Polyurea Spray Coatings

Technologies and advances in raw materials and applications

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Outline

- Introduction
- The PU/Polyurea window
- Polyurea chemistry and technology
- Product developments
- Application references
- Conclusions
Introduction

Global leader in PEA’s, MDI-isocyanates and other specialty amines

Company 2007 revenues of approximately $10 billion.

Wide range of:
- Polyetheramines
- Specialty amines
- MDI isocyanates

Differentiated Chemicals
- Performance Products
- Polyurethanes
- Adhesives Coatings & Elastomers
- Advanced Materials
- Textile Effects
- Inorganics
- Pigments

- Performance Specialties
- Performance Intermediates
- Maleic Anhydride & Licensing
- Materials and Effects
- Appliances
- Automotive
- Construction
- Design & Composites Engineering
- Power & Electronics
- Adhesion
- Composite Wood Products
- Home textiles
- Coatings, Construction & Adhesives
- Technical textiles
- Footwear
- Furniture and Bedding
- TPU
- Apparel
- Footwear
- Technical textiles

PDA Europe 2008 Annual Conference - Vienna, 18-20 Nov.
The PU/Purea window

- extreme properties, extreme conditions, reactivity, cold cure
- price/quality
- compromise, boundaries to be defined

Temperature vs. % R.H.

- PU
- Hybrid
- Polyurea

-5°C to 35°C
- 5% to 100%
Polyurea chemistry

A polyurea coating results from a reaction of an isocyanate prepolymer (A) with an amine resin blend (B).

- **A - component**
  - \( \beta \) ISOCYANATE PREPOLYMERS *
  - \( \beta \) DILUENTS *

- **B - component**
  - \( \beta \) POLYETHER-AMINES *
  - \( \beta \) AMINE CHAIN EXTENDERS *
  - \( \beta \) PIGMENTS *
  - \( \beta \) ADDITIVES

* Offered by Huntsman
Polyurea technologies

Aromatic
Based on aromatic isocyanate prepolymer

Standard technology  (SUPRASEC® MDI-prepolymer)

Aliphatic
Based on aliphatic isocyanates and aliphatic chain extenders

Newer technology, UV stability
Hardness, flexibility and reactivity depend on the relative ratios of the essential components:

- An isocyanate prepolymer (NCO content)
  - Affects hardness, reactivity, also flexibility (prepolymer)
- A flexible polyetheramine (PPG amines, PTMEG amines)
  - Provides flexibility and/or transparency
- A chain extender
  - Affects reactivity, hardness
Product developments

Huntsman is expanding its product range for the formulators’ toolbox, for use in both aromatic and aliphatic polyurea systems

- The JEFFAMINE® SD-amine range
  High bis(secondary) aliphatic, liquid polyetheramines

- The JEFFLINK® chain extender range
  Low viscosity cycloaliphatic bis(secondary amine) chain extenders for UV-stable aliphatic polyurea
Recently introduced and proven to be successful in commercial applications

- Used for low viscosity aliphatic isocyanate quasi-prepolymers
- Used as slower reacting polyetheramine
- Used as chain extender to replace aromatic chain extenders
Product developments
JEFFAMINE® SD-amine range

Used for low viscosity aliphatic isocyanate quasi-prepolymers.

Example: H₁₂MDI quasi-prepolymers

![Graph showing viscosity at 25°C vs. Measured % NCO for H₁₂MDI/JEFFAMINE® D-2000 amine, H₁₂MDI/JEFFAMINE® SD-2001 amine, and Linear (H₁₂MDI/JEFFAMINE® SD-2001 amine).]
JEFFAMINE® SD-amine range
Aliphatic coating formulations

- Used for low viscosity aliphatic isocyanate quasi-prepolymers.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A Side</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPDI</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>JEFFAMINE® D-2000 amine</td>
<td>55</td>
<td>0</td>
</tr>
<tr>
<td>JEFFAMINE® SD-2001 amine</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td><strong>B Side</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tear Strength, N/mm</td>
<td>50.9</td>
<td>52</td>
</tr>
<tr>
<td>Shore D, 0 sec / 10 sec</td>
<td>40/28</td>
<td>44/28</td>
</tr>
<tr>
<td>Spray Gel time, sec</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>A/B Delta P, MPa</td>
<td>4.8</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Main point is the reduced pressure between the A and B sides when spraying, improved mixing.
Product developments
JEFFAMINE® SD-amine range

- Used as slower reacting polyetheramine

- To obtain very high hardness aliphatic or aromatic formulations, while maintaining flexibility and good cure speed

- For slow hand workable polyurea caulking systems (for use as joint filler or as repair system)

  - Substituting secondary polyetheramine for primary polyetheramine can double the gel time

  - Can be applied using dual syringe and static mix dispensing equipment
Product developments

JEFFAMINE® SD-amine range

Used as chain extender to replace aromatic chain extenders

1:1 Volume Ratio with MDI isocyanate prepolymer (~15.5% NCO) (*

<table>
<thead>
<tr>
<th>Formulation</th>
<th>1</th>
<th>2</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td>JEFFAMINE® D-2000 amine</td>
<td>53</td>
<td>55</td>
<td>53</td>
</tr>
<tr>
<td>JEFFAMINE® T-5000 amine</td>
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<td>10</td>
<td>10</td>
</tr>
<tr>
<td>DETDA</td>
<td>22</td>
<td>22</td>
<td>22</td>
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<tr>
<td>Common aromatic chain extender</td>
<td>10</td>
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<td>0</td>
</tr>
<tr>
<td>JEFFLINK® 754 curing agent</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>JEFFAMINE® SD-231 amine</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Pigment</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Max Elongation, %                   | 637| 606| 653|
Shore D, 0 sec / 10 sec             | 50/41| 51/43| 52/41|

(*) RUBINATE® 9480 isocyanate

Secondary aliphatic amines can partially replace aromatic amine extenders, with equivalent properties and cure speed.

Secondary aliphatic amines can reduce cost and improve the initial colour.
New product developments
JEFFLINK® chain extender range

β The next generation JEFFLINK® products is under development.

β One of the performance targets is to lower further the tack-free to gel time ratio

β First experimental products demonstrated the targeted improvements
Application references
Pipe coatings

Very high hardness coating, high abrasion resistance

SUPRASEC® 2067 isocyanate (high NCO)

JEFFAMINE® SD amines

- cost efficient
- lower reactivity

JEFFLINK® chain extenders

- moderate cure time
- maintain hardness
Roofing

Used as chain extender to replace aromatic chain extenders

JEFFAMINE® SD-231 amine as aromatic chain extender substitute in roofing and flooring applications

By 1:1 substitution

Picture by Elastopol
Sports flooring

JEFFAMINE® SD-401 amine providing flexibility and resilient effect
Motorway drains

Pictures by FlexGuard
Stadium

Real Madrid Football Stadium, 15,000 m²
Architectural coating

Forum of Cultures
Barcelona
14,000 m² application

Pictures by DE NEEF TECHNOLOGIES
Fire retardant architectural coating

- Flexibility
- UV resistance
- Lower viscosity
- Cost effective
- Design freedom
Conclusions

- Open the doors for new applications
- Cost beneficial alternative
- For both aliphatic and aromatic systems
- Replacement of aromatics chain extenders
- New chain extenders under development
- Improved gel/tack free ratio
- UV stable, for more colour options

JEFFAMINE® SD-amine
JEFFLINK® chain extenders
Acknowledgements

We thank our customers who were so kind to provide support for the applications references.

Thank you for your attention
www.huntsmanpolyurea.com

SUPRASEC® MDI-prepolymers
JEFFAMINE® polyetheramines
JEFFAMINE® SD-amines
JEFFLINK® chain extenders
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