

Starting Formulation

SF 9002

Preparing Waterborne Dispersions of Elastomer Modified Epoxy Resins EPI-REZ™ Resins WD-510 and WD-512 and EPON™ Resins 58005 and 58006

Introduction Elastomer modified epoxy resins are often used in epoxy resin formulations to increase flexibility, adhesion and fatigue resistance, particularly for adhesive, coatings, fiber sizing, binder and composites applications. Examples of these resins include EPON Resin 58005 and EPON Resin 58006, both of which are adducts of diglycidyl ether of bisphenol A with carboxyl terminated butadiene-acrylonitrile elastomers. Resin formulations that contain these elastomer modified epoxy resins are typically processed as hot melts, but their use can be limited by the very viscous nature of the epoxy-elastomer adduct. Approaches for reducing the formulation viscosity to facilitate application include increasing the processing temperature, using solvents, and processing as water-based systems. The first two approaches present potential disadvantages including increased reactivity and decreased pot life at higher processing temperatures and increased toxicity and environmental concerns due to solvent use. Converting the epoxy resin formulations to water-based systems offers an alternative processing approach that avoids these potential disadvantages.

Suggested Uses

- Adhesives
- Coatings
- Fiber Sizings
- Nonwoven binders
- Composites

Features

- Formulating flexibility
- Can tailor rubber content, solids content, viscosity and other properties as desired
- Completely water reducible to achieve desired application viscosity
- Solvent free compositions
- Curable with water soluble and water reducible epoxy curing agents

Formulating Guidance Materials needed to prepare a waterborne dispersion of an elastomer modified epoxy resin are:

1. A water dispersible epoxy resin, such as EPI-REZ Resin WD-510 or EPI-REZ Resin WD-512. These are liquid bisphenol A type epoxy resins that are specifically designed for water dilution. When appropriately blended with water, these resins form fine particle dispersions of liquid epoxy resin in water.
2. An elastomer modified epoxy resin, such as EPON Resin 58005 and EPON Resin 58006.
3. Optionally, an epoxy resin dispersion, such as EPI-REZ Resin 3510-W-60 or EPI-REZ Resin 3515-W-60.
4. Water

Two example formulations are provided in the table below to demonstrate the formulating options.

Example formulation 1 represents a case where the water dispersible epoxy resin (EPI-REZ™ Resin WD-512) is blended with water to create a resin in water dispersion, followed by addition of the elastomer modified epoxy resin. For this example, the rubber content is 12% by weight based on solids. Increasing the EPON™ Resin 58006 level will give higher rubber contents, but sufficient EPI-REZ Resin WD-512 should be used to

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give higher rubber contents, but sufficient EPI-REZ Resin WD-512 should be used to maintain dispersion stability. The amount of water used for mixing and dilution helps define the in-process and final product viscosity.

Example formulation 2 represents a case where a commercial epoxy resin dispersion is used to facilitate the dispersion of the other epoxy components. Here, EPI-REZ Resin WD-512 is added to EPI-REZ Resin 3515-W-60, followed by addition of the elastomer modified epoxy resin. For this example, the rubber content is 7.5% by weight based on solids. Increasing the EPON Resin 58006 level will give higher rubber contents, but sufficient EPI-REZ Resin 3515-W-60 and EPI-REZ Resin WD-512 should be used to maintain a stable dispersion. Again, the amount of water used for mixing and dilution helps define the in-process and final product viscosity.

Example Formulations	<u>Material</u>	<u>1</u>	<u>2</u>
	EPI-REZ Resin WD-512	70	70
	EPI-REZ Resin 3515-W-60	--	100
	EPON Resin 58006	30	30
	Water for mixing	25-50	0-50
	Water for dilution	40-75	60-120
<u>Final Property Targets</u>			
-			
	WPE (g/eq on solids)	230	238
	Solids Content (wt. %)	44-60	43-62
	Rubber Content (wt. % on solids)	12	7.5

Mixing InstructionsThe two general procedures for dispersing the elastomer modified epoxy resin into water differ somewhat based on whether an epoxy resin dispersion is used to facilitate the process. These two procedures will be discussed separately using formulations 1 and 2 as examples.

Formulation 1

For formulation 1, the case where an epoxy resin dispersion is not used, preheat the EPI-REZ Resin WD-512 and EPON Resin 58006 to about 140°F to lower the viscosity for ease of material transfer. Add EPI-REZ Resin WD-512 and the mixing water to a suitable vessel and begin heating while mixing thoroughly. During the heating and mixing process, the mixture will invert from a resin continuous phase to a water continuous phase. The phase inversion typically occurs between 110-140°F depending on processing conditions, and should occur below 160°F. Phase inversion is quite apparent as it is marked by a dramatic increase in viscosity. If desired, the viscosity of the inverted system can be lowered by further increasing the temperature or adding additional mixing water. In general, the temperature of the system should be kept below about 170°F and more preferably between 130-150°F.

Slowly add the heated EPON Resin 58006 to the resin dispersion while mixing thoroughly and maintaining the temperature. Continue to mix to insure the system is homogeneous. Add the dilution water while mixing and beginning to slowly cool the system. The resulting product will be a viscous, creamy, resin in water dispersion.

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Formulation 2

For formulation 2, the case where the epoxy compounds are mixed into an epoxy resin dispersion, preheat the EPI-REZ™ Resin WD-512 and EPON™ Resin 58006 to about 140°F to lower the viscosity for ease of material transfer. Add EPI-REZ Resin 3515-W-60 to a suitable vessel. While mixing thoroughly, add the warm EPI-REZ Resin WD-512 and any desired mixing water to the EPI-REZ 3515-W-60. If needed to reduce viscosity, heat the system or add more mixing water. Add the warm EPON Resin 58006 while mixing thoroughly, and then heat to 130-150°F while continuing to mix. Add the dilution water while mixing and beginning to slowly cool the system. The resulting product will be a viscous, creamy, resin in water dispersion.

Product Stability Waterborne epoxy resin dispersions prepared as described above exhibit good physical and chemical stability. Formulation 1 and formulation 2 products stored near room temperature for several months showed no phase separation, settling, or loss in creaminess, nor were there any significant changes in dispersion properties (WPE, viscosity, average particle size, etc.) over this time.

Applications The resulting elastomer modified epoxy resin dispersions, such as those described by example formulations 1 and 2, can be blended with other epoxy resin dispersions. The elastomer modified epoxy resin dispersions can be used in non-reactive applications such as fiber sizings or cured with appropriate water soluble or water reducible epoxy curing agents for adhesive, coatings, binders and composites applications.

General Information

These are starting formulations and are not proven in the user's particular application but are simply meant to demonstrate the efficacy of the products and to assist in the development of the user's own formulation. It is the user's responsibility to fully-test and qualify the formulation, along with the ingredients, methods, applications or equipment identified herein ("Information"), by the user's knowledgeable formulator or scientist, and to determine the appropriate use conditions and legal restrictions, prior to use of any Information.

Safety, Storage & Handling

Please refer to the MSDS for the most current Safety and Handling information.

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Contact Information

For product prices, availability, or order placement, call our toll-free customer service number at:

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