Futures of Pressure Sensitive Adhesive Technologies & Applications

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Definition of PSA
(Pressure Sensitive Adhesives)

A special class of adhesive that is:

• Permanently tacky at Room Temperature
• Spontaneously adhere on contact or with little pressure
• Require no activation by water, solvent or heat to form a strong bond
Classification of PS Adhesive by Common Functions

- High Tack & Adhesion
- Cold Temperature
- General Purpose Permanent
- Removable
- Heat Resistant
# PSA Classification by Technologies

<table>
<thead>
<tr>
<th></th>
<th>Solvent</th>
<th>Emulsion</th>
<th>Hot Melt</th>
<th>UV Hot Melt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicone</td>
<td>High</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acrylic</td>
<td>Specialty</td>
<td>Most Common</td>
<td>Developmental</td>
<td>Emerging</td>
</tr>
<tr>
<td>Rubber</td>
<td>Few</td>
<td>Few</td>
<td>Common</td>
<td>Emerging</td>
</tr>
</tbody>
</table>
PSA Polymers Life Cycle

**Infancy**
- Hot Melts of
  - UV radiation cured Acrylic

**Growth**
- Emulsions of
  - Acrylic copolymers
  - SB copolymers

**Maturity**
- Hot Melts of
  - SIS/SBS block Copolymers

**Age**
- Solvent Solutions of
  - Rubber/Resin
  - Acrylic
Typical PSA Polymer Performance

Graph showing typical PSA polymer performance with categories including:

- Heat Resistance
- Chemical Resistance
- UV Resistance
- Adhesive Clearity
- Apolar Adhesion
- Water Resistance

Performance metrics are compared across different types:

- UV Acrylic
- Emulsion Acrylic
- Hot Melt SBS/SIS

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UV Acrylic PSA – The next generation PSA

• Combine the best of Acrylic Chemistry with Hot melts Process performance.
• Able to replace 80% of existing solvent based PSA product applications

Key Performance Advantages:
• Excellent UV Resistance: Out door Decal
• Excellent Water Resistance: Pasteurizable clear Label
• Excellent Solvent Resistance: Wet tissue closure label
• Operate up to 140°C service temperature: Automotive label
• No skin irritation: Skin contact adhesive
• No cytotoxicity: Direct food contact adhesive; Blood-bags label
Drivers of our Future PSA base Business

Environments Conservation & Protection
- Removable & Recyclable Labels

High Performance & High Reliability Devices
- Clean Room Labels
- High Performance Labels

Security & Authentication Counterfeiting
- Security & Smart Labels

Transdermal Drug Delivery
- Medical TDD & Cosmeceutical Patches

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Major Areas of PSA Application Development

- Security & Authentication
  - RFID embedded PSA Materials
- Micro-Electronics
  - Clean Room PSA Materials
- Medical Products
  - Transdermal Drug in Adhesive Delivery System
Security Labels

Area of Application:

• Tamper Evident
• Product Authentication
• Anti-Counterfeit
The Market

- Cosmetic
- Drugs
- Food & Beverages
- Electronics
- Automotives & Planes
- Hospitals
- Animals
- Airports, Customs ….
Smart Label Supply Chain & Manufacturing Processes

RFID Chip Manufacturer

Application System Integrator

Inlay / Transponder Manufacturer

Smart Label Converter

Smart Label Printer Encoder

RFID Label Materials Supplier

RFID Materials Group
Smart Label

Applications:

• Transportation/Distribution
• Industrial
  – Direct product identification
  – Carrier identification
• Security and Access Control
• Animal Identification
• Retail
Typical Smart Label/Tag constructions

- Face-stock
- Adhesive
- RF Transponder
- Adhesive
- Release Coating
- Release Liner

Half-Label | Full-Label | Tag

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Micro-electronic Clean-room Hierarchy

Label Materials Printing & Converting

Transistor / Magnetic Tape manufacturing

IC / LCD manufacturing

LSI / Magnetic Disk manufacturing

ULSI Wafer Fabrication manufacturing

Class-1  –  10 Environment

Class-100 Environment

Class-1000 Environment

Class- 10K Environment

Class-100K Environment
Current Technical Challenge:

- Development of **Functional Pressure Sensitive Adhesive**
  - Low Out-Gassing,
  - Low Bleachable Ions

- Development of **Controllable Release Coating for Synthetic Liner**
  - Silicone free
  - Low Bleachable Ions
### Examples of Contaminants Limits (ug/cm\(^2\))

<table>
<thead>
<tr>
<th>Anion</th>
<th>Cation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloride (Cl)</td>
<td>Lithium (Li)</td>
</tr>
<tr>
<td>Fluoride (F)</td>
<td>Sodium (Na)</td>
</tr>
<tr>
<td>Nitrite (NO(_2))</td>
<td>Ammonium (NH(_4))</td>
</tr>
<tr>
<td>Bromide (Br)</td>
<td>Potassium (K)</td>
</tr>
<tr>
<td>Nitrate (NO(_3))</td>
<td>Magnesium (Mg)</td>
</tr>
<tr>
<td>Phosphate (PO(_4))</td>
<td>Calcium (Ca)</td>
</tr>
<tr>
<td>Sulfate (SO(_4))</td>
<td></td>
</tr>
</tbody>
</table>

**Particles (>0.5um)**

- Wet Test (pt/cm2) LPC
- Helmke Drum @ ≥0.5µm (pt./ft3/sheet)

- NVR _H\(_2\)O (ug/cm\(^2\)) < 2
- NVR _IPA (ug/cm\(^2\)) < 10
  
  <30
  
  <10
## Microelectronic Clean Room Label

**Silicone Contaminants Limits:**

<table>
<thead>
<tr>
<th></th>
<th>Seagate #30825-001 Spec Limit</th>
<th>Read-Rite #15-50043-00 Spec Limit</th>
<th>KOMAG Spec Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facestock – Print side</td>
<td></td>
<td></td>
<td>&lt; 7% Atomic</td>
</tr>
<tr>
<td>Release Liner – Backing side</td>
<td></td>
<td></td>
<td>&lt; 1%* Atomic</td>
</tr>
<tr>
<td>Release Liner – Adhesive side</td>
<td>&lt; 390 ng/cm²</td>
<td>&lt; 40 ng/cm²</td>
<td>&lt; 1%* Atomic</td>
</tr>
</tbody>
</table>

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Pharmaceutical Label Product

• Two Category:
  – Ethical (Prescriptive Drug)
  – Over The Counter (OTC)

• Common Considerations:
  – High Speed Label Dispensing Process
  – High Mandrel Holding Requirement
  – Date, Batch Number variable imprinting
OTC (Over The Counter) Label Product

• Product Considerations:
  – Adhesive compliance for food labelling
    • FDA(21CFR175.105)
    • BgVV Direct & Indirect food contacts
  – Graphical & Consumer Appeal
  – Temper Evident
Ethical Label Product

• Products considerations:
  – Withstand Sterilization processes
  – Adhesive compliance for food labelling
    • FDA(21CFR175.125)
    • BgVV Direct & Indirect food contacts
  – Adhesive should be migration inert
    • For Bloodbags,
    • Plastic bags for infusion liquids
# Range of Pharmaceutical Adhesives

<table>
<thead>
<tr>
<th></th>
<th>Emulsion Acrylic</th>
<th>UV Acrylic</th>
<th>PVP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect Food Contact</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Direct Food Contact</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Gamma Radiation</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>E Tox</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Autoclaving</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Skin Contact</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Transdermal Drug Delivery Offers the Best of IV and Oral Administration

<table>
<thead>
<tr>
<th>Feature</th>
<th>IV</th>
<th>Oral</th>
<th>TDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced liver first-pass effects</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Constant drug levels</td>
<td>Yes</td>
<td>No*</td>
<td>Yes</td>
</tr>
<tr>
<td>Self-administration</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Unrestricted patient activity</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-invasive</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Sometimes can be achieved with controlled release.
Emulsion PS Adhesive Technologies provides a high ecological safety platform suitable for Transdermal Drug Delivery Application

- Adhesive compliance for skin contact:
  - FDA(16CFR1500.41)
- No skin irritation according
  - OECD-test 404
- No cytotoxicity according
  - ISO 10993-5
  - EN 30993-5