TECHNICAL UPDATE

Aqueous Polyurethane Dispersion Based on Poly BD® R45 HTLO Resin

Benefits

- Solvent-free
- Hydrophobic
- Shear-stable and pigment-compatible
- Good compatibility with silicone oils
- Good chemical resistance against many chemicals

Suggested Applications

- Hydrophobic coatings
- Hydrophobic sealants
- Very good adhesion to natural rubber, SBR and PUR-RIM

Additional Information

SDS: Poly BD® R45 HTLO

Description

Poly BD® is Resin Solutions trade name for unique liquid hydroxylated polybutadienes most commonly used by reacting with isocyanates to produce polyurethanes with typical properties including:

- Low water absorption
- High hydrolytic stability
- Low moisture permeability
- High resistance to aqueous mineral acids and bases
- Excellent low-temperature flexibility, low Tg
- Good adhesion to a wide variety of substrates

Resin Solutions continuing its development efforts to supply the market with high-performance products, working with its customers to create a broad range of new formulations and products used in the transportation, electrical, electronic and construction industries.

The intention of this technical bulletin is to present the technology to prepare polyurethane dispersions (PUD) based on Poly BD®, which is covered in a now-abandoned U.S. Patent Application 20030069380A1.

Significant advantages could be gained from these new aqueous systems taking into account the current trend to reduce volatile organic compounds. This makes Poly BD®-based PUD more environmentally friendly, and numerous applications can be foreseen in the major areas where waterborne polyurethanes are formulated and used.

With Poly BD®, Resin Soluions offers assistance in developing new waterborne polyurethanes for specialized applications requiring increased water resistance for higher performance adhesive applications.

Synthesis Process of a PUD Based on Poly BD® R45 HTLO

The PUD synthesis is carried out using the prepolymer route. First, the prepolymer is synthesized in methyl ethyl ketone (MEK) solution with a 40% solids content. The composition of the prepolymer includes an acid diol, dimethylolpropionic acid (DMPA), which is neutralized with a stoichiometric amount of triethylamine (TEA). The molar ratio of DMPA/Poly BD® is chosen close to 1 to ensure the storage stability of the final dispersion.

After degassing the polyol mixture, the diisocyanate is added and the reaction is carried out at 80 °C for 3.5 hours. Isophorone diisocyanate (IPDI) is preferred due to its reactivity. The NCO/OH ratio used is 1.35-1.45.

The prepolymer solution is cooled to room temperature and dispersed in water while stirring. At the end of the dispersion process, an aqueous solution of Jeffamine® D400[1] is added to the mixture to extend the polyurethane chains by reaction with the residual isocyanate (NCO/NH_2=1). The solvent used in the first step is distilled under vacuum until the residual level of MEK is below 0.5%. During distillation, the mixture may be heated to 80 °C without stability problems. It is also possible to use an antifoaming agent during the distillation.

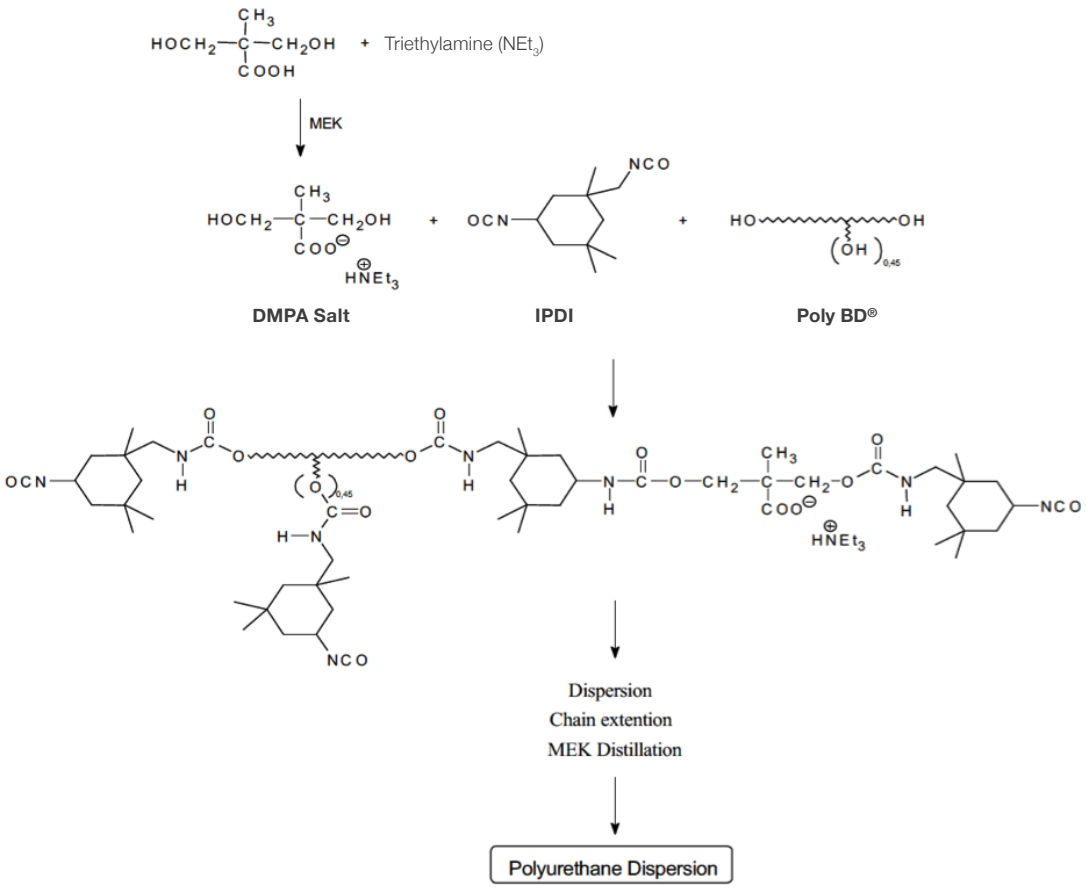

Figure 1: Scheme of the chemistry involved in the PUD synthesis.

Table 1: Characteristics of the PUD obtained.

Particles size	
(Malvern) before distillation	105 nm
(Malvern) after distillation	93 nm
(Malvern) after 1 month storage	89 nm
Brookfield viscosity	
(Ultra low viscosity adapter, 25 °C, 150 rpm)	43 cP
pH	7.9
Solids content	33%
% MEK	0.43%
% TEA	0.78%

Table 2: Properties of films and sheets prepared from the pure PUD.

Mechanical properties of 2 mm sheet	
Elongation at break	330%
Tensile strength	4.7 MPa
Hardness	69 Shore A
Moisture absorption of 2 mm sheet 2 h	
at 100 °C	+ 1.75%
24 h at 22 °C	+1.28%
Mechanical properties of 200 µm film	
Elongation at break	200%
Tensile strength	14.2 MPa
Persoz hardness	45

Table 3 shows the effect of classical thickeners on the rheology of Poly BD®-based PUD. All of these are compatible with the PUD and give good thixotropy.

- The Poly BD®-based PUD is also compatible with coalescing agents such as propylene glycol, butylene glycol and butylene diglycol.
- Acrylic (or styrene-acrylic) emulsions are also compatible with PUD.
- The dispersion and the viscosity are stable after one week's storage.

Table 3: Effect of thickeners on Poly BD® R45 HTLO-based PUD with additives.

Additives	After 24 hours		After 1 week	
	Brookfield viscosity 100 rpm (mPa·s)	ICI viscosity 10,000 s-1 (mPa·s)	Brookfield viscosity 100 rpm (mPa·s)	ICI viscosity 10,000 s-1 (mPa·s)
No additive	54	16	56	16
Natrosol® 250HHR 0.5%/total	4,150	41	4,130	46
Natrosol +430 4%/dry polym	18,200	117	19,240	121
Coatex® Rheo2000 2% dry/dry	5,060	107	2,850	104
Coatex Rheo3000 1.7% dry/dry	20,500	190	17,240	175
Coatex BR100 1.6% dry/dry	15,300	69	17,000	65

Summary

Aqueous polyurethane dispersion based on Poly BD® resin is a solvent-free poly(urethane-urea) dispersion that dries quickly to a clear and crack-free film. It is shear-stable and pigment-compatible. Its main application is the coating and sealing of a great number of substrates.

[1] BDO can be used to replace Jeffamine as chain extender (ref. Malkappa K.; Jana, T., Ind. Eng. Chem. Res., 2015, 54, 7423-7435)

Raw Material Suppliers

Jeffamine® D400	Huntsman Corporation
Natrosol® 250HHR	Ashland, Inc.
Coatex® BR100	Coatex Arkema Group

About Resin Solutions

Resin Solutions is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemical, and liquid and powder tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings and other materials. Resin Solutions has pioneered the development of these advanced technologies, introducing products that enhance the performance of products in energy, printing, packaging, construction, tire manufacture, electronics, and other demanding applications.

For more information, please visit **www.resinsolutions.com.**

Resin Solutions
665 Stockton Drive, Suite 100
Exton, PA 19341
1-484-284-8998