



HUNTSMAN

Enriching lives through innovation

Materials for Batteries and Energy Storage

Huntsman Battery Materials

Dispersant

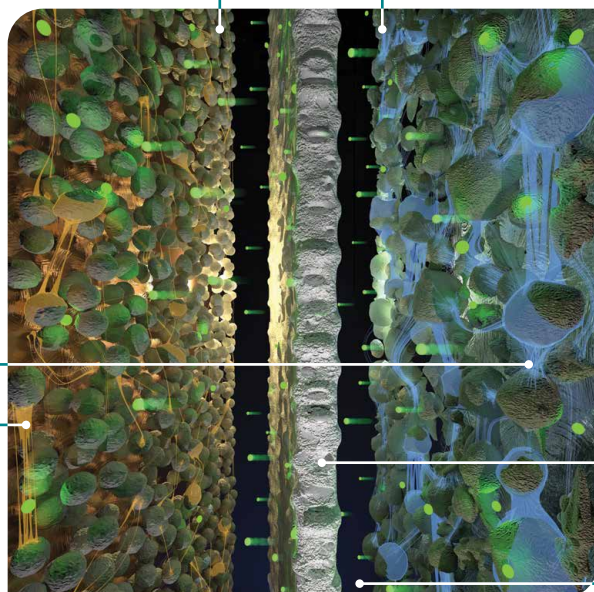
JEFFSPERSE® Dispersant

Binders

JEFFAMINE® Amine
Polyurethane Binder

Conductive Additive

MIRALON®
Carbon Materials



Separator

ELASTAMINE® and
JEFFAMINE® Amine

Electrolyte

ULTRAPURE® Ethylene Carbonate
ULTRAPURE® Propylene Carbonate
JEFFAMINE® Amine for Solid Electrolytes

Huntsman Battery Offering

Huntsman is an established chemical supplier with a history of commercializing innovation. A wide variety of materials and advanced chemistries, a robust global footprint with dedicated regional manufacturing, and a commitment to investment positions Huntsman to meet the long-term needs of the industry and enable next-generation technologies with innovative materials.

Huntsman's battery materials portfolio offers manufacturers products to increase capacity, lengthen cycle life, improve charging times, and reduce EHS concerns through a US and European supply position.

Technical support, sales and testing capabilities, dedicated US and European manufacturing sites, and sophisticated supply chain organizations enable Huntsman to serve the global lithium-ion battery market.

- **Dispersants - JEFFSPERSE® dispersants** provide improved loading and stability
- **NMP free processing solvents - JEFFSOL® solvents** offer improved EHS and handling
- **Binders - JEFFAMINE® amine** modified polymers or Polyurethane based binders offer improved performance
- **Carbonates - ULTRAPURE® carbonates** offer high purity carbonates for electrolyte solvents with US based production
- **Conductive additives - MIRALON® carbon additives** and **MIRAWEB™** structures improve conductivity
- **Polymer modifiers for gel and solid-state electrolytes - JEFFAMINE® amines** increase ionic conductivity and decrease crystallinity

ULTRAPURE® Carbonates

Huntsman is the only North American producer of alkylene carbonates, including **ULTRAPURE® Ethylene Carbonate (EC)** and **ULTRAPURE® Propylene Carbonate (PC)**. Huntsman offers a range of high-purity **ULTRAPURE®** carbonate solvents for lithium-ion batteries, supercapacitors, dynamic glazing, and polymer photoresist removal.

Impurities can reduce battery performance and lifetime, and high-purity carbonates play a critical role as electrolytes in lithium-ion batteries. **ULTRAPURE® Ethylene** and **Propylene Carbonates** offer low water, glycol, trace metals, and anions that are strictly controlled from production to delivery to promote optimal operation.

ULTRAPURE® Carbonates are offered in three different grades with the highest purity, **ULTRAPURE® EV**, is formulated to improve battery working life and provide reliable operation.

Our dedicated research and application staff, world-class Alkylene Carbonate units, and global supply chain security allow customers to shorten supply chains and partner with Huntsman in innovation.



Ethylene Carbonate	Color	Purity	Water	Glycols	Anions	Cation
ULTRAPURE® EV	+++	+++	+++	+++	+++	+++
ULTRAPURE® HP	++	++	++	++	N/A	N/A
ULTRAPURE® BG	++	+	+	+	N/A	N/A

Propylene Carbonate	Color	Purity	Water	Glycols	Halides	UV Absorbance
ULTRAPURE® EV	+++	+++	+++	+++	+++	+++
ULTRAPURE® HP	++	++	++	++	N/A	++
ULTRAPURE® BG	+	+	+	+	N/A	+

KEY

+++ Best Quality

++ High Quality

+ Good Quality

JEFFSPERSE® Dispersants

Huntsman **JEFFSPERSE® dispersants** are patented, nonionic, polymeric dispersants for electrode slurries. The comb polymer structure contains functional groups that provide strong, cohesive adsorption onto the material surface and water-compatible chains, which provide steric stabilization after adsorption onto the surface. They offer a cost-effective solution to enhance lithium-ion battery performance. **JEFFSPERSE® dispersants** help achieve higher loading of active materials and conductive agents in electrode slurries, improve particle size distribution and prevent particle reagglomeration, enabling consistent electrode quality over time. **JEFFSPERSE® dispersants** also provide ease of handling and can lower viscosity.

JEFFSPERSE® X3503

Nonionic comb polymer with higher HLB and aromatic surface-anchoring groups, 35% active dispersant in water

JEFFSPERSE® 4105

Amphoteric comb polymer, 50% active dispersant in water that offers flexibility as a universal dispersant for a wide range of organic and inorganic particles

XHD-070*

Nonionic comb polymer with medium HLB 50% active in water or solvent

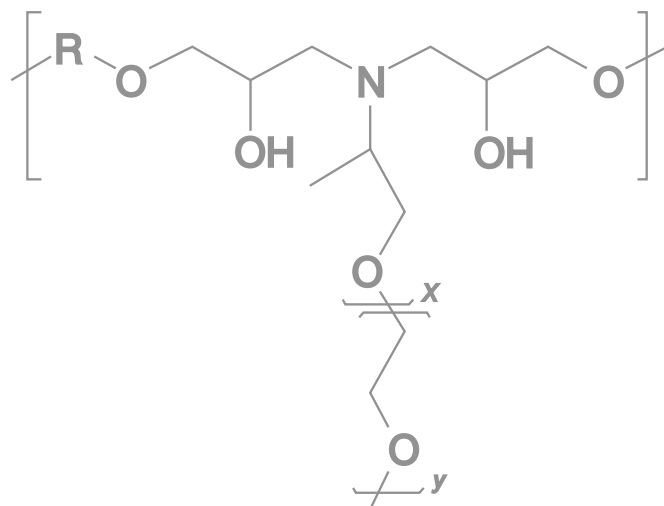
*DEVELOPMENTAL DISPERSANT

JEFFSPERSE® X3204

Nonionic comb polymer with higher HLB and aromatic surface-anchoring groups, 40% active dispersant in water

JEFFSPERSE® X3202

Nonionic comb polymer with higher HLB and aromatic surface-anchoring groups, 25% active dispersant in water



JEFFSOL® Solvents as NMP Alternatives

Huntsman has developed a portfolio of suitable replacements for NMP to be used as processing solvents for electrode slurries in lithium-ion battery manufacturing. These products provide formulators ease of handling and improved EHS profiles without sacrificing performance.

JEFFSOL® DMEU (XHE-123) and JEFFSOL® MeOx (XHE-117) are polar aprotic solvents well suited for use in a wide range of applications because of their excellent solvency, relatively high flash points, low vapor pressure, and ease of handling. They can also be used with aqueous systems to improve solvency while maintaining a primarily water-based system.

Polymer wt%	PVDF		PS			PMMA			BTR		BPDA		BTDA			ODPA			PMDA			6FDA			3,4'-ODA			pPDA		
	5	10	8	15	40	8	15	40	8	30	5	10	5	10	30	5	10	30	5	10	30	5	10	30	5	10	30	5	10	30
NMP	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+
DMEU	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+
MeOx			+	+	-	+	+	+	+	+	-	-	+	+	-	+	+	-	+	-	-	+	+	-	+	+	+	+	+	+

+ Fully soluble

- Limited solubility

JEFFAMINE® Amines

Huntsman's JEFFAMINE® amine line offers an extensive selection of polyetheramines, many of which provide versatile, efficient building blocks for polymer modification in solid-state or gel polymer electrolytes.

Our core JEFFAMINE® amine product line consists of monoamines, diamines, and triamines attached to polyether backbones, typically based on propylene oxide (PO), ethylene oxide (EO), or a mixture of both oxides. Our expertise in polyetheramines allows for developing new materials in collaboration with our customers.

JEFFAMINE® amines are easy to handle and have low color. Their EO/PO chains and amine functionality impart tunable rigidity and hydrophobicity to organic matrices.

Polymers modified with JEFFAMINE® amines provide many benefits for surface modification, including enhanced ionic transport within LFP particle interfaces, improved wetting between electrolyte and electrode, and increased specific capacity. In gel electrolytes, they improve cycling and enhance ionic conductivity.

Product	Functionality	Hydrophobic Effect	Molecular Weight
JEFFAMINE® M-600	Monoamine	Hydrophobic	600
JEFFAMINE® M-2005	Monoamine	Hydrophobic	2,000
JEFFAMINE® M-1000	Monoamine	Hydrophilic	1,000
JEFFAMINE® M-2070	Monoamine	Hydrophilic	2,000
JEFFAMINE® M-2095	Monoamine	Hydrophilic	2,000
JEFFAMINE® M-3085	Monoamine	Hydrophilic	3,000
JEFFAMINE® D-230	Diamine	Hydrophobic	230
JEFFAMINE® D-400	Diamine	Hydrophobic	400
JEFFAMINE® D-2000	Diamine	Hydrophobic	2,000
JEFFAMINE® D-4000	Diamine	Hydrophobic	4,000
JEFFAMINE® ED-600	Diamine	Hydrophilic	600
JEFFAMINE® ED-900	Diamine	Hydrophilic	900
JEFFAMINE® ED-2003	Diamine	Hydrophilic	2,000
JEFFAMINE® T-403	Triamine	Hydrophilic	400
JEFFAMINE® T-800	Triamine	Hydrophilic	800
JEFFAMINE® T-3000	Triamine	Hydrophilic	3,000
JEFFAMINE® T-5000	Triamine	Hydrophilic	5,000



About Huntsman

Huntsman Corporation is a publicly traded global manufacturer and marketer of differentiated and specialty chemicals with 2022 revenues of approximately \$8 billion from our continuing operations. Our chemical products number in the thousands and are sold worldwide to manufacturers serving a broad and diverse range of consumer and industrial end markets. We operate more than 60 manufacturing, R&D and operations facilities in approximately 30 countries and employ approximately 7,000 associates within our continuing operations. For more information about Huntsman, please visit the company's website at www.huntsman.com.

Huntsman Performance Products

Performance Products brings together innovation and world-leading process technologies to produce components used to formulate products that enhance people's lives. Our leading global positions in the manufacture and sale of amines, maleic anhydride and carbonates enable us to serve diverse consumer and industrial end markets, including energy, automotive and transportation, coatings and adhesives, construction and infrastructure, electronics, and industrial manufacturing. With 10 manufacturing facilities in North America, Europe, the Middle East and Asia, we produce and sell over 350 products to over 900 global customers, and provide extensive pre- and post-sales technical service support. The division had 2022 revenues of USD 1.7 billion.

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