Product Guide for Polymer Modification

Your Product Guide to Formulate Smarter Engineering Polymers and Elastomers

Cargill®

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Cargill is a leading supplier of bio-based building blocks with a range of functionalities such as acid, alcohol and amine, that offer unique durable performance benefits in engineering polymers and elastomers.

Our Priplast™, Pripol™, Priacid™, and Priamine™ ranges are used as monomers in the polymer to bring the following benefits:

Flexibility & toughness

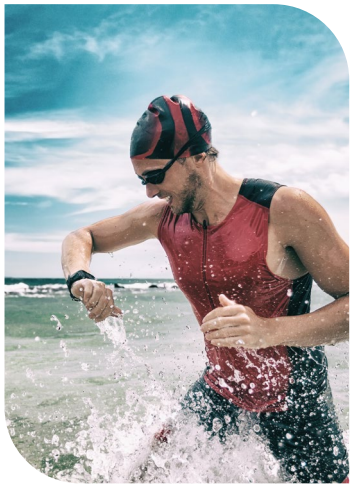
Moisture protection

Improved environmental profile

Hydrolytic stability

Low temperature performance

Thermo-oxidative stability



Polymer Modification with Specialty Dimer Fatty Acids, Azelaic Acid and Dimer Diols

Pripol™ specialty dimer fatty acids and dimer diols are used as monomers to modify polyamide, polyester, polycarbonate, polyurethane and epoxy resins.

The 100% bio-based Pripol range has been designed to enhance performance properties such as improved flexibility, excellent water barrier protection, low and stable color, enhanced melt flow and improved multi-substrate adhesion, as well as carbon footprint improvements and in-use sustainability benefits.

Pripol dimer fatty acids and dimer diols are especially useful in highly demanding applications such as transportation, electronics, sportswear and food packaging. Dimer modification can also reduce polymer density, perfect for light-weight applications.

Priacid™ azelaic acid offers good abrasion resistance and impact strength used to enhance performance in high-end polymers.

TRADENAME	CHEMICAL DESCRIPTION	BENEFIT	APPLICATION / FUNCTION	FORM AT 25°C	RENEWABLE CARBON	FOOD CONTACT APPROVAL	
						FDA*	EU†
Dimer acids							
Pripol™ 1009	Hydrogenated, distilled dimer acid (98%)	Very high purity building block for very high MW polymers that require enhanced mechanical performance	Polyester, polyamide and polycarbonate polymer modification	Liquid	100%	✔ (F grade)	✔
Pripol™ 1006	Hydrogenated, distilled dimer acid (95%)	Low color and color stable high purity building block bringing hydrophobicity, flexibility and thermo-oxidative stability	Polyester, polyamide, polycarbonate and epoxy polymer modification	Liquid	100%	✔ (F grade)	✔
Pripol™ 1012	Distilled dimer acid (97%)	High purity building block that brings flexibility and hydrophobicity for high MW, tough polymers	Polyester and polyamide polymer modification	Liquid	100%	✔	✔
Diacid							
Priacid™ DC1195	Azelaic acid (95%)	100% bio-based, excellent purity for enhanced mechanical properties, improved flexibility, reduced water uptake and good hydrolytic stability	Polyamide and polyester modification	Flakes	100%	✔	✔
Dimer diols							
Pripol™ 2030	Dimer diol, fully amorphous (98%)	Very high purity building block for flexible, high MW polymers. It is extremely stable against UV, thermo-oxidative degradation, hydrolysis and chemicals	Polyester, polyamide, polyurethane, PU elastomers and polycarbonate polymer modification	Liquid	100%	✔	
Pripol™ 2033	Dimer diol, fully amorphous (98%)	Very high purity building block or chain extender for flexible, high MW polymers. Offers high stability against UV, hydrolysis and chemicals	Polyester, polyamide, polyurethane, PU elastomers and polycarbonate polymer modification	Liquid	100%	✔	

* A tick indicates that a product complies with EU10/2011 and/or with specific FDA paragraphs, related to specific uses or polymer types.
Individual statements are available upon request. The user is responsible for ensuring suitability for their intended application.
✔ Statements are available upon individual request with explicit directions.

Bio-based Polyester Polyols in Elastomers & Engineering Plastics

POLYESTER, POLYCARBONATE AND POLYAMIDES ENGINEERING PLASTICS

Our polyester polyol product range, Priplast™, has been developed for the engineering polymers market to improve impact strength and water resistance whilst maintaining the rigidity of the polymer. Due to its low polarity, Priplast can be used as a larger soft modifier, resulting in a two-phase structure. Soft, rubbery Priplast segments are phase separated and homogeneously distributed in the hard plastic matrix.

POLYURETHANE ELASTOMERS

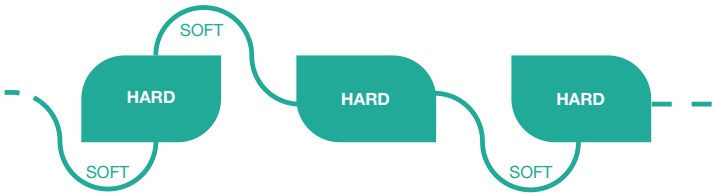
Polyurethane elastomers are rubbery materials used for example in cabling, tubing, sportswear and sealants. These elastomers can be thermoplastic (TPU) and require di-functional polyols to provide flexibility. Polyurethanes are increasingly used in composites as a binder and in pre-forms.

The polyurethane elastomers are commonly based on conventional polyether polyols such as PTMEG and PPG or polyester polyols such as adipate. Due to their good thermo-oxidative stability and UV and hydrolysis resistance, our Priplast range of polyester polyols offers several performance benefits over conventional polyols. These benefits include durability, excellent moisture repellency and flexibility.

With this unique balance of characteristics, our Priplast ingredients are ideal for use in demanding applications like sealants for electronics, sporting goods and automotive applications.

COPOLYAMIDE (COPA) & COPOLYESTER (COPE) ELASTOMERS

Priplast polyester polyols also offer unique properties to copolyamide (COPA) and copolyester (COPE) elastomers. They range from soft to semi-rigid products with good impact strength, low temperature flexibility, chemical resistance and maintain their mechanical properties over a wide temperature range. These elastomers are high-end block copolymers and find use in heavy-duty sports, automotive, electronic cabling and tubing applications. Priplast is used at 5-15% to maintain hardness of an engineering plastic, or at 20-45% in these elastomers.



COPA elastomers consist of polyamide hard segments (typically Nylon 12) and soft segments, often polyether (PTMEG). COPE elastomers consist of polyester hard segments (typically PBT) and soft segments, often polyether (PTMEG), or polyester (adipate or polycaprolactone). The Priplast range offers good thermo-oxidative stability and hydrolysis resistance and outperform conventional polyols.

Benefits include:

- Water resistance
- Wide window of application temperature
- Enhanced melt flow
- Substantial carbon footprint reduction

POLYESTER POLYOLS

TRADENAME	CHEMICAL DESCRIPTION	BENEFIT	APPLICATION / FUNCTION	FORM AT 25°C	MOLECULAR WEIGHT (MW)	RENEWABLE CARBON	FOOD CONTACT APPROVAL*	
							FDA	EU
Dimer acids								
Priplast™ 3199	Amorphous polyester polyol	High purity for high MW polymers with phase separation providing a unique combination of low Tg with high Tm, excellent stability	COPE, COPA and engineering plastics	Liquid	2000	87%	✔	✔
Priplast™ 3238	Amorphous polyester polyol	100% bio-based, high flexibility at low temperatures, no strain hardening, excellent compatibility with low polar components	TPU, cast PU, COPA, COPE, and engineering plastics	Liquid	2000	100%	✔	✔
Priplast™ 3197	Amorphous polyester polyol	Superior hydrolytic and oxidative stability, excellent hydrophobicity and flexibility	TPU, COPA, COPE, and engineering plastics	Liquid	2000	100%	✔	
Priplast™ 1838	Amorphous polyester polyol	Versatile, high flexibility at low temperatures, no strain hardening, excellent compatibility with low polar components, color stable	TPU, COPA, COPE, engineering plastics	Liquid	2000	82%	✔	✔
Priplast™ 3196	Amorphous polyester polyol	Very high flexibility at low temperature, no strain hardening, extreme hydrophobicity, UV and color stable, soft touch	TPU, COPA, COPE, and engineering plastics	Liquid	3000	83%	✔	✔
Priplast™ 3192	Semicrystalline polyester polyol	Superior hydrolytic resistance and mechanical properties, versatile in use	TPU and PU microcellular foam	Waxy Solid	2000	38%	✔	✔
Priplast™ XL 101	Semicrystalline polyester polyol	Superior strength balanced with high flexibility and elongation, excellent hydrolytic, UV and color stability	TPU, cast PU and engineering plastics	Waxy Solid	2000	18%		

* A tick indicates that a product complies with EU10/2011 and/or with specific FDA paragraphs, related to specific uses or polymer types Individual statements are available upon request. The user is responsible for ensuring suitability for their intended application. ✔ Statements are available upon individual request with explicit directions.

Dimer diamine in Polyamides, Polyurethanes, Polyimides and Epoxy Systems

Priamine™ C36 dimer diamine has been developed for use in polyamide plastics and elastomers, polyurethane elastomers and polyimides.

POLYAMIDES

Priamine provides polyamides with flexibility, reduced melt viscosity for enhanced mold flow and improved adhesion. The low moisture absorption reduces strength variations and brings improved dimensional stability. Priamine can also be built in as a tough, segmented block-copolymer. Using it in this way means that the rigidity (high Tg) of the hard matrix can be maintained.

POLYURETHANES

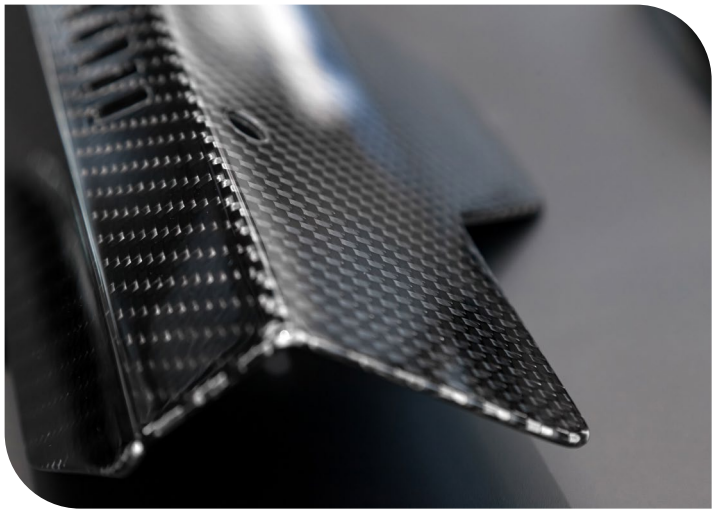
Modifying polyurethanes with Priamine offers formulation possibility to introduce urea sections combined with flexibility. It also offers water resistance and improved adhesion.

POLYIMIDES

Priamine 1075 has been selected for use in high performance polyimides due to its high purity, high di-functionality and low color. This low viscosity material allows producers to reduce the use of expensive solvents during processing. Furthermore, Priamine is a 100% sustainable solution with an extremely low color that allows for transparent polyimide applications.

TRADENAME	CHEMICAL DESCRIPTION	BENEFIT	APPLICATION / FUNCTION	FORM AT 25°C	AMINE VALUE (MGKOH/G)	RENEWABLE CARBON
Dimer diamines						
Priamine™ 1075	Dimer diamine >99%	Low viscosity monomer or chain extender offering high formulation flexibility, moisture repellency, color stability, high purity for excellent mechanical properties and ease of handling. A low VOC solution in polyimides	Polyamides, COPA, TPU and polyimides	Liquid	205	100%

Enhancing performance of composite materials



BUILDING BLOCKS

Pripol and Priplast offer benefits to composite such as stronger fiber adhesion with the matrix, combined with toughness and reduced moisture uptake.

EPOXY TOUGHENING AGENTS

B-Tough™ epoxy functional grafted toughening agents offer the following benefits in composite materials: boosting impact in glass fiber composites, improved inter-laminar strength and improved compatibility between fibers and the resin in carbon fiber parts.

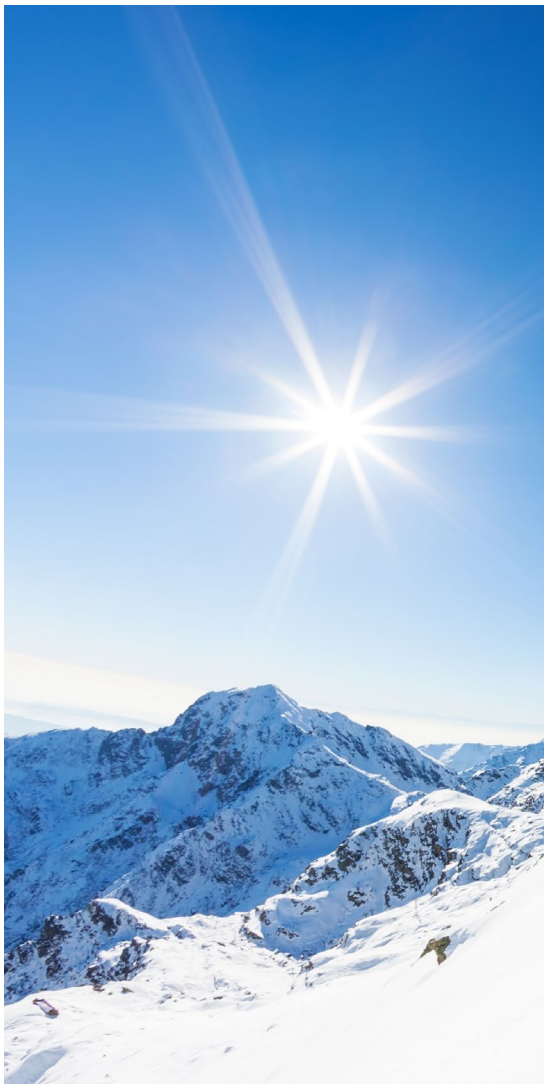
POLYMER PROCESSING ADDITIVES

Internal lubricants to increase throughput and improve flow and give a superior surface finish to composite materials.

Further Information

Cargill Bioindustrial sales and distribution are coordinated through an extensive worldwide network of technical and commercial experts. For further information or guidance please contact us:

coatings_andpolymers@cargill.com



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