Poly bd® and Krasol® resins are low molecular weight, hydroxyl-terminated homopolymers of butadiene. These hydroxyl-terminated polybutadiene (HTPB) resins are characterized by low volatiles content, low glass transition temperatures, excellent hydrophobicity and a high level of reactive functionality. The facile reaction of Poly bd and Krasol polyols with curing agents such as di- and polyisocyanates provides an attractive route to the preparation of general-purpose polyurethane elastomers. The unique structure of the Poly bd and Krasol polyols provides properties that surpass typical polyether and polyester polyol based urethane systems, as well as conventional, general-purpose rubbers. Most grades of Poly bd and Krasol resins contain unsaturated double bonds (except Krasol HLBH-P 2000 and Krasol HLBH-P 3000) that can be cured or crosslinked.

Some of the outstanding performance characteristics Poly bd and Krasol resins provide to polyurethanes include:

- Adhesion to a variety of substrates
- Hydrolytic stability
- Resistance to strong aqueous acids and bases
- Low-temperature flexibility
- Low moisture vapor transmission rates (MVTR)
- Low embedment stress
- Thermal cycling stability
- Electrical insulation properties
- High elongation with good elastic recovery
- Compliance with title 21 (Food and Drugs) of the Code of Federal Regulations, paragraph 175.300, Resinous and Polymeric Coatings

Poly bd and Krasol resins are used in various industries including construction, automotive, electronics and rubber. They are incorporated in castable elastomers, caulks, sealants, waterproof membranes, foams, adhesives, coatings, binders for composites, and potting and encapsulation compounds as well as other rubber fabricated materials.
## Product Descriptions

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Molecular Weight ($M_n$, g/mol)</th>
<th>1,2 Vinyl (%)</th>
<th>Viscosity (cps) @ $T_g$ °C</th>
<th>$T_g$ °C</th>
<th>Specific Gravity</th>
<th>-OH (/chain)</th>
<th>Epoxy (eq. wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Poly bd</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Poly bd R-45HTLO</td>
<td>Hydroxyl-Terminated Polybutadiene</td>
<td>2,800</td>
<td>20</td>
<td>5,000 @ 30 °C</td>
<td>-75</td>
<td>0.90</td>
<td>2.5</td>
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</tr>
<tr>
<td>Poly bd R-20LM</td>
<td>Hydroxyl-Terminated Polybutadiene</td>
<td>1,200</td>
<td>20</td>
<td>1,400 @ 30 °C</td>
<td>-70</td>
<td>0.91</td>
<td>2.5</td>
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<tr>
<td><strong>Epoxidized</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Poly bd 605E</td>
<td>Epoxidized Hydroxyl-Terminated Polybutadiene</td>
<td>1,450</td>
<td>20</td>
<td>22,000 @ 30 °C</td>
<td>-47</td>
<td>1.01</td>
<td>2.5</td>
<td>300</td>
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<tr>
<td><strong>Krasol</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Krasol LBH 2000</td>
<td>Hydroxyl-Terminated Polybutadiene</td>
<td>2,100</td>
<td>65</td>
<td>13,000 @ 25 °C</td>
<td>-35</td>
<td>0.89</td>
<td>1.9</td>
<td>--</td>
</tr>
<tr>
<td>Krasol LBH-P 2000</td>
<td>Hydroxyl-Terminated Polybutadiene (Primary-OH)</td>
<td>2,100</td>
<td>65</td>
<td>13,000 @ 25 °C</td>
<td>-35</td>
<td>0.89</td>
<td>1.9</td>
<td>--</td>
</tr>
<tr>
<td>Krasol LBH 3000</td>
<td>Hydroxyl-Terminated Polybutadiene</td>
<td>3,000</td>
<td>65</td>
<td>20,000 @ 25 °C</td>
<td>-35</td>
<td>0.89</td>
<td>1.9</td>
<td>--</td>
</tr>
<tr>
<td>Krasol LBH-P 3000</td>
<td>Hydroxyl-Terminated Polybutadiene (Primary-OH)</td>
<td>3,000</td>
<td>65</td>
<td>20,000 @ 25 °C</td>
<td>-35</td>
<td>0.89</td>
<td>1.9</td>
<td>--</td>
</tr>
<tr>
<td><strong>Hydrogenated</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Krasol HLBH-P2000</td>
<td>Hydroxyl-Terminated Hydrogenated Polybutadiene</td>
<td>2,100</td>
<td>--</td>
<td>1,750 @ 60 °C</td>
<td>-46</td>
<td>0.88</td>
<td>1.9</td>
<td>--</td>
</tr>
<tr>
<td>Krasol HLBH-P3000</td>
<td>Hydroxyl-Terminated Hydrogenated Polybutadiene</td>
<td>3,100</td>
<td>--</td>
<td>3,000 @ 60 °C</td>
<td>-46</td>
<td>0.88</td>
<td>1.9</td>
<td>--</td>
</tr>
</tbody>
</table>

*Poly bd and Krasol products require a license for export.
Poly bd® R-45HTLO Resin

**DESCRIPTION**
Poly bd R-45HTLO resin is a liquid hydroxyl-terminated polymer of butadiene with a number average molecular weight of approximately 2800. Poly bd resins have primary, allylic alcohol groups that exhibit high reactivity in either condensation polymerization reactions or the preparation of derivatives. The degree of polymerization is approximately 50 for the R-45HTLO. Hydroxyl functionality is typically in the 2.4 – 2.6 range for R-45HTLO.

**PRODUCT HIGHLIGHTS**
- Hydrophobicity
- Reactive hydroxyl groups
- Low glass transition temperature
- Miscibility with asphalt
- Low color, high clarity

**PERFORMANCE PROPERTIES**
- Hydrolytic stability
- Low temperature flexibility
- Low-moisture permeability
- Resistance to aqueous acids and bases
- Excellent adhesion to a variety of substrates
- Electrical insulation properties

**SUGGESTED APPLICATIONS**
- Potting and encapsulation
- Adhesives
- Sealants
- Binders
- Waterproof coatings and membranes

**TYPICAL PHYSICAL AND CHEMICAL PROPERTIES**
- Nonvolatile material, wt% ........................................ 99.9
- Viscosity, mPa·s @ 23 °C ....................................... 8000
- Viscosity, mPa·s @ 30 °C ....................................... 5000
- Hydroxyl number, mg KOH/g .................................. 47.1
- Hydroxyl value, meq/g ......................................... 0.84
- Hydroxyl functionality ........................................ 2.4-2.6
- Molecular weight, (Mₙ), g/mol ................................ 2800
- Polydispersity, Mₘ/Mₙ ........................................... 2.5
- Water, wt% ......................................................... 0.02
- Specific gravity @ 23 °C ........................................ 0.901
- Iodine number, g/100 g ......................................... 400
- Glass transition temp. (Tₘ), °C ............................... -75

**Solubility, g/100 ml of solvent @ 25 °C**
- Mineral Spirits ...................................................... >50
- Toluene ............................................................... >50
- Chloroform .......................................................... >50
- Methyl ethyl ketone .............................................. >50
- Ethyl acetate ......................................................... >50
- Acetone .............................................................. <10⁽¹⁾
- Hexane ............................................................... >50
- Aromatic 100 ....................................................... >50
- Isopropanol ......................................................... <10⁽¹⁾

⁽¹⁾ Cloudy: 5% solution also cloudy

**REGULATORY NOTICE**
This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.
**Hydroxyl-Terminated Polybutadiene Resins**

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**Poly bd® R-20LM Resin**

**LOW MOLECULAR WEIGHT HYDROXYL-TERMINATED POLYBUTADIENE RESIN**

![Chemical Structure](image)

**DESCRIPTION**

Poly bd R-20LM Resin is a low-viscosity, low molecular weight, liquid hydroxyl-terminated polymer of butadiene.

Poly bd resins have primary, allylic alcohol groups that exhibit high reactivity in either condensation polymerization reactions or the preparation of derivatives. The degree of polymerization is approximately 25 for the Poly bd R-20LM and the molecular weight is 1200.

**PRODUCT HIGHLIGHTS**

- Reactive hydroxyl groups
- Hydrophobicity
- Low glass transition temperature
- High solids loading
- Low color, high clarity

**PERFORMANCE PROPERTIES**

- Hydrolytic stability
- Low moisture permeability
- Resistance to aqueous acids and bases
- Low-temperature flexibility
- Electrical insulation properties

**SUGGESTED APPLICATIONS**

- Potting and encapsulation
- Adhesives
- Sealants
- Waterproof coatings and membranes

---

**TYPICAL PHYSICAL AND CHEMICAL PROPERTIES**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonvolatile material, wt%</td>
<td>99.9</td>
</tr>
<tr>
<td>Viscosity, mPa·s @ 30 °C</td>
<td>1400</td>
</tr>
<tr>
<td>Hydroxyl number, mg KOH/g</td>
<td>101.0</td>
</tr>
<tr>
<td>Hydroxyl value, meq/g</td>
<td>1.8</td>
</tr>
<tr>
<td>Hydroxyl functionality</td>
<td>2.4-2.6</td>
</tr>
<tr>
<td>Molecular weight, (Mn), g/mol</td>
<td>1200</td>
</tr>
<tr>
<td>Polydispersity, Mw/Mn</td>
<td>2.0</td>
</tr>
<tr>
<td>Water, wt%</td>
<td>0.05</td>
</tr>
<tr>
<td>Specific gravity @ 23 °C</td>
<td>0.913</td>
</tr>
<tr>
<td>Iodine number, g/100 g</td>
<td>420</td>
</tr>
<tr>
<td>Glass transition temp. (Tg), °C</td>
<td>-70</td>
</tr>
</tbody>
</table>

**Solubility**

- Mineral spirits: >50
- Toluene: >50
- Chloroform: >50
- Methyl ethyl ketone: >50
- Ethyl acetate: >50
- Acetone: <10<sup>(1)</sup>
- Hexane: <50
- Aromatic 100: >50
- Isopropanol: <10<sup>(1)</sup>

<sup>(1)</sup> Cloudy: 5% solution also cloudy.

**REGULATORY NOTICE**

This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.
DESCRIPTION
Poly bd 605E is an epoxidized polybutadiene resin offering the compounder a variety of functionalities for formulating finished products. The 605E resin is hydroxyl terminated and brings hydrophobicity, flexibility and water resistance to urethane applications. In addition, oxirane groups on the polymer backbone allow it to be used as the sole resin in epoxy formulations or in combination with Bisphenol A or cycloaliphatic epoxy resin formulations, where 605E resin improves the flexibility and impact resistance. These epoxy groups will cure with Lewis acids or anhydrides. Primary and secondary amines are not recommended as curing agents. Poly bd 605E resin may be used as a reactive oligomeric additive in cationically cured coatings to impart high flexibility.

PRODUCT HIGHLIGHTS
Most highly epoxidized Poly bd resin
Multiple functionality
Low viscosity
Compatibility with other epoxy resins
UV cationic cure

PERFORMANCE PROPERTIES
Flexible epoxy systems
Hydrophobicity
Aqueous acid and base resistance
Adhesion to a variety of substrates
Excellent water resistance

SUGGESTED APPLICATIONS
Adhesives
Electronic coatings
Flexibilization of epoxy systems

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES
- Oxirane oxygen, % .............................................. 6.5
- Epoxy value, meq/g ........................................... 3.5
- Specific gravity ................................................. 1.01
- Viscosity, mPa·s @ 30 °C ............................ 22,000
- Epoxy equivalent weight ............................ 300
- Hydroxyl functionality .............................. 2.4-2.6
- Water, wt% ................................................. 0.05
- Hydroxyl value, meq/g ......................... 0.174
- Molecular weight (M_n), g/mol ............... 1300

REGULATORY NOTICE
This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.
Hydroxyl-Terminated Polybutadiene Resins

Krasol® LBH 2000

HYDROXYL-TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol LBH 2000 is a linear polybutadiene polymer with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol LBH 2000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in nonpolar organic liquids, oils, and bitumens. Krasol LBH 2000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low-temperature properties
Hydroxyl functionality
Narrow molecular weight distribution
Hydrolysis resistance

SUGGESTED APPLICATIONS

Adhesives
Coatings
Composites, as binding agent
Elastomers, castable urethane
Elastomers, thermoplastic
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure
1,2-vinyl, % .................................................. 65
1,4-cis, % .......................................................... 12.5
1,4-trans, % .......................................................... 22.5
Density, g/cm .................................................. 0.9 @ 20 °C
Hydroxyl value, meq/g ........................................ 0.91
Molecular weight (M_n), g/mol ............................ 2100
Nonvolatile material % ........................................ 99.5
Polydispersity ..................................................... 1.35
Viscosity, Pa·s @ 25 °C ......................................... 13
Water, wt% ....................................................... 0.04
Hydroxyl functionality .......................................... 1.9-2.0

REGULATORY NOTICE

This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.
Krasol® LBH 3000

HYDROXYL-TERMINATED POLYBUTADIENE

DESCRIPTION
Krasol LBH 3000 is a linear polybutadiene polymer with hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol LBH 3000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in nonpolar organic liquids, oils, and bitumens. Krasol LBH 3000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS
Excellent chemical resistance
Good electrical characteristics
Good low-temperature properties
Hydroxyl functionality
Narrow molecular weight distribution
Hydrolysis resistance

SUGGESTED APPLICATIONS
Adhesives
Coatings
Composites, as binding agent
Elastomers, castable urethane
Elastomers, thermoplastic
Electronics, potting compounds
Encapsulants
Hydrolytic stability enhancer for polyurethanes
Polymer modification
Polyurethane foams
Sealing and putty compounds

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure
1,2-vinyl, % .......................................................... 65
1,4-cis, % ........................................................... 12.5
1,4-trans, % .......................................................... 22.5
Density, g/cm³ ................................................... 0.9 @ 20 °C
Hydroxyl value, meq/g ........................................... 0.64
Molecular weight (M_n), g/mol .................................. 3000
Nonvolatile material % ......................................... 99.5
Polydispersity .................................................... 1.35
Viscosity, Pa·s @ 25 °C .......................................... 20
Water, wt% .......................................................... 0.04
Hydroxyl functionality ......................................... 1.9-2.0

REGULATORY NOTICE
This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.
Krasol® LBH-P 2000

**HYDROXYL-TERMINATED POLYBUTADIENE**

**DESCRIPTION**

Krasol LBH-P 2000 is a linear polybutadiene polymer with primary hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol LBH-P 2000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in nonpolar organic liquids, oils, and bitumens. Krasol LBH-P 2000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

**PRODUCT HIGHLIGHTS**

Excellent chemical resistance
Good electrical characteristics
Good low-temperature properties
Hydrolysis resistance
Hydroxyl functionality
Narrow molecular weight distribution

**SUGGESTED APPLICATIONS**

Adhesives
Binders
Cast polymers
Coatings
Electronics, potting compounds
Encapsulants
Polymer modification
Sealants

**TYPICAL PHYSICAL AND CHEMICAL PROPERTIES**

**Microstructure**

1,2-vinyl, % ............................................................ 65
1,4-cis, % ..............................................................12.5
1,4-trans, % ........................................................... 22.5
Density, g/cm³ .................................................. 0.9 @ 20 °C
Hydroxyl value, meq/g ............................................ 0.91
Molecular weight (M_n), g/mol ............................. 2000
Nonvolatile material % ........................................ 99.5
Polydispersity ....................................................... 1.35
Viscosity, Pa·s @ 25 °C .............................................. 20
Water, wt% .......................................................... 0.04
Hydroxyl functionality ........................................ 1.9-2.0

**REGULATORY NOTICE**

This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.
Krasol® LBH-P 3000

HYDROXYL-TERMINATED POLYBUTADIENE

DESCRIPTION

Krasol LBH-P 3000 is a linear polybutadiene polymer with primary hydroxyl end groups. Due to a high concentration of olefinic double bonds and low molecular weight, Krasol LBH-P 3000 is a liquid at ambient temperature. The product is immiscible in water and alcohols; however, it is miscible in nonpolar organic liquids, oils, and bitumens. Krasol LBH-P 3000 reacts through the double bonds along the polymer chain and through the terminal hydroxyl groups. It is particularly useful as the polyol component in polyurethane systems.

PRODUCT HIGHLIGHTS

Excellent chemical resistance
Good electrical characteristics
Good low-temperature properties
Hydrolysis resistance
Hydroxyl functionality
Narrow molecular weight distribution

SUGGESTED APPLICATIONS

Adhesives
Binders
Cast polymers
Coatings
Electronics, potting compounds
Encapsulants
Polymer modification
Sealants

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Microstructure
1,2-vinyl, % .......................................................... 65
1,4-cis, % .............................................................. 12.5
1,4-trans, % .......................................................... 22.5
Density, g/cm³ ......................................................... 0.9 @ 20 °C
Hydroxyl value, meq/g ........................................... 0.64
Molecular weight (Mn), g/mol .................................. 3200
Nonvolatile material % .......................................... 99.5
Polydispersity .................................................... 1.35
Viscosity, Pa·s @ 25 °C ........................................... 20
Water, wt% ........................................................... 0.04
Hydroxyl functionality ......................................... 1.9-2.0

REGULATORY NOTICE

This product is regulated by the United States Department of Commerce and may not be exported without a license from that organization.
Krasol® HLBH-P 2000

Hydrogenated Hydroxyl-Terminated Polyolefin

Description
Krasol HLBH-P 2000 is an odorless, water-clear, saturated aliphatic liquid polyol. The saturated nature of the resin provides light and weather stability, enabling formulators to develop polyurethane coatings that will not yellow or lose their critical mechanical properties, such as flexibility, adhesion, elongation, and strength. In addition, Krasol HLBH-P 2000 provides improved heat resistance and adhesion to difficult substrates (e.g., polyolefins) compared to standard hydroxyl-terminated polybutadiene resins.

Product Highlights
Excellent thermal stability
Good weatherability
Hydrophobicity
Low color, high clarity
Low glass transition temperature
Reactive hydroxyl groups

Performance Properties
Acid and base resistance
Adhesion
Asphalt miscibility
Electrical insulation properties
Low-temperature flexibility

Suggested Applications
Adhesives, coatings & sealants
Electronics, encapsulants
Polymer modification
Two-component prepolymer
Thermoplastic polyurethane (TPU)

Typical Physical and Chemical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear liquid</td>
</tr>
<tr>
<td>Diol purity, %</td>
<td>&gt;97</td>
</tr>
<tr>
<td>Hydrogenation extent, %</td>
<td>&gt;98</td>
</tr>
<tr>
<td>Hydroxyl functionality</td>
<td>1.9</td>
</tr>
<tr>
<td>Hydroxyl number, mg KOH/g</td>
<td>49.8</td>
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<tr>
<td>Hydroxyl value, meq/g</td>
<td>0.89</td>
</tr>
<tr>
<td>Molecular weight (Mn), g/mol</td>
<td>2100</td>
</tr>
<tr>
<td>Viscosity, Pa·s @ 25 °C</td>
<td>37</td>
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<tr>
<td>Water, wt%</td>
<td>0.03</td>
</tr>
<tr>
<td>Glass transition temp. (Tg), °C</td>
<td>-46</td>
</tr>
</tbody>
</table>
Krasol® HLBH-P 3000

HYDROGENATED HYDROXYL-TERMINATED POLYOLEFIN

DESCRIPTION

Krasol HLBH-P 3000 is an odorless, water-clear, saturated aliphatic liquid polyol. The saturated nature of the resin provides light and weather stability, enabling formulators to develop polyurethane coatings that will not yellow or lose their critical mechanical properties, such as flexibility, adhesion, elongation, and strength. In addition, Krasol HLBH-P 3000 provides improved heat resistance and adhesion to difficult substrates (e.g., polyolefins) compared to standard hydroxyl-terminated polybutadiene resins.

PRODUCT HIGHLIGHTS

Excellent thermal stability
Good weatherability
Hydrophobicity
Low color, high clarity
Low glass transition temperature
Reactive hydroxyl groups

PERFORMANCE PROPERTIES

Acid and base resistance
Adhesion
Asphalt miscibility
Electrical insulation properties
Low-temperature flexibility

SUGGESTED APPLICATIONS

Adhesives, coatings & sealants
Electronics, encapsulants
Polymer modification
Two-component prepolymer
Thermoplastic polyurethane (TPU)

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Appearance .................................................. Clear liquid
Diol purity, % .......................................................... >97
Hydrogenation extent, % .................................... >98
Hydroxyl functionality ........................................ 1.9
Hydroxyl number, mg KOH/g ............................. 31
Hydroxyl value, meq/g ........................................... 0.56
Molecular weight (Mn), g/mol .......................... 3100
Viscosity, Pa-s @ 50 °C ......................................... 7
Viscosity, Pa-s @ 25 °C ....................................... 65
Water, wt% .............................................................. 0.03
Glass transition temp. (Tg), °C ......................... -46
Reactions at the Hydroxyl Groups

The hydroxyl functionality in Poly bd and Krasol resins can be utilized in both polymerization and derivatization reactions as indicated in the diagram on page 13 in section a.

Polyurethanes

Poly bd and Krasol resins are readily chain extended with di- and polyisocyanates to produce polyurethanes with a wide range of mechanical properties. Typical one-shot and prepolymer techniques can be employed. The end products have excellent hydrolytic stability and low-temperature flexibility, and can be extended with a wide range of organic and inorganic materials including hydrocarbon oils and inorganic fillers.

Poly bd resins have predominantly primary and allylic hydroxyl functionality. Krasol products come with primary (LBH-P grades) and secondary (LBH grades) hydroxyl functionality.

Ester Derivatives

Ester derivatives can be prepared by reaction of Poly bd and Krasol resins with the appropriate carboxylic acids, acid chlorides, anhydrides or by transesterification.

Reactions at the Alkene Groups

The carbon-carbon bond unsaturation in Poly bd and Krasol resins, which is predominantly internal, can be utilized in both polymerization and derivatization reactions, as illustrated in section b. on page 13.

Oxidative Crosslinking – Poly bd and Krasol resins are reactive under oxidative conditions to yield internally crosslinked, film-forming materials. Coatings derived from such processes can range from flexible to brittle compositions.

Epoxidation — Oxirane derivatives can be prepared with various epoxide contents. The resulting products can be cured by the reaction of the epoxide groups (UV cationic) and/or the hydroxyl groups. These materials can also be used in combination with other epoxy resins to produce a variety of products.

Addition to Double Bonds

Other reactions common to olefinic unsaturation, in theory, are applicable to Poly bd and Krasol resins. For example, addition of thiols to the double bond gives unique functional derivatives.

Saturated Hydroxyl-Terminated Polybutadiene Krasol

HLBH-P 2000 and HLBH-P 3000 are hydroxyl-terminated polyolefins. These products can be used where weathering and heat stability properties are critical and when specific adhesion properties are required.
Reactions of Poly bd® Resins

a.) At the hydroxyl groups

\[
\begin{align*}
\text{Poly bd Resin} & \quad \text{Disocyanate} \\
& \quad \text{RC-X} \\
& \quad \text{Carboxylic Acid, Acid Chloride Or Anhydride} \\
& \quad \text{Poly bd - based Ester}
\end{align*}
\]

b.) At the alkene groups

\[
\begin{align*}
\text{Poly bd Resin} & \quad \text{Heat + Air} \\
& \quad \text{H-SR} \\
& \quad \text{Hydrogen Peroxide or Peroxide} \\
& \quad \text{Poly bd 605E}
\end{align*}
\]
I. General

Poly bd resins are liquid hydroxyl-terminated homopolymers of butadiene. These resins are only slightly combustible with flash points greater than 400 °F (205 °C). They exhibit excellent stability if properly handled and stored.

II. Drum Storage

Poly bd resins are supplied in 55-gallon non-returnable, open-head steel drums having an epoxy phenolic lining. Krasol resins are supplied in 200-kg drums. Storage of the drums out of direct sunlight at temperatures between 50 °F (10 °C) and 90 °F (32 °C) is recommended. Due to the viscosity of the products, heating may be required to facilitate removal from the drums. Exposure of the drum or contents to temperature in excess of 150° F (66 °C) should be avoided. As a result, the use of band or bayonet heaters should be avoided due to the possibility of localized overheating and the resultant oxidative crosslinking and viscosity increase. Suggested methods of heating include the use of hot boxes or water baths. After opening and removal of a portion of the contents, it is recommended that the vapor space in the drum be flushed with an inert gas, such as dry nitrogen, prior to reclosure.

Poly bd resins should be stored in nitrogen-padded vessels to prevent moisture contamination and oxygen degradation. Elevated temperatures can result in thermal degradation. The storage vessel should be constructed of 300 series stainless steel or epoxy-lined carbon steel. Since the polymers are viscous, lines must be sized carefully and positive displacement pumps are necessary. Lines should be electrically traced and insulated. Suction heaters are often used to assure good supply to the pump. Traced piping and heater skin temperatures should not exceed 150 °F (66 °C).

III. Bulk Storage

Poly bd resins are best stored in low-pressure, cone-roof tanks under slightly positive nitrogen pressure. The material should be stored at ambient temperature of 50 – 90 °F (10 – 32 °C), so insulation is often advantageous. The tank should be located in a sheltered area to help minimize heat gain and heat loss.

Level indicators should be provided as well as a high-level alarm to warn of overfilling the tank. The bottom of the tank should be sloped to the pump suction and sump. The suction nozzle should be at such an elevation that normal piping layout will put the center line of the nozzle at the center line of the pump. A recirculation line with a back-pressure control valve will allow safe operation without requiring pump shut-down.

Pumping out the heel, when service or inspection of the tank is required, should be by use of the scavenger line if the suction line is located above the bottom of the tank. Lines should be sized carefully, allowing for the viscosity of the product.

The use of a suction heater between the tank and pump is recommended to assure good pump operation. The maximum temperature of the product should not exceed 150 °F (66 °C). Therefore, the use of live steam is not recommended. Hot condensate may be used without overheating the exchanger tube walls. Another possibility is the use of electric heaters which can control the sheath (heating surface) temperature. Where condensate or hot water is used for heating, precautions must be taken to prevent water contact with the product.

Before the pump is shut down, the suction heater should be shut off and product pumped through to remove the residual heat before the circulation is stopped. This procedure will prevent loss of quality due to “heat-soaking” the product which can result in product crosslinking and viscosity increase.

No internal coils, bayonets or other heating devices should be installed.
IV. Materials of Construction

A. Tanks

Storage vessels may be made of stainless steel or epoxy-lined carbon steel.

Small vessels are usually fabricated from stainless steel while large storage tanks are more economically fabricated in epoxy-lined carbon steel.

Tanks should be insulated to minimize heat loss and heat gain.

B. Pumps

In general, 300 series stainless steel positive-displacement pumps such as Sier-Bath brand double-screw pumps or Viking brand gear pumps are recommended. These units are equipped with external bearings which give good service life and are easily inspected and repaired.

C. Heat Exchanger

Product-wetted parts of heaters should be constructed of 300 series stainless steel.

D. Piping

Lines should be adequately sized considering the viscosity of the material being handled. Electrical tracing and insulation should be provided where lines are exposed to low temperatures. Piping should be 300 series stainless steel.

V. Tank Truck Shipments

Clean, dry, insulated stainless steel trailers, preferably equipped for rear or center off-loading (subject to availability), should be specified. Product is loaded at 140-150 °F (60-66 °C). Depending on the outside temperature, the product temperature will decrease approximately 5-10 °F (3-6 °C) per day. Since a minimum off-loading temperature of 120 °F (49 °C) is recommended, in-transit heating will usually be required during cold weather. Clean, dry pumps and hoses should be used for product discharge. Positive-displacement, double-screw or gear pumps and three-inch hoses and connections are recommended. A minimum 60 gpm pump size is suggested.

Off-loading may be assisted by the application of dry nitrogen pressure to the truck.

Poly bd® Typical Tank Arrangement

![Poly bd® Typical Tank Arrangement Diagram]
The firm of Keller and Heckman (Washington, D.C.) advises that hydroxyl-terminated polybutadiene resins (HTPB) may be used by adhesives formulators in food-contact articles.

According to the firm’s opinion, the HTPB resins, which include Cray Valley’s Krasol resins, as well as Poly bd R-45HTLO and Poly bd R-20LM resins, may be used “as components of adhesives used in food-contact articles, including polyurethane adhesives, and that such use may properly be said to comply fully with the Federal Food, Drug, and Cosmetic Act and all applicable food additive regulations, including 21 C.F.R. § 175.105 (‘Adhesives’).” One such use includes the laminating adhesives commonly found in food packaging applications.

In addition, Cray Valley’s Krasol and Poly bd HTPB resins, including the internally epoxidized Poly bd 605E products, may be used in compliance with FDA 21 C.F.R § 175.300 (“Resinous and polymeric coatings”), for example, as part of an oxidatively crosslinked or UV cationically cured coating.

Technical literature including starting formulations, technical papers, product bulletins, and material safety data sheets are available to optimize the use of Cray Valley’s products.

Literature can be obtained through Cray Valley’s customer service group (1-877-871-2729) or our website (www.crayvalley.com). Cray Valley offers these additional documents discussing our Poly bd and Krasol resins to aid in formulating.

- Prepolymers General Bulletin
- Polyurethane Elastomers Derived from Krasols and Hydrogenated Krasols and Their Weathering and Thermal Aging Properties
- The Poly bd Resin in Urethane Elastomers
- Poly bd Resins Starting Formulations
- Poly bd Resins in Electrical Applications
- Poly bd Resins in Adhesives
- Poly bd Resins in Foam Applications
- Polyurethane Gels from Poly bd Resins
- Poly bd 605E – Epoxidized Polybutadienes
- Novel Polybutadiene Diols for Thermoplastic Polyurethane
- Krasol Prepolymers
- Grafting of Hydroxyl-Terminated Polybutadiene with 2-Mercaptoethanol
- Polyurethane Binders for the Production of Composites Materials
- Poly bd Resins in the Coatings Industry
- Poly bd Resins in Insulated Glass Window Sealants
- Poly bd Resins With Low Hydroxyl Functionality
- Poly bd Resins in Construction Applications
- Thermal and Light Stabilization of Poly bd Resin Formulations
Typical Viscosity Properties of Poly bd® and Krasol® Resins

Poly bd and Krasol resins are viscous liquids at room temperature. To facilitate transfer of these products, the viscosity can be reduced by heating the neat resin as in the figure below or by cutting with solvent.
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