

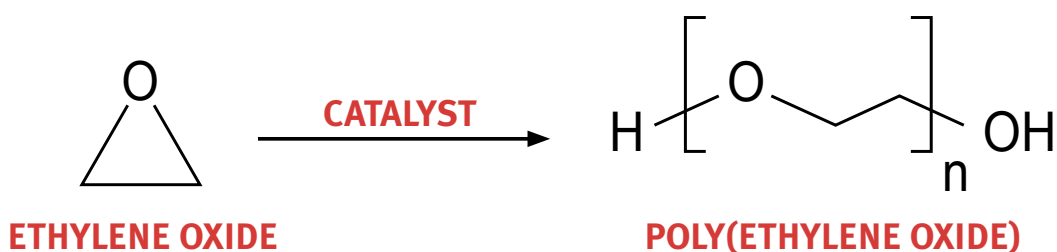


POLYOX™

Versatile Water-Soluble Resins for Industrial Applications

WHAT ARE POLYOX™ WATER-SOLUBLE RESINS (WSR)?

POLYOX™ Water-Soluble Resins (WSR) are thermoplastic, nonionic polymers with high molecular weight. They are obtained through the heterogeneous polymerization of ethylene oxide ($\text{CH}_2\text{CH}_2\text{O}$)_n, which in turn creates poly(ethylene oxide) or PEO.



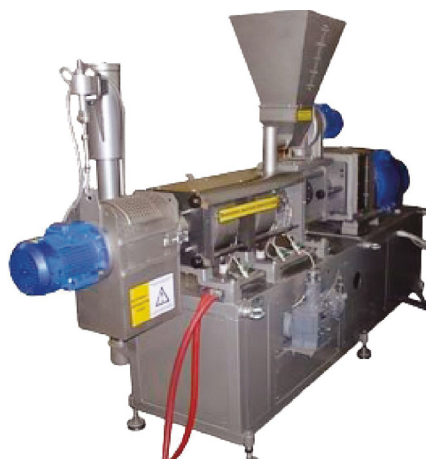
POLYOX™ WSR can be supplied in a wide range of molecular weights to meet specific formulation and processing requirements.

POLYOX™ WSR OFFERS A UNIQUE RANGE OF FUNCTIONAL PROPERTIES

POLYOX™ WSR exhibits many properties that are typical of other classes of water-soluble polymers:

- Lubricity
- Thickening and rheology modification
- Binding
- Film formation
- Water retention

They are also unique in that they are **thermoplastic polymers** that can be calendared, extruded, injection-molded or cast.



UNIQUE PERFORMANCE PROPERTIES THAT ADD VALUE TO YOUR PRODUCTS AND PROCESSES

POLYOX™ WSR has been used for over 50 years for its unique properties. Unlike other polymers, POLYOX™ WSR combines water and solvent solubility. While thermo-elastic, POLYOX™ WSR polymers can also exhibit a thermoplastic behavior. This versatility has made POLYOX™ WSR a popular choice for many industrial applications.

POLYOX™ WATER-SOLUBLE RESINS ARE VERSATILE AND PROVIDE BINDING, LUBRICITY, ADHESION AND MORE



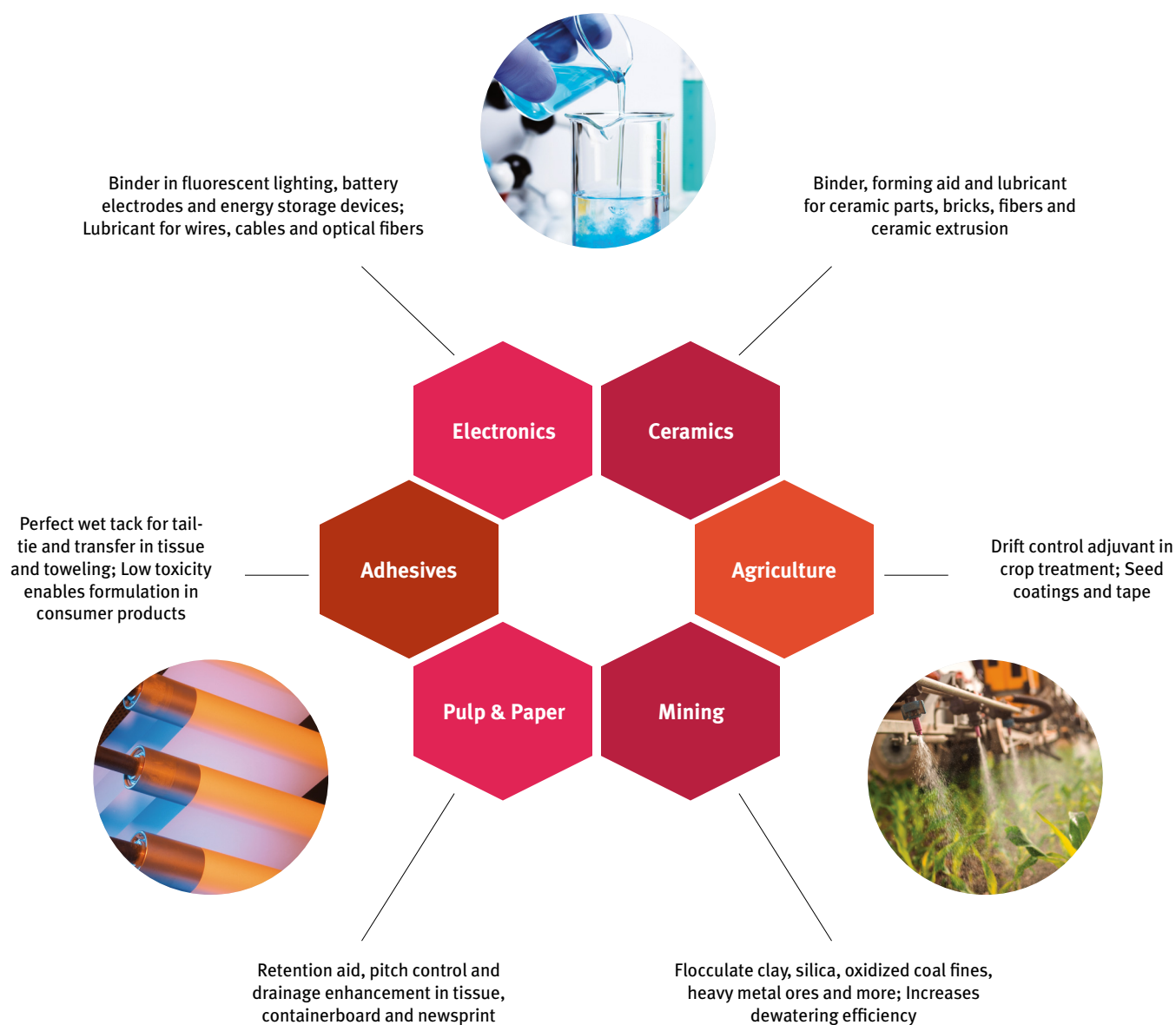
Films of POLYOX™ WSR are flexible, tough and resistant to most oils and greases.

With their very high molecular weight, POLYOX™ WSR polymers are viscoelastic, so their aqueous solutions can reduce splattering and misting.

POLYOX™ WSR can also form association compounds with many other substances to achieve a wide variety of additional, useful formulation properties.

POLYOX™ WSR APPLICATIONS

At DuPont Nutrition & Health, we support our customers in their efforts to develop new products, constantly solving new challenges as they arise. POLYOX™ WSR can be used in a wide range of applications and has seen increasing adoption in industrial applications. We often customize new POLYOX™ WSR grades or chemistries to meet specific customer requirements.



The applications mentioned above are typical of POLYOX™ WSR polymers. POLYOX™ WSR can also be used in many other applications, such as inks & coatings, release liners, automotive fluids, paper coating, textile sizing and many more.

DUPONT POLYOX™ WSR PRODUCT LINE

POLYOX™ Water-Soluble Resins come in a wide range of molecular weights and viscosities to meet your specific needs.

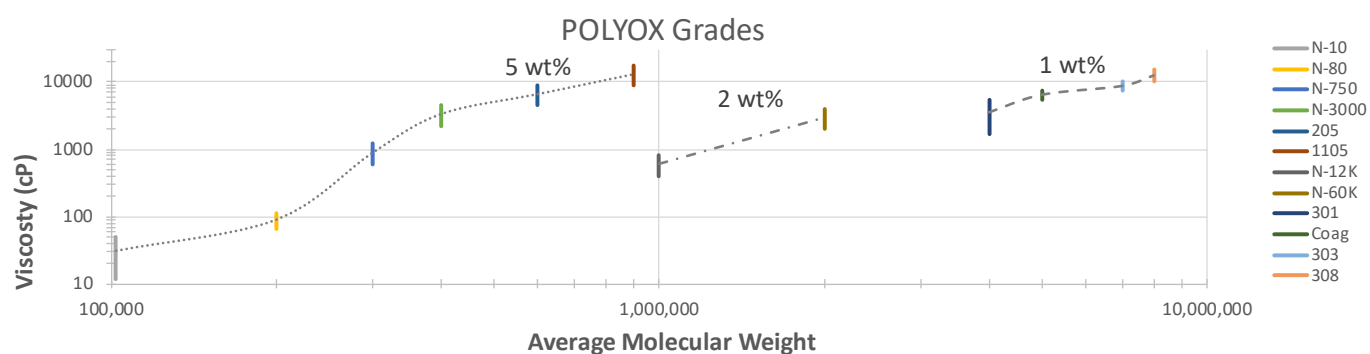
GRADES	Approximate Molecular Weight ²	Viscosity of aqueous solution at 25 °C and given concentration, Brookfield RVF	
		wt%	mPa.s(cP)
POLYOX™ WSR N-10	100,000	5	12 – 50
POLYOX™ WSR N-80	200,000	5	65 – 115
POLYOX™ WSR N-750	300,000	5	600 – 1,000
POLYOX™ WSR N-3000	400,000	5	2,250 – 4,500
POLYOX™ WSR 205	600,000	5	4,500 – 8,800
POLYOX™ WSR 1105	900,000	5	8,800 – 17,600
POLYOX™ WSR N-12K	1,000,000	2	400 – 800
POLYOX™ WSR N-60K	2,000,000	2	2,000 – 4,000
POLYOX™ WSR 301	4,000,000	1	1,650 – 5,500
POLYOX™ WSR Coagulant	5,000,000	1	5,500 – 7,500
POLYOX™ WSR 303	7,000,000	1	7,500 – 10,000
POLYOX™ WSR 308	8,000,000	1	10,000 – 15,000
UCARFLOC™ Polymer 304 CP ²	7,500,000	1	7,500 – 13,000
UCARFLOC™ Polymer 309 CP ²	8,500,000	1	> 13,000

¹Based on rheological measurements. Molecular weights obtained by other methods, including light scattering and gel permeation chromatography, may not be directly comparable.

²Coarse Particle (CP) grade specified as less than 15% through a 200 mesh screen (74 µm)

POLYOX™ (WSR) VISCOSITY AS A FUNCTION OF MOLECULAR WEIGHT

POLYOX™(WSR) provides you with a one-of-a-kind toolbox, enabling you to customize viscosity according to your requirements.



PROCESSING RECOMMENDATIONS FOR POLYOX™ WSR



Although POLYOX™ Water-Soluble Resins are completely water soluble in typically 0.5 to 3 hours, dispersing the powder with minimal shear is important to facilitate complete dissolution. If the resins are added too quickly, they will form gel-coated agglomerates that prevent complete hydration. Detailed procedures and equipment recommendations for laboratory- and commercial-scale dissolving methods are available upon request.

There are three major techniques that ensure sufficient dispersion of POLYOX™ WSR resin particles, but the choice depends on the final viscosity target and required volume.

DIRECT ADDITION TO WATER

Recommended for laboratory-scale and less-than-drum quantities.

This is best accomplished by introducing POLYOX™ WSR at an adequate rate of addition. If you add it too slowly, the viscosity will build too rapidly, and you will not be able to add the remaining resin. However, if the resin is added too quickly, it will form gel-coated agglomerates.

PRE-DISPERSION IN WATER-MISCIBLE NON-SOLVENTS

Recommended for laboratory-scale and less-than-drum quantities.

POLYOX™ WSR is first dispersed in a water-miscible non-solvent, such as isopropyl alcohol, to separate the individual particles from each other. Each individual particle has a chance to swell, hydrate and dissolve. This technique avoids the typical clumping that occurs when dissolved in water alone. The use of alcohols or glycols has the added benefit of stabilizing the solution viscosity over time.

USE OF MECHANICAL DEVICES THAT ACHIEVE DISPERSION WITH MINIMAL SHEAR

For large volume or continuous operations.

The relative ease of dissolving POLYOX™ WSR directly in water depends on three factors:

- Rate of viscosity buildup, which is a function of solution concentration and molecular weight
- Particle size
- Type of agitation; the underlying factor, once again, is to obtain good resin dispersion before the solution viscosity builds to a point where it is no longer possible to disperse additional resin

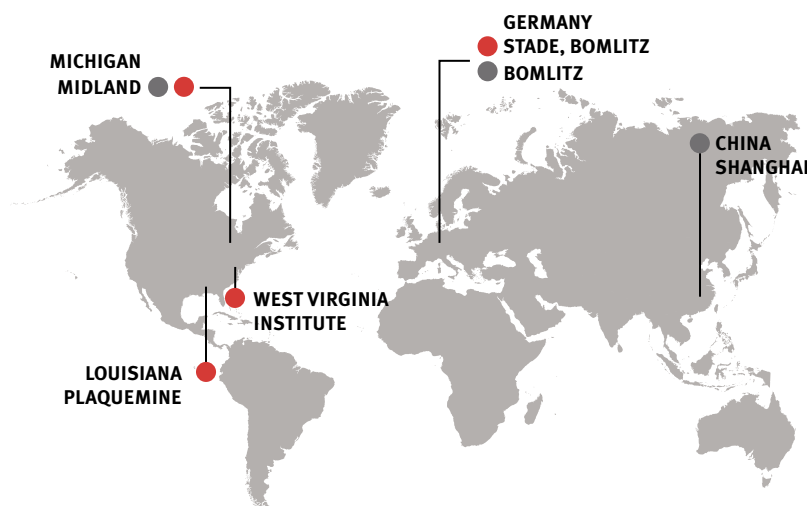
Additional information and detailed procedures, laboratory equipment recommendations and commercial scale methods for dissolving POLYOX™ Water-Soluble Resins are described in a separate brochure. Our sales and technical team can assist you with process-related questions.

DUPONT GLOBAL SPECIALTY SOLUTIONS

- Global manufacturing and technology footprint
- Robust business continuity planning procedures and standards
- Sales and technical support network for local customer support
- Three technical support and development (TS&D) facilities
 - » Bomlitz, Germany
 - » Midland, MI, U.S.A.
 - » Shanghai, China

GLOBAL SPECIALTY SOLUTIONS MANUFACTURING & RESEARCH SITES

5 production sites, 3 R&D/Technical Support and Development (TS&D) centers



WHAT WE DO

POLYOX™ Water-Soluble Resins for industrial applications are available only from DuPont Global Specialty Solutions and its distributors. Global Specialty Solutions, a business of DuPont Nutrition & Health (N&H), manufactures cellulosic polymers alongside other N&H portfolio products. Our dedicated Global Specialty Solutions team commercializes DuPont products into various global markets.

OUR CORE VALUES

More than just goals, our core values reflect the way we work every day with our customers and partners in communities around the globe:

- Safety & Health
- Environmental Stewardship
- Respect for People
- Highest Ethical Behavior

WHO WE ARE

We are innovative problem solvers, drawing on deep application understanding and market insight to help our customers turn challenges into high-value business opportunities.

[Learn more at dupontspecialtysolutions.com](http://dupontspecialtysolutions.com)



CONTACT OUR KEY OFFICES

Connect with DuPont sales and application experts to further explore integrating POLYOX™ into your application.

dupontspecialtysolutions.com



PRODUCT SAFETY

When considering the use of any DuPont products in a particular application, please review our latest Material Safety Data Sheets first to ensure that your intended use can be accomplished safely. For Material Safety Data Sheets and other product safety information, contact our DuPont experts. Before handling any other products mentioned in the text, obtain available product safety information and take necessary steps to ensure safety of use.

The information contained herein is based on data known to DuPont or its affiliates at the time of preparation of the information and believed by them to be reliable. This is business-to-business information intended for food, beverage and supplement producers, and is not intended for the final consumer of a finished food, beverage or supplement product. The information is provided "as is" and its use is at the recipient's sole discretion and risk. It is the recipient's sole responsibility to determine the suitability and legality of its proposed use of DuPont products for its specific purposes. Information and statements herein shall not be construed as licenses to practice, or recommendations to infringe, any patents or other intellectual property rights of DuPont or others.

DUPONT HEREBY EXPRESSLY DISCLAIMS (I) ANY AND ALL LIABILITY IN CONNECTION WITH SUCH INFORMATION, INCLUDING, BUT NOT LIMITED TO, ANY LIABILITY RELATING TO THE ACCURACY, COMPLETENESS, OR USEFULNESS OF SUCH INFORMATION, AND (II) ANY AND ALL REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO SUCH INFORMATION, OR ANY PART THEREOF, INCLUDING ALL REPRESENTATIONS AND WARRANTIES OF TITLE, NON-INFRINGEMENT OF COPYRIGHT OR PATENT RIGHTS OF OTHERS, MERCHANTABILITY, FITNESS OR SUITABILITY FOR ANY PURPOSE, AND WARRANTIES ARISING BY LAW, STATUTE, USAGE OF TRADE OR COURSE OF DEALING.

Copyright © 2019 DuPont or its affiliates. All Rights Reserved. The DuPont Oval Logo, DuPont™ and all products denoted with ® or ™ are registered trademarks or trademarks of E.I. du Pont de Nemours and Company or its affiliated companies.

