need for priming or surface activation; including plastics, glass, PVC, wood, paints and aluminum
- Easy to process using automatic equipment
- Increases production rates in assembly manufacturing

Shear Strength vs. Cure Time

Adhesive	15min $x10^3Pa$	1 day $x10^3Pa$	7 days $x10^3Pa$	7 days + 24hrs water $x10^3Pa$
Silicone reactive hot melt	85	130	280	300
Silicone sealant	0.1	40	110	100
Bonding tape #1	14	26	29	<10
Bonding tape #2	38	40	40	<10

Cost Savings

Reduced Material Waste

- 24-hour pot life
- Reduces squeeze out
- Improves beading consistency
- 15-minute open time to adjust materials being set

Extended Performance Life

- Reduces sealant failure → reduced part replacement
- Reduces total cost of ownership

Expanding Applications

Assembly Trends

- Improve productivity
- Reduce labor costs
- Improve reliability
- Eliminate need for penetrating fasteners
- Increase heat stability
- Allowing bonding of differing materials

Expanding Applications

Plastic Bonding

- Silicone hot melts bond readily to plastics
  - Polyethylene, polycarbonate, polypropylene, acrylic
- Provides a flexible seal that withstands differing thermal expansion coefficients
- Reduces stress on bond line with low elastic modulus

Replacement for Mechanical Fasteners

- Bonds more completely than mechanical fasteners
- More durable over time
- Low stress point cracking
- Absorbs stress from thermal expansion

Expanding Applications

- Sports & Leisure
- Home Appliance
- Industrial Applications
- Automotive Headlamps
- Solar Cells
- PC Boards

Summary

- **Takeaway #1:**
  Silicone reactive hot melts have the mechanical properties, adhesion performance and temperature resistant characteristics required to support an expanding range of applications, including plastic bonding and replacement of mechanical fasteners.
- **Takeaway #2:**
  Silicone reactive hot melt supports higher-speed assembly to increase manufacture output while reducing maintenance costs.

For more information…

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