performance specialties

reference guide

EMEA product line

Ashland™
always solving

ashland.com / efficacy usability allure integrity profitability™

contents

introduction

Ashland Global Holding Inc. is recognized as one of the best global specialty ingredients and formulations businesses in the world. We strive to exceed our customers' expectations through a relentless focus on our customers and innovation and by helping our customers to solve and improve their formulations anywhere in the world. Integral to the current success of our above-and beyond efforts is Ashland's exceptional technical service organization, which works directly with formulation and application scientists. We keep abreast of market trends to provide for our customers' future needs. With over 6,000 employees in more than 100 locations around the globe, Ashland serves industries such as adhesives, coatings, construction, oilfield, digital printing, electronics, household, industrial and institutional (HI&I), metallurgy and plastics – as well as markets as diverse as pharmaceutical, agricultural, food, beverage and personal care. Our product family of over 20,000 SKUs, while sometimes representing a relatively small portion of customers' product, generally constitute key ingredients in the end products in which they are used.

Ashland offers a broad spectrum of organo- and water-soluble polymers that are derived from both natural and synthetic resources. Our extensive product line includes derivatized cellulose polymers, synthetics and guar derivatives that impart effective functionalities to serve a wide variety of industrial markets and specialized applications.

Our application specialists, located throughout the world, provide our customers with expert technical assistance using state-of-the-art analytical, testing and evaluation equipment. They are the key to bringing out the unique and highly functional performance of our products that go far beyond their relatively low addition levels in complex formulations. In addition to our ongoing effort to better understand how our products are used in each specialty application, the Functional Ingredients team is dedicated to developing new products and technologies to provide solutions that satisfy the needs of our customers.

Our customers are vital to our business and we want to hear from you! If you have any questions about our products or are interested in receiving samples.

For more information, visit us at **ashland.com**.

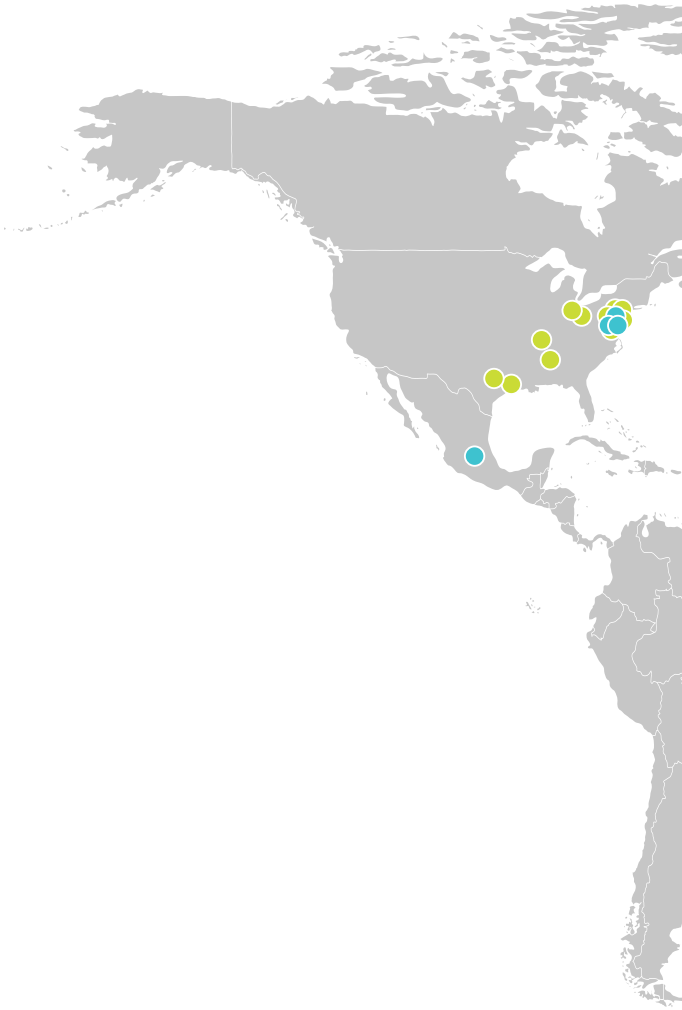
manufacturing facilities

North America

- Huntsville, Alabama
- Wilmington, Delaware
- Calvert City, Kentucky
- Columbia, Maryland
- Freetown, Massachusetts
- Chatham, New Jersey
- Parlin, New Jersey
- Columbus, Ohio
- Lima, Ohio
- Kenedy, Texas
- Texas City, Texas
- Hopewell, Virginia

Latin America

- Cabreuva, Brazil



Europe

- Doel-Beveren, Belgium
- Alizay, France
- Sophia Antipolis, France
- Marl, Germany
- Memmingen, Germany
- Zwijndrecht, Netherlands
- Newton Aycliffe, United Kingdom
- Poole, United Kingdom

Asia Pacific

- Jiangmen, China
- Nanjing, China

research and development and technical service centers

North America

- Wilmington, Delaware[1]
- Columbia, Maryland[1]
- Bridgewater, New Jersey[1]
- Dublin, Ohio

Latin America

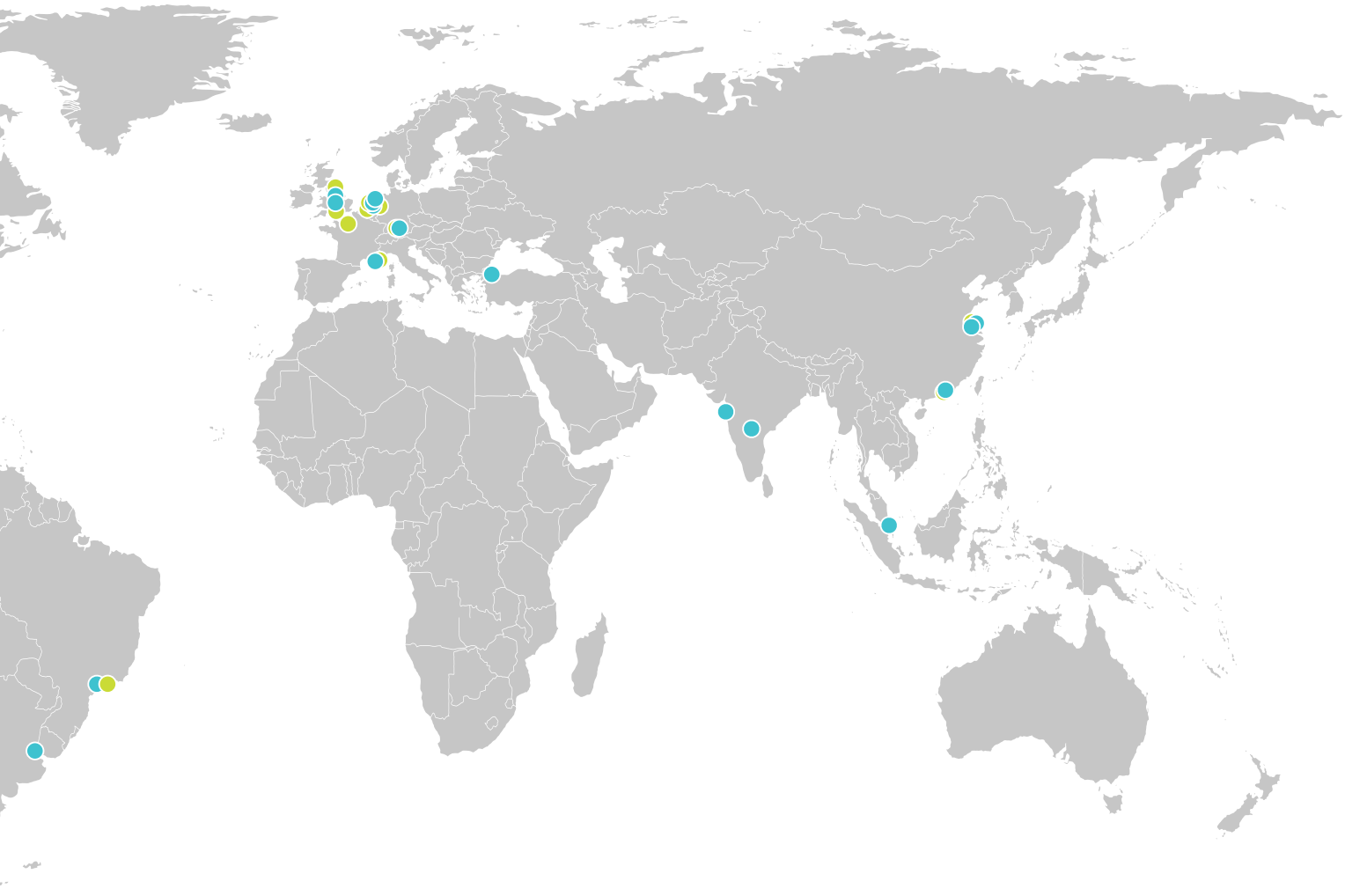
- São Paulo, Brazil
- Mexico City, Mexico
- Buenos Aires, Argentina

Europe

- Sophia Antipolis, France[1]
- Düsseldorf, Germany[1]
- Rotterdam, Netherlands
- Zwijndrecht, Netherlands[1]
- Istanbul, Turkey
- Bradford, United Kingdom[1]
- Kidderminster, United Kingdom

Asia Pacific

- Jiangmen, China
- Nanjing, China
- Shanghai, China[1]
- Hyderabad, India[1]
- Mumbai, India[1]
- Pantech, Singapore



[1]Centers of Excellence

a selected overview of applications

adhesives

Ashland's synthetics, cellulosic and guar-based polymers are typically employed as binders, rheology modifiers and tack enhancers in latex-based and water-soluble adhesives. In these systems, Ashland water-soluble polymers deliver superior performance in thickening, improved sag resistance, increased cohesion and adhesion as well as in achieving the required viscosity. In addition, surfactants and foam control agents complete the portfolio.

cables

Aquasorb™ and Blanose™ carboxymethyl cellulose functions as a water-blocking agent and protects underground and underwater cables from water intrusion.

ceramics

Our products are used in both advanced and traditional ceramics as binders and green strength additives. Our organic additives provide ceramic formulations with the plasticity required for shaping by improving the workability of the material and increasing mechanical strength.

advanced ceramics

In high-performance ceramics such as catalytic converters, diesel particulate filters and industrial environmental filters, Culminal™ and Benecel™ methylhydroxypropylcellulose exhibit an excellent balance between plasticity and shape retention during high-temperature extrusion. In addition, Culminal methylcellulose and methylhydroxypropylcellulose polymers act as clean burn out binders with minimal residue.

traditional ceramics

Blanose carboxymethylcellulose products are particularly suited for use as binder systems in traditional ceramics and glazing. They impart high green strength at relatively low addition levels while producing excellent plasticity and clean burnout upon firing. Our cellulose ethers are also extensively used as binders in glazing applications to provide excellent rheological performance, outstanding adhesive properties and strong water retention. These functionalities produce a strong, tight bond between the glaze and the ceramic body which prevents damage to the surface prior to firing.

civil engineering

In civil engineering applications, such as special foundations, tunneling, micro tunneling and horizontal directional drilling, drilling muds are used to improve fluid loss control, maintain wall stability, enhance the ability to suspend cuttings and improve the ability to plug open formations (thixotropic properties). Our AquaVIS™ solid and liquid polymer products are used extensively as additives in these applications to boost the performance of bentonite through water retention, stabilization of the mud suspension and increased shear thinning (improved pumpability).

electronics

Aqualon EC™ ethylcellulose polymers are organic, solvent soluble derivatives of cellulose that act as agents for rheology control and binding with very clean burn out performance in thick metal and specialty electronic pastes. These binders are used in the manufacture of multi-layer ceramic capacitors; plasma display panels and solar cells. Continual improvements in the manufacturing process quality control systems have resulted in high-quality products with excellent solubility in numerous solvent systems.

fire-fighting fluids

Fast-dissolving Galactasol™ guar derivatives build fluid rheology to impart cohesion and prevent the misting of these solutions during aerial drops onto fires. The unique solubility characteristics of Ashland's guar derivatives provide the desired rheology behavior as well as stability in the presence of high concentrations of fire-fighting salts.

foundry

Blanose carboxymethylcellulose and Natrosol™ hydroxyethylcellulose are used to improve green strength and shape retention in bricks and monolithics before firing. They can also be used in self-leveling concrete refractory bases to improve stability without cross-linking. These polymers are excellent dispersants in castables, aid in the extrusion process and burn out upon firing.

fuel pastes

Produced from alcohol, thickeners and water, fuel pastes are mainly used in hotels, restaurants and by caterers for warming food. These fuel pastes need to burn cleanly and completely without any physical residue. Klucel hydroxypropylcellulose derivatives are excellent thickeners for alcohol applications. They are compatible with and soluble in various solvent-water mixtures and demonstrate a fast response to new formulations and products.

inks and coatings

Aqualon EC ethylcellulose is a key ingredient in gravure printing inks as well as a thickening binder in flexographic and screen printing inks. In this application, Aqualon ethylcellulose polymers provide adhesion, enhanced pigment dispersion, fast solvent release, improved gloss and outstanding viscosity control. Also V-Pyrol and V-Cap are important ingredients in UV curable systems. Surfactants and FCA are added to water based systems. PVP and Ganex are acting as film formers and dispersants. For Ink receptive media, PVPP and crosslinkable PVP copolymers can improve the ink acceptance.

lithographic printing and fountain solutions

Due to environmental concerns surrounding the volatility of alcohols in fountain solutions, there is increased demand for cleaner substitutes. Our Ambergum™ water-soluble polymers come from a reliable, stable raw material source to provide clean viscosity control and unique rheology in gumming and fountain solutions. These excellent wetting agents help prevent emulsification and bleeding of the ink to provide more uniform wetting of the printing plate and yield a high print quality and rich, solid color. Also Easy-Wet™ and the Surfadone LP™ product range can help here.

mining

Our cellulose ethers and guar polymers are used in numerous mining and mineral processing applications including froth flotation, iron ore pelletization, and tailings flocculation. In gangue depressant applications, low dosages of our water-soluble polymers can provide an increase in both the

quality and quantity of the valuable mineral component by deactivating the surface of undesirable impurities. As a result, separation of the gangue from the valuable ore is greatly improved. Tacabind™ pellet binder provides excellent binding performance in the formation of taconite iron ore pellets, imparts both dry and wet (green) strength and, more importantly, does not contribute unwanted silica to the final product.

paint removers

Our products are used to thicken solvent-based paint removers and provide easier application, enhanced vertical cling and can slow rapid solvent evaporation. Klucel™ hydroxypropylcellulose is especially suitable as the primary thickener in a variety of different flammable and non-flammable paint remover formulations due to its wide-ranging solubility in moderate to highly active solvents. Culminal methylhydroxypropylcellulose can also be used in certain chlorinated solvent/alcohol mixtures with maximum thickening potential achieved through preliminary high shear dispersion of the polymer into the chlorinated solvent.

paper

Ashland's Blanose carboxymethylcellulose is used to increase the wet and dry strength of a specific paper product. It can be added in the pulpers or in the stock where it greatly enhances the durability and strength of the fibers. Blanose carboxymethylcellulose and Natrosol hydroxyethylcellulose products are also frequently used at the calendar stacks for curl control in specialty grades of paper such as food packaging (for grease-proofing) and in carbonless papers for ink enhancement. In addition, our Galactasol guar derivatives are often used for better retention, improved drainage and improved paper web formation. The ability of these polymers to retain fibers in the paper sheet results in cleaner water systems.

paper coatings

Several of our products have use in various segments of the coated paper industry. For example, Ashland provides a range of high purity carboxymethylcellulose grades for use in traditional paper coating formulations and a variety of hydroxyethylcellulose products for more specialized coatings including high quality free sheet, bleached board, ink jet and transparencies. Ashland has also developed liquid versions of selected carboxymethylcellulose and hydroxyethylcellulose products for use in those paper coatings with the highest performance objectives. In these cases, the use of Admiral™ and Liberty™ fluidized polymer suspensions provide unique coating properties including improved smoothness, brightness, opacity and gloss through superior water retention and unique structuring behavior with pigments. Paper surface upgrading agents. Gafgard radiation-curable coatings are patented, 100% solids, vinyllactam-polyacrylate based formulations, which may be cured using either UV-light or an e-beam energy source. The cured coating is optically clear and is used to impart hardness and a high level of abrasion, solvent and stain resistance. Gafgard may be applied to various substrates including, polyester, polycarbonate, acrylic, ABS and PVC. The low viscosity of these products permits their use with various types of coating equipment including, but not limited to, direct or offset gravure, or Mayer rod. Typical applications for Gafgard are abrasion resistant clear coatings for polycarbonate lenses, interior solar polyester films, credit card magnetic strips, etc.

pencils

A blend of finely ground graphite and clay is mixed with water and a rheology modifier. This mixture is extruded into strands, dried and dipped in wax. The strands are then fitted into grooved, wooden plank halves and covered with the other half of the pencil. The methylcellulose and carboxymethylcellulose polymers act as an excellent binder, rheology modifier and lubricant in the extrusion process and also provide the pencil lead with green strength and reduce cracking.

pigment and mineral slurries stabilization

Selected Ashland polymers including Blanose carboxymethylcellulose and Natrosol hydroxyethylcellulose are significantly more effective than traditional low molecular weight dispersants for stabilizing dispersions of various pigments in concentrated aqueous slurries. In these cases, our polymers are designed to adsorb to the pigment surface providing a powerful dispersing effect and thereby reducing or eliminating dense-pack settling phenomena.

reconstituted tobacco sheets

Reconstituted tobacco sheets are produced from recycled tobacco dust generated during the production of cigars and cigarettes. These sheets serve as a layer between the 'filler' layer of tobacco and the wrapper. Culminal methylcellulose polymers, Natrosol hydroxyethylcellulose and Blanose carboxymethylcellulose are outstanding when used as a binder to minimize cracks, lumps and shrinkage of the sheets during drying. They also provide high tenacity (tearing strength), sheet elasticity and uniform appearance.

suspension polymerization

Klucel hydroxypropylcellulose is employed extensively as a colloidal stabilizer in the suspension polymerization of polyvinyl chloride (S-PVC), as well as Natrosol hydroxyethylcelullose in polystyrene polymerization (PS). PVP is used in suspension polymerization of styrene, methyl acrylate and polyurethane.

textile printing

Blanose carboxymethylcellulose is used for thickening and rheology control for textile printing color formulations. The excellent washout and minimal dusting of these polymers ensures adhesion of the dye to the fibers and optimum print quality to secure the web integrity of nonwoven fabrics.

welding rods

Welding rods are typically made from a wide variety of thermoplastic metals and alloys and are coated with a flux to assist in the formation of the welded bond. Blanose carboxymethylcellulose and Natrosol hydroxyethylcellulose polymers are incorporated during the welding rod extrusion process to improve the bonding and coating uniformity of the flux to the core. The critical performance characteristics include increased viscosity, lubrication and shear thinning under pressure. After the extrusion process, the cellulose ether components immediately resume viscosity and prevent separation of inhomogeneity of the flux. Water- soluble polymers help to bond the flux to the core electrode and provide a highly plastic, smooth coating to counteract any imperfections during drying.

and many more...

For more information, please contact your Ashland sales representative or visit us at **ashland.com**.

surfactants, solvents and intermediates

overview

surfactants

The **Surfadone**™ alkyl pyrrolidones are hydrophobic in nature, functioning as excellent wetting agents and effective dispersing and cleaning aids.

Dextrol™ and **Strodex**™ phosphate ester surfactants are leading technologies within our extensive portfolio of high-quality additives. These high-performance specialty surfactants exhibit superior wetting and emulsifying properties and are unique in that their compositions can be modified to achieve specific properties. Dextrol and Strodex phosphate ester surfactants demonstrate a strong viscosity profile and broad compatibility as well as good stability to a wide range of temperatures, pH and hard water. They provide corrosion inhibition, emulsification and dispersion properties.

solvents and intermediates

Pyrrolidones

This family of chemicals varies in properties as a function of substitution on the lactam nitrogen atom. All members are characterized by low vapor pressure, high flash point, high dipole moment, ready complex formation, surface activity as the alkyl chain lengthens, and biodegradability when the alkyl chain is linear.

2-Pyrol™ solvent (2-pyrrolidone)

It is used as a humectant, cosolvent with water, coalescent aid and plasticizer.

The lower alkyl pyrrolidones, most notably **M-Pyrol**™ n-methyl-2-pyrrolidone, are excellent polymer solvents, paint and photoresist strippers, paint coalescents, industrial cleaners and extraction solvents.

- **M-Pyrol**™ solvent (n-methyl-2-pyrrolidone)

  Solvent, cosolvent and diluent. Used in cleaners, coating and photoresist strippers, coalescents and rechargeable battery manufacture.

- **HEP**™ solvent (n-hydroxyethyl-2-pyrrolidone)

  Cosolvent formulated individually or in combination with M-Pyrol solvent for strippers and cleaners and as an intermediate.

- **CHP**™ solvent (n-cyclohexyl-2-pyrrolidone)

  Individual cosolvent or in combination with M-Pyrol n-methyl-2-pyrrolidone and **BLO**™ gamma-butyrolactone solvents to enhance performance by broadening solubility range in circuit board fabrication, cleaning formulations, dyeing bath additive and paint strippers.

  The common characteristic of these chemicals is high solubility in hydrophilic media.

Butenediol, having a cis double bond enters into Diels-Alder reactions, and Butanediol finds application as a plasticizer and humectant. All four alcohols function as precursors to numerous derivatives such as esters, carbamates, polyesters and urethanes.

THF is an inert solvent for numerous polymer and organometallic reactions and is the precursor of polytetramethyleneglycol.

BLO™ gamma-butyrolactone is a polar solvent for ionic substrates and functions as an acid donor in aqueous media at elevated temperatures.

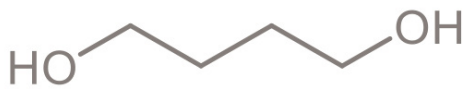
emulsifiers, dispersants and lubricants

Ashland has a broad family of water-insoluble esters and hydroxyesters sold under the **Ceraphyl**™ and **Cerasynt**™ trademarks as lubricants, dispersants and emulsifiers. These chemicals typically are surface active and find use in plastics, textile, photography, inks and coatings markets. A variety of esters is available with a range of properties, including liquids and waxy solids. In addition, amide and quaternary-ammonium salts are available.

solvents and intermediates

Butanediol

1,4-butanediol



applications

Butanediol is used mainly as a co-monomer in classical diol-condensation reactions with:

- terephthalic acid to produce polybutylene terephthalate (PBT)
- diphenylmethane diisocyanate (MDI) yielding polyurethane foams, elastomers and adhesives
- adipic acid to yield polyesters with biodegradability characteristics

In general, polymers produced from butanediol exhibit greater hydrophobicity, crystallinity, strength, hydrolysis resistance and better low temperature flexibility than those produced from ethylene glycol.

- Physical properties of butanediol make it useful as a plasticizer and humectant.

physical properties

- boiling point 228°C
- vapor pressure <0.075mm Hg @ 24°C
- flash point 139°C
- viscosity 71.5 cP @25°C
- specific gravity 1.017 @ 25°C

chemistry

Butanediol's reactive sites are its hydroxyl groups, which undergo all the typical reactions of alcohols. In addition to the condensation reactions noted above, it can be converted to simple esters, halides, dehydrated to tetrahydrofuran and dehydrogenated to gamma-butyrolactone.

THF (Tetrahydrofuran)

1,4-epoxybutan

applications

- solvent for vinyl polymers used in PVC pipe adhesives, industrial cleaning, magnetic tape coatings, vinyl fabric topcoats among others
- reaction medium for organometallic reagents, including linear low-density polyethylene catalyst manufacture
- monomer for polytetramethylene glycol, a Spandex™ intermediate

physical properties

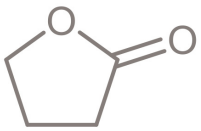
- boiling point 66°C
- vapor pressure 161mm Hg @ 20°C
- flash point -14°C
- freezing point -108.5°C
- viscosity 0.5 cP @20°C
- dipole moment 1.75D
- specific gravity 0.886 @ 25°C
- dielectric constant 7.52

chemistry

THF (stabilized with 250-400 ppm BHT) is an excellent polymer solvent, combining rapid dissolution and evaporation with significant solubilizing capacity for many high molecular weight polymers at moderate viscosity. It has unique characteristics in Grignard and other organometallic reactions. As noted above, THF undergoes an acid-catalyzed ring opening polymerization reaction to produce polytetramethylene glycol.

BLO™ / GBL (gamma-butyrolactone)

1-oxa-cyclopentan-2-on



applications

- electrolyte dissociating solvent for non-aqueous capacitors
- photoresist stripper
- solvent for a wide spectrum of polymers and an effective substitute for chlorinated hydrocarbons
- paint strippers, industrial cleaners and lithographic developers
- hydrolyzed in water at elevated temperatures to yield 4-hydroxybutyric acid, leading to its use as an acid donor in nylon fiber dyeing
- stabilizes urea in fertilizers

physical properties

- boiling point 66°C
- vapor pressure 161mm Hg @ 20°C
- flash point -14°C
- freezing point -108.5°C
- viscosity 0.5 cP @20°C

phemistry

Although BLO is stable under a wide range of conditions, at elevated temperatures and in the presence of appropriate reagents, it serves as an intermediate in a variety of useful syntheses, such as:

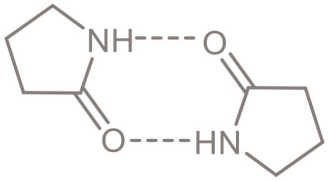
- precursor to 2-pyrrolidone and the extensive family of alkyl pyrrolidones produced from ammonia and primary amines
- reacting with phenols to yield phenoxybutyric acid derivatives with applications in pharmaceuticals and as photographic coupling agents

pyrrolidones

The family of 2-pyrrolidones offered by Ashland has a variety of properties primarily derived from the unique features of the lactam ring and modified by substitution on the nitrogen atom. The general characteristics of these compounds result from the polar N-C=O linkage in the fi e-membered ring. The reactivity, physical properties and stability of these molecules result from the well-documented amide resonance. In anionic media, the partially positive nitrogen readily coordinates with negatively charged species while in acidic systems the electron-rich carbonyl oxygen is rapidly protonated.

2-Pyrol™ (2-Pyrrolidone)

γ-butyrolactam



applications

- solubilization of complex organic molecules in water
- humectant and cosolvent in digital printing inks
- coalescent or plasticizer for acrylic resins, especially in floor polishes, inks and adhesives

physical properties

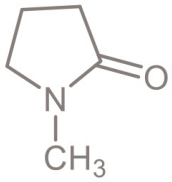
- boiling point 245°C
- vapor pressure <0.1mm Hg @ 20°C
- flash point 129°C
- freezing point 25°C
- viscosity 13.3 cP @ 25°C
- dipole moment 3.5D
- specific gravity 1.116 @ 25°C

chemistry

The reactive site of 2-Pyrol® is its labile hydrogen on the nitrogen. It can undergo vinylation with acetylene, alkylation with alkylhalides and acylation with acylhalides. Hydrolysis produces gamma-aminobutyric acid. It is also available as 95% active solution that freezes/solidifies at 12°C to ensure ease of handling.

M-Pyrol™ (NMP)

N-methyl-2-pyrrolidon



applications

- high precision electronic cleaning agent
- polymerization medium for polyethersulfones, polyaramids, polyesters, polyamide-imides
- polyamide-imide diluent for wire enamel coatings
- paint and photoresist strippers
- coalescent in latex paints allowing excellent formulation latitude
- polydifluoroethylene solvent in rechargeable battery manufacture
- industrial cleaners; neat or in combination with numerous other solvents
- solvent for extraction of aromatics from lube oil
- solvent for separation of acetylene and butadiene from light hydrocarbon streams

physical properties

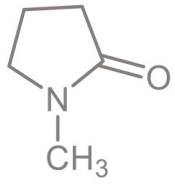
- boiling point 202°C
- vapor pressure 0.27 mm Hg @ 20°C
- flash point 90°C
- freezing point -24°C
- viscosity 1.7 cP @ 25°C
- dipole moment 4.06 Debye @ 25°C
- specific gravity 1.027 @ 25°C
- dielectric constant 32.2
- soluble in water and most organic solvents; sparingly soluble in aliphatic hydrocarbons

chemistry

M-Pyrol™ is extremely resistant to hydrolysis from pH 2-10, even at elevated temperatures. Beyond these limits, hydrolysis to 4-(methylamino) butanoic acid occurs at a rate dependent on pH and temperature. A large body of chemistry has been developed on the reactions of strong nucleophiles with M-Pyrol™. High purity, low trace metal grades are sold under the Micropure™ and Pharmasolve™ tradenames for the electronic and pharmaceutical industries.

HEP™ Solvent

N-hydroxyethyl-2-pyrrolidone



applications

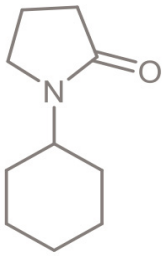
- photoresist strippers - used as a co-solvent, usually in combination with M-Pyrol™ (N-methyl-2-pyrrolidone) solvent, to enhance performance by broadening solubility range
- paint strippers - as a solvent in high temperature stripping applications for chemically resistance coatings
- silk screen cleaners - as a co-solvent in cleaning formulations to enhance removal of inks from silk screen fibers
- hard surface cleaners - used as a co-solvent with glycol ethers in oven cleaning formulations
- intermediate for alkoxylated derivatives used in gasoline additives

physical properties

- boiling point 295°C
- vapor pressure <0.005 mm Hg @ 20°C
- flash point 160°C
- freezing point 20°C
- viscosity 53 cP
- specific gravity 1.139 @ 25°C

CHP™ Solvent

N-cyclohexyl-2-pyrrolidone



applications

- photoresist strippers - used as a co-solvent, usually in combination with M-Pyrol™ (N-methyl-2-pyrrolidone) and BLO (gamma- Butyrolactone) solvents, to enhance performance by broadening solubility range
- circuit board fabrication - used in chemical polishing of copper and copper alloys to increase the stability of hydrogen peroxide in acid brightening baths
- dye carrier or dyeing bath additive - used in dyeing of aromatic polyamide fibers (i.e. Dupont's Kevlar®*) as a swelling/diffusion agent to enhance dye and flame-retardant penetration
- paint strippers - as a solvent in high temperature stripping applications for chemically resistant coatings
- silk screen cleaners - as a co-solvent in cleaning formulations to enhance removal of inks from silk screen fibers

* trademark owned by a third party

physical properties

- boiling point 284°C
- vapor pressure <0.005 mm Hg @ 20°C
- flash point 145°C
- freezing point 12°C
- viscosity @ 25°C 11.5 cP
- specific gravity 1.026 @ 25°C

Easy-Wet™ 20

applications

- textile processing
- pigment wetting

benefits

- faster wetting
- lower use levels
- low contact angles
- improved spreading on most surfaces
- better equilibrium surface tension
- enhanced cleaning performance

physical properties

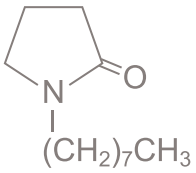
- physical form: clear liquid
- pH (10 wt% aq.): 4.0–6.0
- viscosity: 15-30 cP at 25 °C
- specific gravity at 25 °C: 0.92–0.95

chemistry

Easy-Wet 20 wetting agent is a proprietary super-wetting agent in a convenient-to-use liquid form. Easy-Wet 20 wetting agent is a cost-effective premium wetter/surfactant suitable for HI&I cleaning, textiles, pigments and other industrial applications where superior wetting and spreading performance is required.

Surfadone™ LP-100

N-octyl-2-pyrrolidone



applications

- softener in surface optimization and metal cleaning
- isopropyl alcohol replacement in fountain solutions
- solvent for polymers and hydrophobic substances
- pigment dispersion aid and pigment conditioning solvent
- component of photoresist strippers
- wetting agent for aqueous systems
- component in microemulsifying systems

physical properties

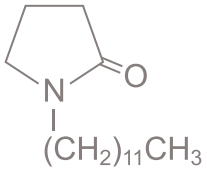
- boiling point: 100 °C at 0.3 mm Hg
- vapor pressure: <0.001 mm Hg at 25 °C
- flash point: 113 °C
- freezing point: -25 °C
- viscosity: 8 cP at 20 °C
- minimum equilibrium surface tension: 28 mN/m at 1200 ppm
- minimum dynamic surface tension: 35 mN/m at 10 bubbles/sec

chemistry

Surfadone LP-100 is a low-foaming, nonionic rapid wetting agent with an HLB of 6 and having no critical micelle concentration. Due to the electron delocalized lactam ring, Surfadone LP-100 wetting agent interacts with anionic surfactant micelles. This greatly enhances its water solubility, resulting in a synergistic surface tension reduction and wetting enhancement at low concentrations.

Surfadone LP-300

N-dodecyl-2-pyrrolidone



applications

- high-boiling solvent for polymers and hydrophobic substances
- substitute for fluorocarbon surfactants
- ingredient in pressure-sensitive adhesives
- use as plasticizers in PVC

physical properties

- boiling point: 145 °C at 0.2 mm Hg
- flash point: 116 °C
- freezing point: 10 °C
- viscosity: 17 cP at 25 °C
- minimum equilibrium surface tension: 26 mN/m at 20 ppm

chemistry

Surfadone LP-300 is sparingly soluble in water (0.02 weight percent) and soluble in most organic solvents. It is a low-foaming, nonionic surfactant with an HLB of 3 and has no critical micelle concentration. Like its lower homolog, Surfadone LP-300 wetting agent interacts with anionic surfactants forming mixed micelles that greatly enhance its solubility, resulting in a synergistic surface tension reduction and wetting enhancement. Appropriate combinations of Surfadone LP-300 wetting agent and anionic surfactants produce viscous solutions and gels.

phosphate ester specialty surfactants

Dextrol™ and Strodex™

Phosphate ester surfactants are a leading technology within our portfolio of high-performance additives. Dextrol and Strodex surfactants have been developed for a variety of end-use applications by engineering specific chemistries under precisely controlled reaction conditions.

Dextrol and Strodex are unique mono- and diester phosphates as well as specialty surfactants that provide wetting, improve dispersion and emulsion stabilization, and provide corrosion protection.

E.g., for developing a full color intensity and achieving increased gloss, the pigment must be very finely distributed in the binder. Wetting of each pigment particle prevents from agglomerating, flocculating or settling. This is achieved by pigment wetting due to lowering the viscosity of the mill base. This enables a higher amount of pigment to be used. Dispersants weaken the intermolecular forces and prevent agglomeration, caused by electrostatic charging, formation of a protective covering or steric hindrance.

Water metallic pigment pastes for aqueous paints and printing inks must be protected against corrosion because conversion of even a small amount of metallic pigment leads to an undesired change in the metallic color. This is where phosphate esters can be an advantage.

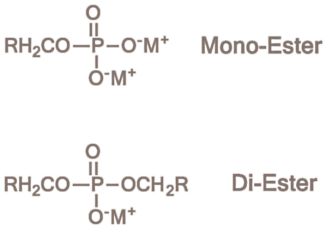
Increased surface conductivity can lower troublesome electrostatic charges on plastic films. Phosphate esters can act as antistatic agents.

Generally speaking, to strengthen adhesion, phosphate esters can interact with polar groups in the substrate (e.g. metal oxide surfaces). Also lowering the surface or interfacial tension at phase boundaries helps to easier wet the substrate, a prerequisite for good adhesion of the paint to the substrate.

To avoid the formation of nips or crack-off of the ink when the cardboard is folded, our phosphate esters are noted for their excellent softening ability by increasing the elasticity of coatings and printing inks.

Depending on the system the acidic grades should be neutralized with an amine.

Below list represents the most recommended types. All grades are APEO free.



product	salt form	chemical description/ moles of EO	typical active content (%)	typical viscosity (cPs at 25 °C)	surface tension: 0.1 active wt% in water; pH ~7(dynes/cm)	VOC % (according to current EU guidelines, with boiling points < 250C)	co-dispersant	application
Dextrol OC-180	K	6 moles	45	600	30.1	< 0.01	+++	general screening, paper coatings, inks
Dextrol OC-180HS	Na	6 moles	90	2000	30.1	< 0.01	+++	general screening, paper coatings, inks
Dextrol OC-40		3 moles	97	800	26.5	< 0.01	++	
Dextrol OC-60	H	phosphate ester of tridecyl alcohol ethoxylate (6 moles)	97	800	30.1	< 0.01	+	paper coatings
Dextrol OC-60 EP	H	phosphate ester of tridecyl alcohol ethoxylate (6 moles)	97	800	30.1	< 0.01	+	
Dextrol OC-6025	NH_4	6 moles	25	600	26.5	< 0.01	++	
Dextrol OC-70	H	phosphate ester of tridecyl alcohol ethoxylate (10 moles)	97	800	36.2	< 0.01	++	
Dextrol OC-70 EP	H	phosphate ester of tridecyl alcohol ethoxylate (10 moles)	97	800	36.2	< 0.01	++	
Dextrol OC-7525	NH_4	phosphate ester of tridecyl alcohol ethoxylate (9-10 moles)	25	600	36.2	< 0.01	+	
Strodex FT-428	K	proprietary blend	76	350		< 0.3	+	
Strodex PK-90	K	phosphate coester alcohol and aliphatic ethoxylate	90	7000	29.8	< 3	+++	general screening, paper coatings
Strodex PK-85NV	K	phosphate coester alcohol and aliphatic ethoxylate	65	250	29.8	< 0.5	++	textile
Strodex FT-50K	K	phosphate ester of glycerol ethoxylate (7)	50	< 100	~ 70	< 0.01	+	
Strodex TH-100	K	proprietary blend	81	300	~33	< 0.5	+++	Textile

emulsifiers, dispersants and lubricants

Ceraphyl™ and Cerasynt™

Ashland has a broad family of water-insoluble esters and hydroxyesters sold under the Ceraphyl and Cerasynt trademarks as lubricants, dispersants and emulsifiers. These chemicals typically are surface active and find use in plastics, textile, photography, inks and specialty coatings markets.

A variety of esters is available with a range of properties, including liquids and waxy solids. In addition, amide and quaternary-ammonium salts are available.

A representative group of this product line is shown below.

grade	chemical name	applications
Ceraphyl 28	hexadecyl lactate	printing plate protection
Ceraphyl 31	lauryl lactate	
Ceraphyl 41	C12 - C15 alkyl lactate	plasticizing effects
Ceraphyl 50	tetradecyl lactate	
Ceraphyl 55	tridecyl neopentanoate	
Ceraphyl 230	diisopropyl adipate	plasticizing effects; lubricant; hard-surface cleaners; erasable markers; mold release agent; inkjet inks
Ceraphyl 368 M	2-ethylhexyl palmitate	circuit board cleaning; pigment dispersment inkjet inks; tissue paper lotion; lubricant
Ceraphyl 375	isostearyl neopentanoate	pigment dispersion
Ceraphyl 424	tetradecyl tetradecanoate	dispersant in magnetic recording media
Ceraphyl 494	isocetyl stearate	
Ceraphyl 791	isocetyl stearoyl stearate	pigment dispersions
Ceraphyl 847	octyldodecyl stearoyl stearate	pigment dispersions; polycarbonate mold release agent
Ceraphyl ICA	isohexadecanol	pigment dispersions; mold release; graffiti removal; polyester finishing agent
Ceraphyl ODS	octyldodecyl stearate	polycarbonate mold release agent
Ceraphyl RMT	castor oil monomaleate	
Ceraphyl SLK	isodecyl neopentanoate	
Cerasynt 945	glyceryl stearate and polyoxyethylene lauryl ether	inkjet inks; pigment dispersion
Cerasynt IP	glycol stearate and stearamide AMP	opacifier and pearlizing agent
Cerasynt M	2-hydroxyethyl stearate	pearlizing agent; liquid detergent compositions
Cerasynt PA	propylene glyco stearate	asphalt microdispersions; circuit board defluxing detergents
Cerasynt SD	glyceryl stearate	
Emulsynt™ 1055	polyglyceryl-4-oleate	emulsifier
Emulsynt GDL	glyceryl dilaurate	emulsifier

vinyl monomers

overview

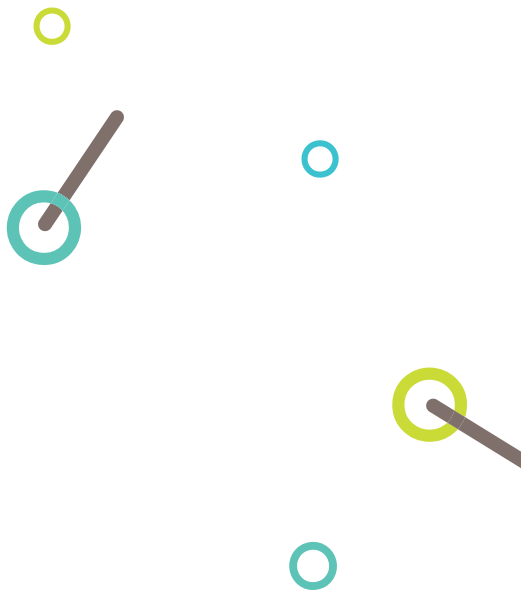
vinyllactam ethers

Vinyllactam ethers are offered for applications based on the utility of their olefin linkage.

V-Pyrol™ inhibited or caustic n-vinyl-2-pyrrolidone is water-soluble and undergoes free radical homo- and copolymerizations as well as grafting reactions. V-Pyrol n-vinyl-2-pyrrolidone is a low-viscosity reactive diluent for UV radiation curing processing.

V-Cap™ n-vinyl-2-caprolactam is only slightly soluble in water, but can function in many applications similar to V-Pyrol n-vinyl-2-pyrrolidone.

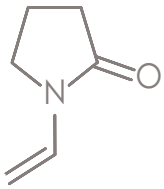
Fully formulated UV-curable **Gafgard**™ coating systems impart abrasion and solvent resistance to a wide variety of surfaces.



vinyl monomers

V-Pyrol™ vinylpyrrolidone

N-vinyl-2-pyrrolidone



applications

- reactive diluent for radical initiated UV radiation curing used in vinyl flooring, wood coatings, release coatings, inks, etc.
- numerous conventional polymerizations to generate an array of materials with a variety of properties as noted in the following polymer section.

physical properties

- boiling point: 193 °C at 400 mm Hg
- melting point: 13 °C
- vapor pressure: <0.10 mm Hg at 20 °C
- flash point: 96 °C
- viscosity: 2 cP at 25 °C

chemistry

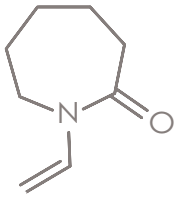
V-Pyrol vinylpyrrolidone is a clear liquid stabilized with insoluble sodium hydroxide or soluble N,N'-di-sec-butyl-p-phenylenediamine.

The latter inhibitor is supplied in V-Pyrol vinylpyrrolidone at concentrations of 25 ppm and at 100 ppm, respectively, for radiation curing and non-radiation curing applications. This monomer is known to be a super-cooled liquid well below its freezing point of 13 °C. It can remain as a liquid at room temperature for extended periods. Rapid, exothermic crystallization under these conditions should not be confused with bulk polymerization.

V-Pyrol vinylpyrrolidone accelerates UV curing rates as the reactive diluent. Typically formulated with an acrylate oligomer, it imparts its unique solution viscosity reduction and enhanced adhesion to nonpolar substrates. The activated double bond of V-Pyrol vinylpyrrolidone facilitates its use in free radical homo- and copolymerizations and grafting reactions. The products of these reactions are either linear or crosslinked homopolymers and nonionic, anionic and cationic copolymers. Polymers from V-Pyrol vinylpyrrolidone are amorphous, and the pyrrolidone ring imparts hydrophilicity, adhesiveness, strength and complexing capability.

V-Cap™ vinylcaprolactam

N-vinyl-2-caprolactam



applications

- reactive diluent for radical-initiated UV radiation curing used in inks (especially silkscreening), vinyl flooring, wood coatings, release coatings, etc.
- conventional polymerizations to generate materials that have more hydrophobic character than analogous V-Pyrol vinylpyrrolidone based products

physical properties

- boiling point: 116 °C at 10 mm Hg
- melting point: 35 °C
- vapor pressure: <0.1 mm Hg at 20 °C
- flash point: 114 °C
- viscosity: 3.5 cP at 40 °C

chemistry

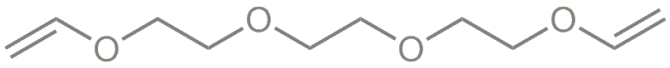
V-Cap vinylcaprolactam is a pale yellow crystalline solid stabilized with 10 ppm N,N'-di-sec-butyl p-phenylenediamine and having chemical reactivity characteristics similar to those cited for V-Pyrol vinylpyrrolidone. Polymers synthesized from V-Cap vinylcaprolactam are significantly more hydrophobic than their V-Pyrol vinylpyrrolidone analogs but still exhibit the adhesiveness, strength and complexing capability characteristic of the lactam functionality. As with V-Pyrol vinylpyrrolidone, V-Cap vinylcaprolactam is a super-cooled liquid and can remain as a liquid at room temperature for extended periods. Rapid, exothermic crystallization under these conditions should not be confused with bulk polymerization.

V-Cap vinylcaprolactam accelerates UV curing rates as the reactive diluent. Typically formulated with an acrylate oligomer, it imparts unique solution viscosity reduction and enhanced adhesion to nonpolar substrates. The activated double bond of V-Cap vinylcaprolactam facilitates its use in free radical homo- and copolymerizations and grafting reactions. The products of these reactions are either linear or crosslinked homopolymers and nonionic, anionic and cationic copolymers. Polymers from V-Cap vinylcaprolactam are amorphous, and the caprolactam ring imparts hydrophobicity, adhesiveness, strength and complexing capability.

Gafgard™ 233 formulated UV-curable coating containing V-Pyrol vinylpyrrolidone and a multifunctional acrylate is used to impart high levels of abrasion resistance to coatings for plastic lenses, protective window films, credit cards, etc.

Rapi-Cure™ DVE-3

Triethyleneglycol divinyl ether



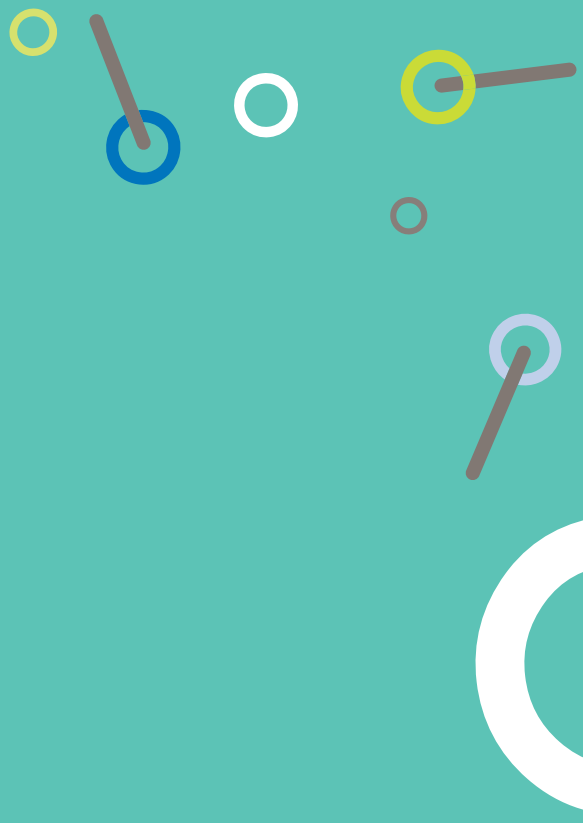
Rapi-cure DVE-3 is a reactive diluent/monomer for free radical curable coatings and printing inks. It provides benefits and properties for cationic systems.

applications

- difunctional reactive diluent
- cationic systems with epoxy and vinyl ether functional oligomers
- good solvency for onium salt photoinitiators
- imparts flexibility to cured films
- facilitates pigment wetting/dispersion
- charge transfer systems with unsaturated polyester oligomers for wood coatings
- free radical and hybrid systems with acrylate oligomers

physical properties

- physical form: colorless liquid with mild odor
- purity: 98.5% and 96%
- boiling point: 120–126 °C at 18 mm Hg
- freezing point: -8 °C
- flash point: 119 °C
- viscosity: 3 mPa•s at 25 °C
- refractive index: 1.4695 at 25 °C
- Tg of homopolymer: 20 °C
- skin irritation: minimal



performance polymers

overview

acetylene chemistry

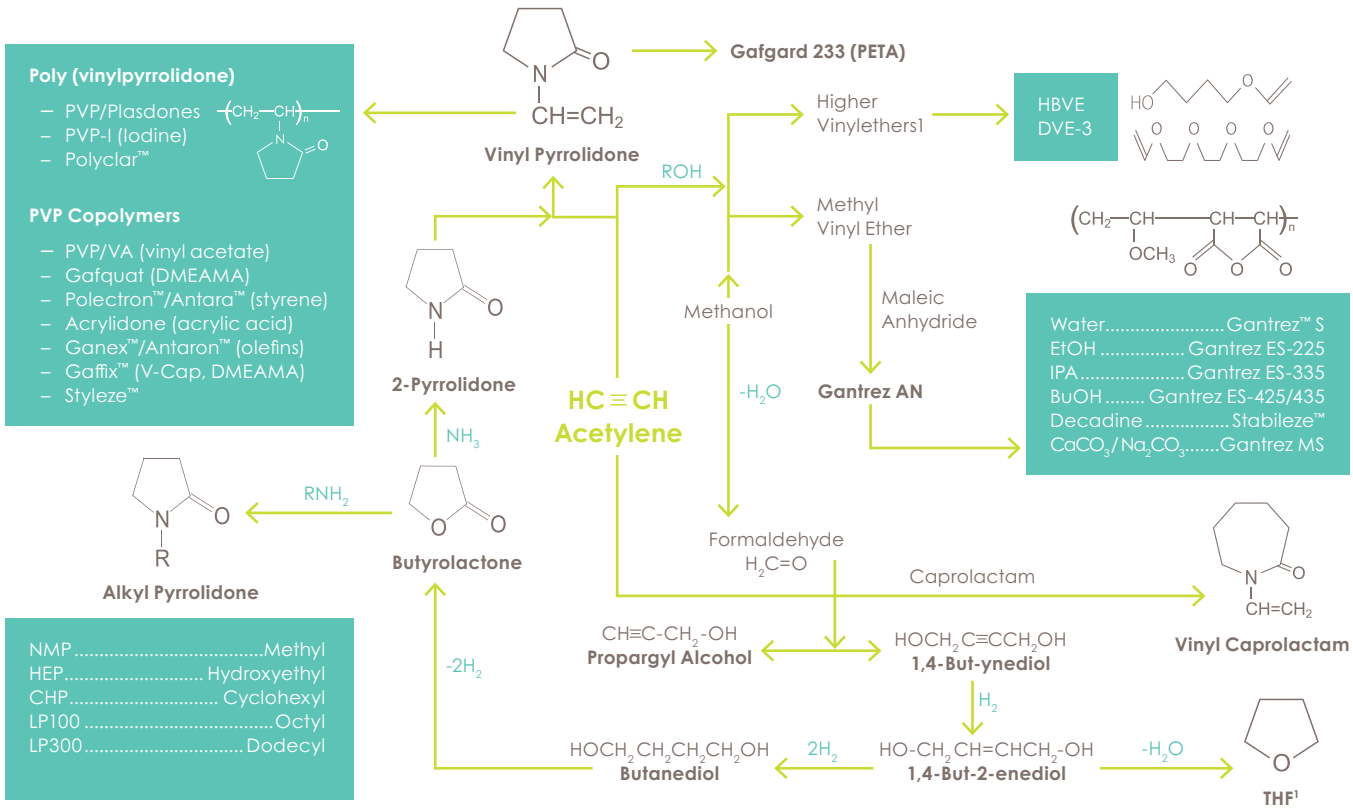
The largest family of polymers produced by Ashland is based on n-vinyl-2-pyrrolidone and cellulose ethers. These include polyvinylpyrrolidone (PVP) homopolymers and copolymers. The latter contain functionality from coreactants, including vinyl acetate, PVP/VA, alpha-olefin, and **Ganex™/Antaron™**[a] copolymers. Dimethylaminoalkylene-methacrylate or -methacrylamide copolymers and their derivatives make up the **Gafquat™** and styrene and **Polectron™/Antara™ 430** copolymers[b]. Many properties are shared among the groups, but each also has unique characteristics, varying with structure.

The following are examples:

- **PVP**: high polarity, dispersancy, hydrophilicity, adhesion, cohesivity and high Tg.
- **PVP/VA**: thermoplasticity, oxygen permeability, varying hydrophilicity and adhesion.
- **Ganex/Antaron** copolymers: hydrophobicity, an emulsifier and dispersant for nonaqueous systems.
- **Gafquat** copolymer: basicity, substantivity and high charge density.
- **Polectron/Antara** copolymers: thickening and opacifying emulsion.

[a]Ganex™ is sold as Antaron™ in Europe and Canada.
[b]Polectron™ 430 is sold as Antara™ 430 in Europe and Asia Pacific.

multi-faceted acetylene chemistry



Ashland also offers polymers based on V-Cap reactive monomer. These include vinylcaprolactam homopolymers, copolymers with vinylpyrrolidone and terpolymers containing both lactam monomers and dimethylaminoalkylenemethacrylate or -methacrylamide. These polymers are generally more hydrophobic than the V-Pyrol reactive monomer based products mentioned above but offer many of the functional properties inherent in the lactam ring. Among other applications, **Inhibex**™ polymers are highly efficient as inhibitors of gas hydrate formation.

A range of alternating copolymers based on methylvinylether and maleic anhydride are produced by Ashland:

methylvinylether/maleic anhydride chemistry

The **Gantrez**™ **AN** family of methylvinylether/maleic anhydride copolymers is characterized by aprotic polar solvent solubility and reaction with protic compounds such as water, alcohols and amines with facile film formation.

The hydrolyzed **Gantrez S** polycarboxylic acid resins function as dispersants, divalent cation binding agents and polymeric acidifiers.

acrylate chemistry

Ashland offers an acrylate product portfolio that we can offer chemistry that is highly targeted to particular applications. Our **Jaypol**™ products include rheology modifiers, dispersants, cobinders and emulsifiers that work as processing aids and performance enhancers for applications as diverse as paint and specialty coatings, civil engineering chemicals, textile manufacture, water treatment and more.

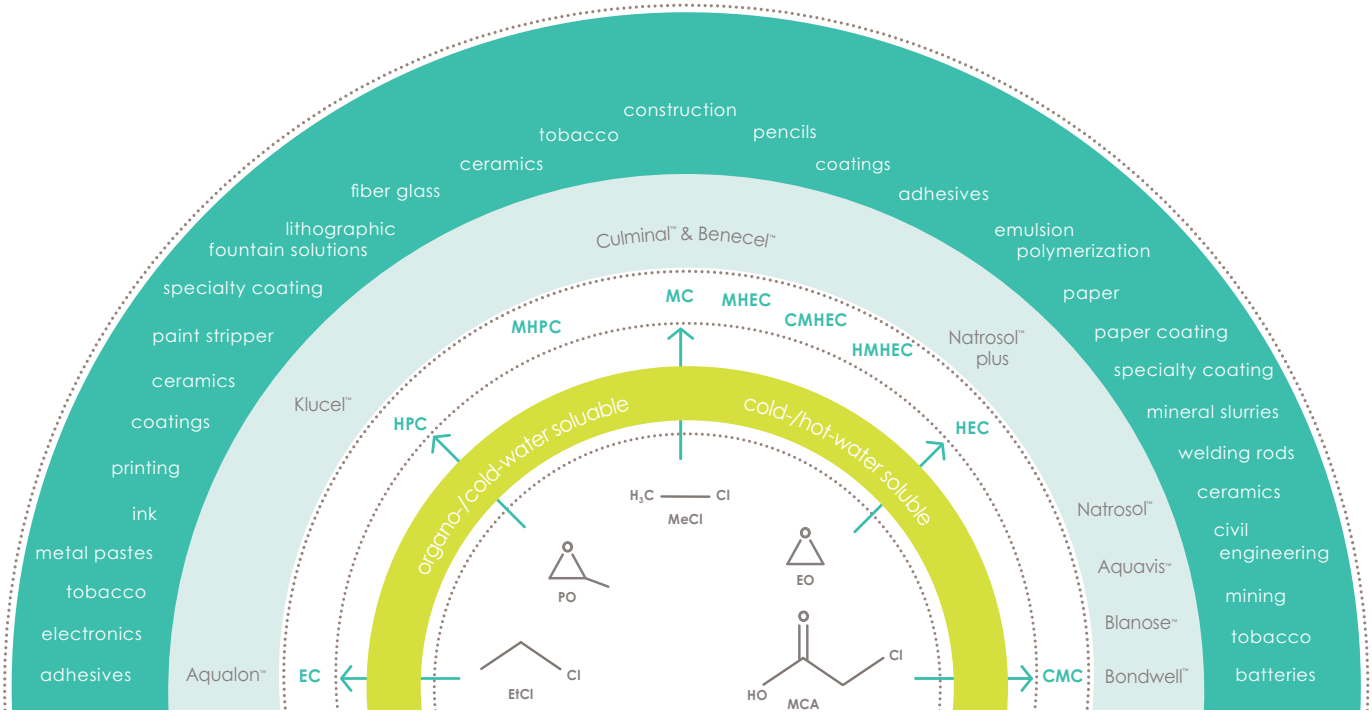
cellulose ethers

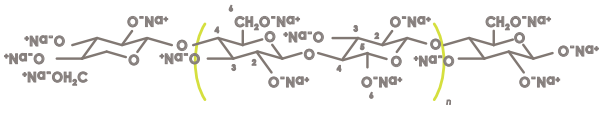
Cellulose ethers are divided into ionic and nonionic types. The ionic cellulose ethers, **Blanose™/AquaVIS™** sodium carboxymethylcellulose, contain substituents that are anionic electrically charged. Nonionic cellulose ethers include **Natrosol™** hydroxyethylcellulose, **Benecel™** and **Culminal™** methylhydroxyethylcellulose, methylcellulose and methylhydroxypropylcellulose, **Klucel™** hydroxypropylcellulose and **Aqualon™** ethylcellulose and carry electrically neutral substituents. Nonionic cellulose ethers can be further classified by their solubility in cold, warm or hot water, and in organic solvents.

Cellulose is a polysaccharide composed of anhydroglucose units, which are linked through beta-glycosidic bonds. The number "n" of anhydroglucose units in the polymer chain is defined as the degree of polymerization (DP). Each anhydroglucose ring carries three free OH groups at positions 2, 3 and 6. Ethers of cellulose are formed by substituting one or more of the three hydroxyl groups. The distribution of the substituents introduced onto the polymer chain is largely determined by the relative reactivity of these three OH groups.

The number of substituted hydroxyl groups per anhydroglucose unit is expressed as DS or average degree of substitution. The DS can vary between 0 and 3. In the case of alkoxylation, the molar ratio of alkoxy groups in the side chains to cellulose is specified and expressed as the average molecular substitution (MS). Instead of DS and MS, the weight percent of the substituents in the cellulose ether is often quoted. The use of one etherification agent in the substitution process results in a simple cellulose ether, whereas using different kinds of agents leads to mixed ethers. Industrial cellulose ethers are alkyl, alkylhydroxyalkyl, hydroxyalkyl and carboxyalkyl ethers.

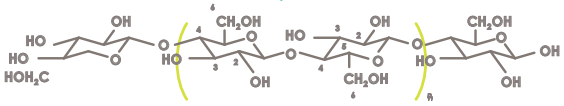
natural polymers leverage natural raw materials to produce value-added ingredients serving diverse applications





alkali cellulose

NaOH



cellulose

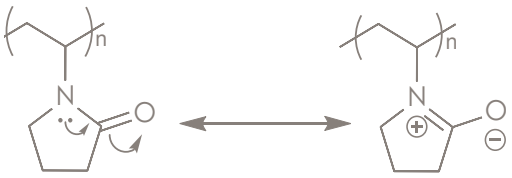
performance properties

thickening
suspension
flow/leveling
water retention
colloid stabilization
film formation
adhesive strength
binder / stabilizer
surface activity
crystal growth modification

Ashland™
always solving

polyvinylpyrrolidone (PVP)

PVP K-series



Polyvinylpyrrolidone is a hygroscopic, amorphous polymer supplied as a white, free-flowing powder or a clear aqueous solution. Available in several molecular weight grades, they are characterized by K-value, and used in various applications.

applications

- dye transfer inhibition in detergents using PVP K-15 and K-30 to form complex fugitive
- textile dye stripping and strike rate control through complexation and dispersion with PVP K-30
- photo processing where sulfide salts are complexed by PVP K-30 in developing baths to inhibit redeposition on film
- dispersions using PVP K-30 and K-90 for non-aqueous dye-and pigment-based writing ink delivery systems
- production of expandable polystyrene, with PVP K-90 used as the protective colloid
- polyvinylpyrrolidone and a number of its copolymers used as media components in digital inkjet printing
- hollow fiber membrane manufacture in which PVP K-90 and K-30 create voids and hydrophilic domains in polysulfone membranes
- on lithographic plates using hydrophobic inks, PVP K- 15 provides enhancement of the nonimage area
- PVP K-85 and 90 in stearate-based adhesive sticks for arts and crafts applications
- on both ends of toilet paper rolls and tissue, PVP K-60 is used as an adhesive
- in fiber glass sizing, PVP K-30 and K-90's film-forming action promotes polyvinylacetate adhesion
- as combustible ceramic binders, PVP K-30 and K-90 enhance green strength
- in production of electrolead hydrogels, PVP K-90 is crosslinked by E-beam irradiation to produce a conducting medium
- in metal quenchant bath, PVP K-60, K-90 and K-120 are effective thickeners
- production of nano-sized metal pigments
- dispersant for carbon nano-fibers

physical properties

Grade	K-Value Range	Molecular Weight (GPC/MALLS)
K-12	10–14	5,000
K-15	13–19	9,700
k-30	26–35	66,800
K-60	50–62	396,000
K-90	88–100	1,570,000
K-120	114–130	3,470,000

- water absorptivity: ~17% water at 60% RH/20 °C
- glass transition temperature: 130–180 °C, increases with Mw to max. 180 °C
- film formation: hard, glossy, transparent, oxygen permeable
- film refractive index: ~1.53 at 25 °C

solubility characteristics

- soluble in water and most polar solvents
- insoluble in esters, ethers, ketones and hydrocarbons

PVP K-60 is currently available only as aqueous solution. All other PVPs are available as dried powder or in solution.

chemistry

Polyvinylpyrrolidone (PVP) can be plasticized with water and most common organic plasticizers. It is considered to be physiologically inert. Applications take advantage of one or more properties inherent in the polymer, typically due to the lactam ring.

High polarity and the resultant propensity to form complexes with hydrogen donors, such as phenols and carboxylic acids, as well as anionic dyes and inorganic salts.

Dispersancy, where components in a mixture are uniformly distributed through the use of polyvinylpyrrolidone.

Hydrophilicity, where the substantial water solubility of PVP is its dominant feature and frequently a factor along with other properties valuable to numerous applications.

Adhesion, taking advantage of the higher molecular weight PVP formulating in aqueous media, then evaporating sufficient water to generate a solid product for the desired application.

Cohesivity, where cohesive strength is achieved through a variety of dry blending and granulation techniques.

PVP is cross-linkable to a water insoluble, swellable material either in the course of vinylpyrrolidone polymerization, by addition of an appropriate multifunctional comonomer or by post-reaction, typically through hydrogen abstraction chemistry.

polyvinylpolypyrrolidone (PVPP)

PVPP (Polyvinylpolypyrrolidone) is a highly cross-linked, amorphous, white, free-flowing polymer produced through a unique proliferous (popcorn) polymerization. Although insoluble in water, acids, bases and organic solvents, the polymers offered have swell volumes of between 4 and 8 ml/g in water. PVPP strongly complexes with phenols such as tannins, flavonoids and dyes, adsorbing these compounds within its interior cavities.

Disintex™ disintegrants

applications

- tablet and granule disintegrants, high capillary activity and hydration capacity

physical properties

Grade	Disintex 75	Disintex 200
Chemistry	PVPP	PVPP
Particle Size	75 µm	150 µm
Use level	2%	2%

chemistry

Disintex disintegrants are propertiary blends of PVPP, cellulose and/or inert salts. They are used extensively as disintegrants in laundry and dishwashing detergent tablets, taking advantage of their swell volumes. The cross-linked PVPP homopolymers are highly hydrophilic and will rapidly absorb water on contact to swell and create internal stress points that will break-up tablets.

Polyplasdone™ and Polyclar™

Polyvinylpolypyrrolidone

Polyplasdone, Polyclar and ViviPrint PS-10 polyvinylpolypyrrolidone (PVPP) are cross-linked homopolymers of vinylpyrrolidone (VP). These PVPPs are water-insoluble solids but retain many of the functional properties of polyvinylpyrrolidone (PVP). Many of the properties of PVPP are related to the unique pseudo cationic (zwitterionic) chemistry of pyrrolidone and effectively chemical complex phenolic and aromatic compounds via hydrogen bonding and dipole interaction and adsorb a variety of materials including dyes, printing inks, aromatic species (e.g., polyphenols) and colors in wine. They have high capillary activity and hydration capacity. Surface area typically ranges 1 to 1.5 m^2/g. Product grades range in particle size from <30 µm to >200 µm. Smaller particle size grades (<30 µm) can be used in digital printing applications with microporous silica as ink-receptive coatings to enhance drying of printed images, minimize impact on coating gloss, improve ease of formulation dispersion and reduce color variation and water resistance of printed images.

PVPP Functionality

- disintegration
- dispersion
- complexation
- adsorption
- clarification

Xxtradura™ 5636 (flexithix™)

Rheology modifier

Xxtradura 5636 powdered rheology modifier is a PVPP that works under extreme conditions for aqueous or ethanolic or polar-oil based formulations. Capable of thickening aqueous and anhydrous formulations, Xxtradura rheology modifier is compatible with a wide range of ingredients, effective across a broad pH range (1–13) and has been shown to be stable with numerous solvents and acids. No neutralization is required.

performance polymers

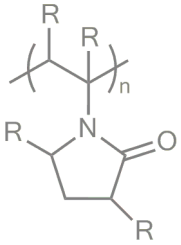
vinylpyrrolidone copolymers

The copolymers of vinylpyrrolidone and a number of other vinyl monomers are described on the following pages. These products are used in applications that benefit from the unique characteristics of the pendant pyrrolidone ring in combination with the properties of the co-monomers' functionalities.

Antaron™ (Ganex™) polymers

alkylated polyvinylpyrrolidone

Sold as Antaron alkylated polyvinylpyrrolidone in Europe and Canada.



applications

Antaron alkylated PVP are relatively low molecular weight polymers varying in degree of hydrophobicity from water-soluble powder (P-904LC) to water-insoluble flaked solid (WP-660) and are useful in the following applications:

- emulsifiers and dispersants in non-aqueous systems
- desensitizer/wax dispersant in melt-cast explosives
- dye dispersant for candles and shoe polish
- water-resistant film former in wood coatings
- asphaltene dispersant
- pigment dispersant in solvent-based coatings and inks

physical properties

Grade	Co-Polymer Composition[1]	Tg/ Melting Pt	Viscosity[2]	Supplied as
P-904L C	90% VP, 10% C4 olefin	155 °C	14 at 25 °C[a]	White powder
V-216	20% VP, 80% C16 olefin	Melting Pt. 8.5 °C	2500 at 50 °C[b]	Viscous liquid
V-220F	30% VP, 70% C20 olefin	Melting Pt. ~35 °C	20M at 80 °C[c]	Wax
WP-660	20% VP, 80% C30 olefin	Melting Pt. ~63 °C		Flaked solid

[1]VP = Vinylpyrrolidone, C4 alpha-olefin = 1-butene, C16 alpha-olefin = 1-hexadecene, C20 alpha-olefin = 1-eicosene, C30 alpha-olefin = 1-tricosene.

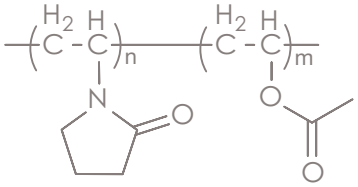
[2]Brookfield, cP. a) RVT#2, 20 rpm/10% solids; b) RVT#2, 20 rpm/neat; c) RVT# 5, 20 rpm/neat.

chemistry

Antaron resins are copolymers produced from alpha-olefin and vinylpyrrolidone. The alkyl component varies from a C-4 to C-30 moiety in concentrations from 10 to 80%. The combination of vinylpyrrolidone and alkyl functionalities produces a balance of dispersing and waterproofing capacity in the Antaron line.

PVP/VA polymers

vinyl pyrrolidone/vinyl acetate copolymers



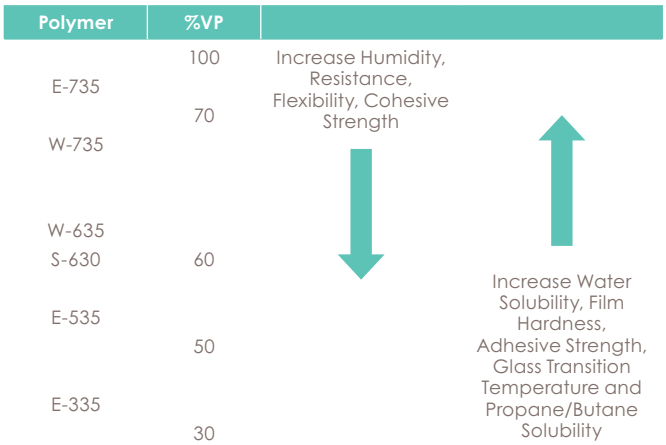
applications

PVP/VA polymers produce transparent, flexible, oxygen permeable films which adhere to glass, plastics and metals. These properties, coupled with the ability to control their hydrophilicity through monomer composition, enable extensive industrial use:

- in re-moistenable, hot melt adhesives
- in re-pulpable, pressure sensitive adhesives, where the water solubility of pvp/va s-630 facilitates recycling
- as a binder for dry-film photoresists
- in solder masks utilizing aqueous processing
- inkjet coatings improves print receptivity

physical properties

Grade	Supplied as	~Mw	Tg in °C
E-335, E-535, E-635, E-735	50% Ethanol solution	29,000–57,000	69, 96, 106, 117
W-635, W-735	50% Aqueous solution	15,000–27,000	99, 114
S-630	Dry powder	51,000	110



chemistry

PVP/VA polymer resins are linear, random copolymers produced by the free-radical polymerization of the monomers in ratios varying from 70/30 to 30/70 vinyl acetate to vinylpyrrolidone. PVP/VA polymers are thermoplastic resins with molecular weights ranging from approximately 15M-60M. Their glass transition temperatures vary from 70 to 115 °C and hydrophilicity increases with vinylpyrrolidone content. PVP/VA polymers are available as white powders or clear solutions in ethanol and water. Polymers in the four ranges of vinylpyrrolidone content (30, 50, 60 and 70%), are produced in ethanol. PVP/VA polymers with 60 and 70% vinylpyrrolidone content are available as solids or as 50% aqueous solutions. In addition to being soluble in alcohols, PVP/VA polymers dissolve in esters and ketones but are insoluble in ethers and aliphatic hydrocarbons. The water-soluble PVP/VA polymers exhibit a 5% aqueous cloud point, i.e., the 60% vinylpyrrolidone content resin has a minimum critical solution temperature of 68 °C.

Antara™ (Polectron™ 430) polymer

Sold as Antara 430 PVP/Polystyrene latex in Europe and Asia Pacific.

applications

Antara 430 polymer, with a glass transition temperature of approximately 100 °C, gives transparent, thermoplastic films that readily adhere to glass, plastics and metals. The emulsion, compatible with many polymers and surfactants, is typically used as:

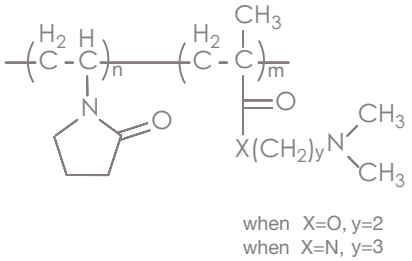
- hydrophobic coating for inkjet recording media
- oil-resistant coatings
- cold-seal adhesive component

chemistry

Antara 430 polymer is a white, thermoplastic, 38–41% solids, latex produced as a graft, emulsion copolymer of 30% polyvinylpyrrolidone and 70% styrene in the presence of an anionic surfactant. The size distribution of the emulsion is such that 90% of the particles are <0.5 micron with a maximum 25 °C viscosity of 750 cps at pH 2.0-5.0. Antara 430 polymer is thermally and mechanically stable in the presence of a variety of ionic compounds. The viscosity is unaffected after three freeze-thaw cycles between ambient and –20 °C; the emulsion is unbroken at 25 °C after 1/2 hr at 10,000 rpm and does not coagulate on addition of 1% hydrochloric acid, calcium chloride, alum or sodium borate.

vinylpyrrolidone copolymers

vinylpyrrolidone/alkylaminomethacrylate and alkylaminomethacrylamide copolymer



applications

These polymers have a number of unique properties such as substantivity to anionic materials that make them useful as:

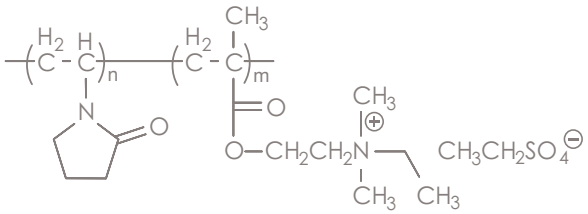
- dye receptors in inkjet and digital printing media
- adjuvant for electrodeposition of copper in printed circuit board fabrication

chemistry

The copolymers of vinylpyrrolidone and dimethyl-aminoethyl-methacrylate (VP/DMAEMA, X=O, y=2) or vinylpyrrolidone and dimethylaminopropylmethacrylamide (VP/DMAPMA, X=N, y=3) are supplied as viscous solutions in either water or ethanol. These polymers serve to a great extent as precursors for cationic polymers through quaternization reactions on the pendant tertiary amino function. They are described on the following pages.

Sorez™ HS-205 and Gafquat™ copolymers

vinylpyrrolidone/dimethylaminoethylmethacrylate copolymers (VP/DMAEMA)



Two VP/DMAEMA copolymers are quaternized with diethylsulfate-producing Gafquat 755/755N and Gafquat 734 VP/DMAEMA, which give transparent, glossy, tack free, flexible films. The polymers are substantive to negatively charged surfaces and compatible with anionic and amphoteric surfactants.

physical properties

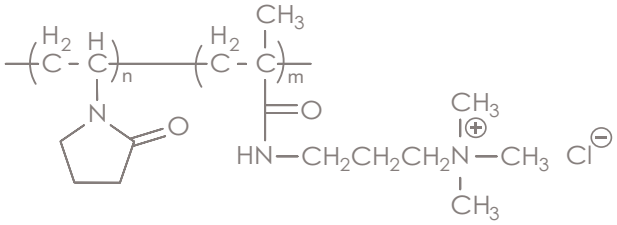
Grade	Solution	Mw[1]	Tg	Viscosity[2]
Copolymer 845	20% H_2O	1,000,000	172 °C	20,000–70,000
Copolymer 937	20% H_2O	1,000,000	104 °C	20,000–70,000
Copolymer 958	50% Ethanol	80,000–150,000	100 °C	60,000–90,000
Gafquat 755/755N VP/DMAEMA	20% H_2O	1,000,000	155 °C/149 °C	20,000–70,000
Gafquat 734 VP/DMAEMA	50% Ethanol	60,000–110,000	140 °C	30,000–70,000
Sorez HS205 VP/DMAEMA	20% H_2O	1,000,000	172 °C	20,000–70,000

[1]Determined by GPC using polyethyleneoxide standard

[2]cP as is, at 22–23 °C, Brookfield RVT #7, 30 rpm

Gafquat™ HS-100 polymers

vinylpyrrolidone/methacrylamidopropyl trimethylammonium chloride copolymer



The copolymer of methacrylamidopropyltrimethyl-ammonium chloride (MAPTAC) and vinylpyrrolidone, Gafquat HS-100 vinylpyrrolidone/methacrylamidopropyl trimethylammonium chloride copolymer gives transparent, glossy and tack-free flexible films. Amide linkage in the MAPTAC moiety imparts greater hydrolysis resistance. Typical of this cationic polymer family, Gafquat HS-100 vinylpyrrolidone/methacrylamidopropyl trimethylammonium chloride copolymer is substantive to negatively charged surfaces and compatible with anionic and amphoteric surfactants.

physical properties

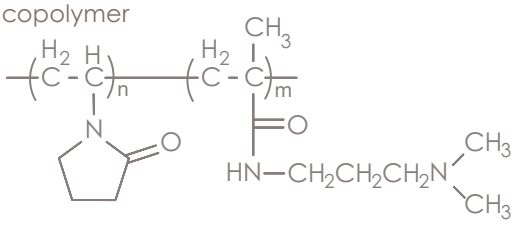
Grade	Solution	Mw[1]	Tg	Viscosity[2]
Gafquat HS-100 vinylpyrrolidone/ methacrylamidopropyl trimethylammonium chloride copolymer	20% H_2O	900,000–1,200,000	184 °C	50,000–125,000

[1]Determined by GPC using polyethyleneoxide standard

[2]cP as is, at 22–23 °C, Brookfield RVT #7, 30 rpm

Styleze™ CC-10 and Setleze™ 3000 copolymers

vinylpyrrolidone/dimethylaminopropylmethacrylamide copolymer



applications

- settling agent (Setleze 3000 vinylpyrrolidone/ dimethylaminopropylmethacrylamide copolymer)

physical properties

Properties	Styleze CC-10	Setleze 3000
pH (as is)	6.0–8.0	6.5–7.8
Viscosity (cP)	10,000–35,000	6,000–24,000
Mw	1,200,000–1,500,000	1,500,000–2,000,000
Nanoparticles	No	Yes
Neutralized	H_2SO_4	HCl
Tg	161 °C	167 °C

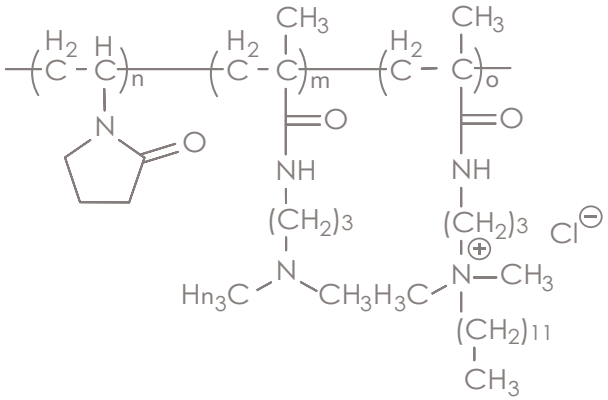
chemistry

These high molecular weight copolymers have a strong affinity for anionically charged substrates, which can be further enhanced through quaternization. It produces transparent, flexible, high-gloss coatings with improved water resistant. Cross-linking significantly improves water resistance. Presence of the amide linkage imparts greater hydrolysis resistance. Compatible with nonionic, cationic and amphoteric surfactant, soluble in ethanol and water, insoluble (Styleze CC-10 vinylpyrrolidone/dimethylaminopropylmethacrylamide copolymer) and partially soluble (Setleze 3000 vinylpyrrolidone/dimethylaminopropylmethacrylamide copolymer) in acetone. Setleze vinylpyrrolidone/ dimethylaminopropylmethacrylamide copolymer are produced by a proprietary in-situ process resulting in a 2-phase matrix consisting of soluble copolymer and nanoscale particles approximately 320 nm in size that impart improved water-resistance, light fastness and curl resistance in digital media applications.

vinylpyrrolidone copolymers

Styleze™ W polymers

vinylpyrrolidone/dimethylaminopropylmethacrylamide/me thacryloylaminopropyl lauryl dimethyl ammonium chloride terpolymer



applications

- thickener for strong acid formulations
- inkjet receptive media

physical properties

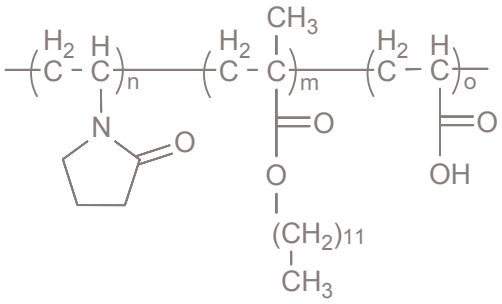
Properties	Styleze W polymers
Physical form	Slightly hazy aqueous solution
% Solids	10% (W-10), 20% (W-20)
pH (as is)	3.5-5.0
Viscosity	<5000 cP (W-10) 40,000-100,000 (W-20)
Molecular weight	2,700,000
Tg	135 °C

chemistry

Styleze W polymers are random terpolymers of vinyl pyrrolidone, dimethylaminopropyl methacrylamide and methacryloylaminopropyl lauryl dimethyl ammonium chloride. They promote and stabilize foam through their ability to reduce surface tension, excellent adhesion to high energy substrates and are flexible, elastic, low-tack and heat-resistant films. Additional solution viscosity improvements can be achieved by the addition of salts.

Styleze™ 2000 and Acrylidone™ LM polymers

vinylpyrrolidone/acrylic acid/lauryl methacrylate terpolymer



applications

- metal quenching
- inkjet receptive media

physical properties

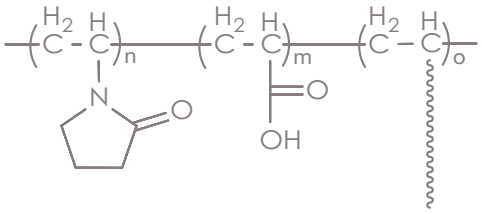
Properties	Styleze 2000
Physical form	White, free flowing powder
Molecular weight	1,010,000 (MALLS)
Tg	176 °C

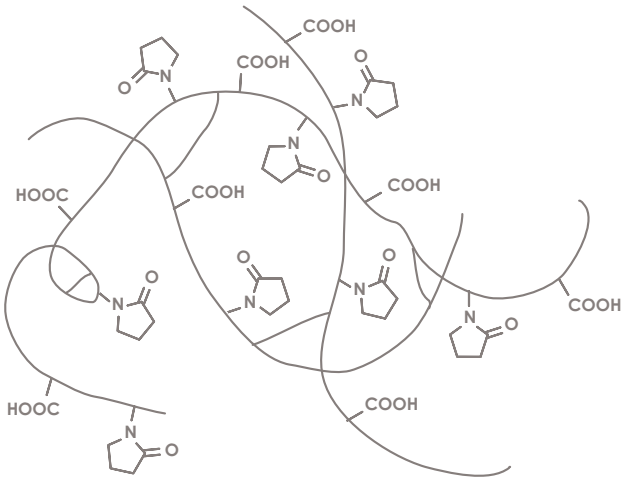
chemistry

Styleze 2000 is a high molecular weight, film-forming anionic terpolymer composed of vinyl pyrrolidone and an acrylate backbone with a hydrophobic pendant C-12 chain. It is insoluble in ethanol and water until neutralized for easy dispersion. Exhibits synergistic thickening when combined with associative rheology modifiers.

Ultrathix™ P-100 crosspolymer

acrylic acid/VP crosspolymer





applications

- clear gels
- emulsion Stabilizer

physical properties

Properties	UltraThix P-100
Physical form	White, powder
Acid Number	340–390
Viscosity (1% aq., 75% neutralized)	35,000–65,000 cps

chemistry

UltraThix P-100 is an anionic polymer. It is a shear thinning rheology modifier with high Brookfield yield to suspend solids. Compatible with anionic, nonionic and some cationic polymers.

vinylcaprolactam polymers

Inhibex™ 501 and BIO-800

applications

Vinylcaprolactam-derived polymers Inhibex give hard, glossy transparent films with excellent adhesive and cohesive properties. The polymers also find use in many of the markets noted for polyvinylpyrrolidone. In general, vinylcaprolactam imparts reduced water solubility and cloud point relative to vinylpyrrolidone-based polymers while enhancing the hydrophobicity of the resin.

physical properties

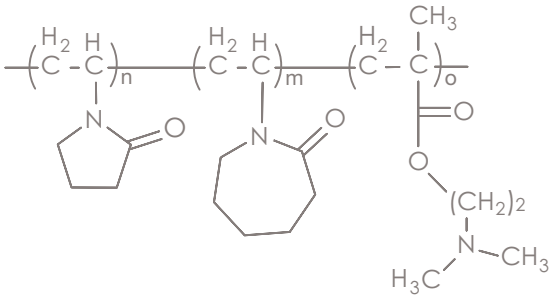
Grade	Monomer Composition	Solution	Mw[1]	Viscosity[2]
Inhibex 501	50% VCL/ 50% VP	50% butoxyethanol	5-8x10^3	3000–6000
Inhibex BIO-800	VCL/VOH/VA	55% butoxyethanol	2-4x10^3	2500–7500

[1]Determined by GPC using polyethylene oxide standard
[2]Brookfield cP, as is, at 25 °C, RVT #3, 20 rpm

copolymer VC-713 polymer

vinylpyrrolidone/vinylcaprolactam/ dimethylaminoethylmethacrylate terpolymer

Sold as Gaffix™ VC-713 vinylpyrrolidone/ vinylcaprolactam/dimethylaminoethylmethacrylate terpolymer in North America.



applications

- flocculating agent
- inkjet receptive media

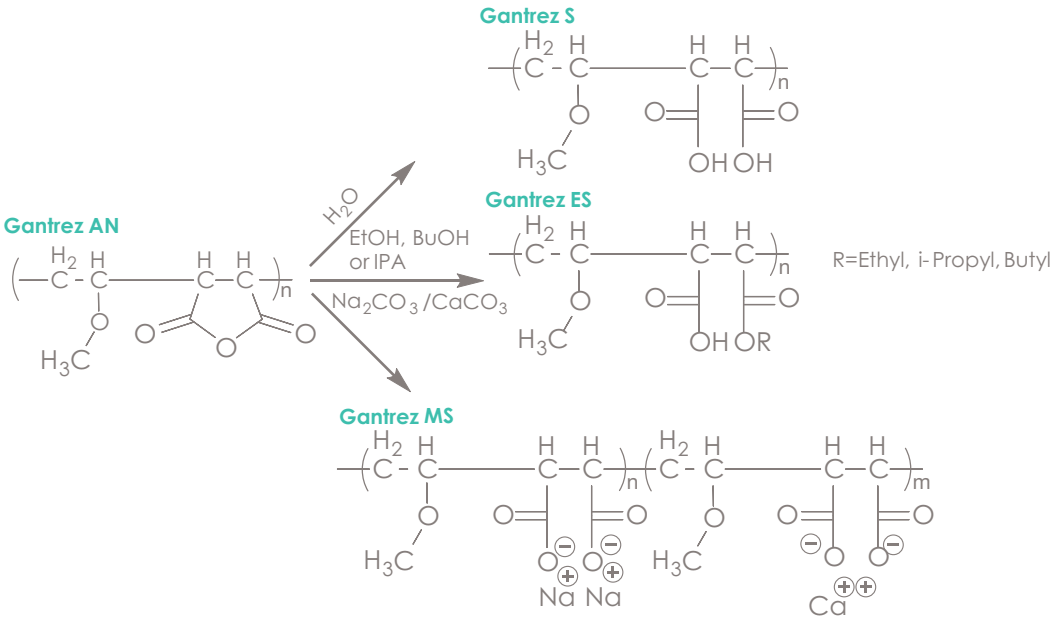
physical properties

Properties	Copolymer VC-713
Physical form	Viscous ethanol solution
Molecular weight	82,700
Tg	152 °C

chemistry

Vinyl caprolactam imparts increased hydrophobicity and reduces tack. Water soluble film former, pseudo-cationic functionality, substantive to negatively charged surfaces. Quaternization yields cationic polymer; compatible with anionic, nonionic and cationic surfactants, silicones and thickeners.

methylvinylether/maleic anhydride copolymers and analogues



Gantrez™ AN copolymers

Polymethylvinylether/maleic anhydride copolymer

applications

Because of their unique chemical structure and reactivities, Gantrez copolymers function well as:

- dispersants for fluorescent light phosphors
- microcapsule clusterants in carbonless paper and latex systems
- complex coacervates with gelatin to form the micro- capsule wall in carbonless paper
- calcium encrustation inhibitors
- acid layers in diffusion transfer film to neutralize alkaline developers and dyes
- intermediates in adhesive applications
- imide derivatives for anti-reflective layers on silicon wafers prior to photoresist coating and light exposure
- gas fade inhibitors for synthetic fibers
- metal sequestrants
- anionic polyacids

physical properties

Grade	Viscosity[1]	Molecular Weight[2]
AN-119 BF	1.0–1.5	216,000
AN-169-BF	3.0 - 3.9	1,980,000

[1]1 cSt 1% in MEK at 25 °C, Cannon Fenske, tube size 100
[2]SEC/LALLS detector

Reaction of the anhydride functional group with essentially any molecule having an "active hydrogen" opens a wealth of opportunities to synthesize useful derivatives.

chemistry

Gantrez AN copolymers contain alternating units of methylvinylether and maleic anhydride. The fundamental character of this polymerization requires that a maleic anhydride unit must be adjacent to a methylvinylether unit and vice versa, resulting in a true alternating copolymer. As shown in the table above, Gantrez AN (anhydride form) copolymer is available in the molecular weight range of 0.13–2.0 M. The polymers are white hygroscopic powders soluble in tetrahydrofuran and M-Pyrol™ solvent; they are insoluble in aliphatic and halogenated hydrocarbons. All four grades have a glass transition temperature of 151–154 °C, independent of molecular weight, and form transparent, tack-free films.

methylvinylether/maleic anhydride copolymers and analogues

Gantrez™ S copolymers

poly(methylvinylether/maleic acid) copolymer

applications

- calcium encrustation inhibitors
- dispersant aid
- aluminum surface conditioning
- base-activated adhesive for peel-apart instant film

chemistry

Gantrez S95 and S97 copolymers have repeating co-maleic acid units produced by hydrolysis of Gantrez AN copolymer. The polycarboxylic acid derivatives with a pH of ~2 at 5% concentration are available either as viscous solutions or white powders. The vicinal dicarboxylic acid functionality of these materials is useful in a number of applications. The free acid forms are water-soluble, giving clear and tacky films. Solution rheology can be modified by the addition of salts and bases.

Gantrez ES copolymers

poly(methylvinylether/maleic acid) half esters copolymer

applications

- pigment dispersants in cosmetic formulations
- pH-dependent soluble films (enteric coatings)

chemistry

Ethyl, isopropyl and n-butyl half esters are produced by opening up the anhydride in alcohol. These polymers, based on Gantrez AN-119 copolymer, are sold as 50% solutions in ethanol or isopropanol.

They are water-soluble when neutralized greater than 40% using either an organic or inorganic base. Adhesive strength can be adjusted through controlling the degree of neutralization. Films are flexible, clear and glossy and have improved water resistance compared to Gantrez S copolymer.

Gantrez MS copolymers

poly(methylvinylether/maleic acid) mixed-salts copolymer

applications

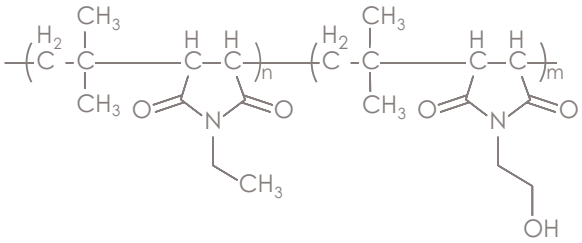
- bioadhesives
- inkjet coatings

chemistry

Gantrez MS-955 copolymer is a mixed salt of sodium/calcium and is supplied as a free-flowing powder. The copolymer is soluble in water and produces solutions with high viscosity.

Aquaflex™ FX-64 copolymer

isobutylene/ethylmaleimide/hydroxyethylmaleimide copolymer



applications

- film former
- adhesive/cohesive properties

physical properties

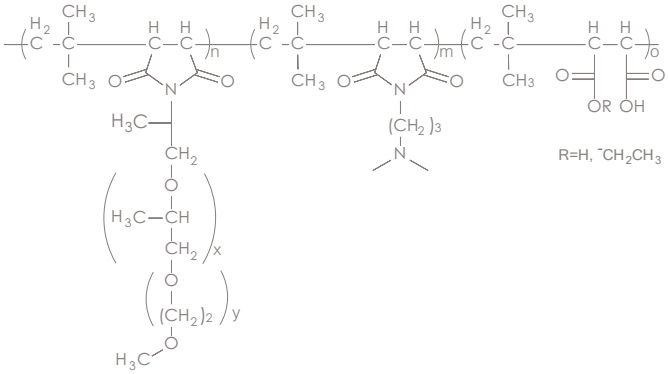
Physical form	Yellow viscous liquid
Molecular Weight	39,000
Tg	135 °C

chemistry

Aquaflex FX-64 copolymer is an imidized isobutylene/maleic anhydride copolymer that produces low-tack, glossy films supplied as 40% hydroalcoholic solution. (Material is not listed on the US EPA TSCA inventory.)

Aquaflex XL-30 copolymer

isobutylene/dimethylaminopropyl maleimide/ethoxylatedmaleimide/maleicacid copolymer



applications

- film former, flexible coating with low coefficient of friction

physical properties

Properties	Aquaflex XL-30
Physical form	Straw-like hazy, viscous aqueous solution
Molecular Weight	86,000

chemistry

Aquaflex XL-30 copolymer is an isobutylene dimethylaminopropylmaleimide/ethoxylated maleimide/maleic anhydride copolymer that produces highly flexible, glossy and humidity-resistant films and forms clear gels with anionic rheology modifiers. (Material is not listed on the US EPA TSCA inventory)

acrylates

Ashland has a range acrylate based polymers to suit all applications that require this type of chemistry. Due to the molecular structure and/or monomer composition, the polymers will be most suited to different scale or dispersing/stabilizing/thickening applications.

copolymer

physical properties

Grade	Type	Active solids (%)	pH	Mw	PD
Jaypol™ HN70	Maleic	45	~7	1500–2500	1.5–2.0

liquid dispersion polymers LDP

Jaypol AL range is high molecular weight liquid dispersion polymers which when added to water swell to give thickening. The polymers are effective over a pH range of 4 to 12. One shot additive that can be incorporated at any stage of the formulation manufacturing process and can provide an opacifier effect.

physical properties

Grade	Active solids (%)	Textural response	pH
Jaypol AL	60	Promoting texture, spreadability – non flow rheology Secondary effect produces opacity	~7
Jaypol AL2	60		~6
Jaypol 213	50		~4

methacrylic acid/ethylacrylate copolymers

Methacrylic acid/ethylacrylate copolymers act as thickeners. They are hydrophobically modified alkali-swellable (HASE) polymers. They are generally used in aqueous, highly filled and surfactant systems.

applications

Jaypol AT1

- gloss paint
- semi-gloss paint

Jaypol AT2

- semi-gloss paint
- screen printing inks
- flexographic printing inks and over lacquers

Jaypol AT4

- matt/emulsion paint
- adhesives
- wood coatings
- screen printing inks

physical properties

Grade	Active solids (%)	Salt tolerance	T tolerance	Solution quality	Rheology Type (at 0.8% solution)
Jaypol AT1	30	High	Moderate	Clear water white	Newtonian flow
Jaypol AT2	30	High	Low	Clear water white	Hybrid Rheology flow
Jaypol AT4	30	High	Low	Clear water white	Pseudoplastic drop flow/gel

Methacrylic acid/ethylacrylate copolymers are supplied as aqueous emulsions at pH 2 to 3 with typical molecular weights of 20,000 to 40,000. They are supplied with a range of crosslinking and hydrophobicity to optimize rheological properties and develop rheology by the swelling mechanism of the addition of suitable alkali with optimum rheology development between pH 6 to 12.

Rapithix™ A-100

Sodium polyacrylate

RapiThix A-100 polymer is a free-flowing, fully active white powder sodium polyacrylate for rheology. RapiThix A-100 polymer is designed for use in cold mix processes and is easy to use, shear-tolerant, shear-thinning and effective at low use levels.

- no pre-set oil phase
- makes oil-free systems possible
- high solids content for higher efficiency

applications

- mud viscosifier, shale swell inhibition and friction reducer in civil engineering
- anti-capping, erosion control, improved water filtration, lubrication and water absorbents
- alternative rheology modifiers for extreme acid and alkali formulations

physical properties

Properties	RapiThix A-100
Physical form	Fine powder
Solids content	85–95%
Viscosity (1% solution)	28,000–38,000 cP
pH (1% solution)	5.7–6.7

Rheothix™ 601 thickening agent

Sodium polyacrylate

applications

- adhesives
- caulking
- sealants

physical properties

Properties	RheoThix 601
Physical form	Off-white milky dispersion
Active content	57–59%
Viscosity	500–2000 cP

chemistry

RheoThix 601 thickening agent is an anionic, pseudo-plastic thickening agent, emulsifying and stabilizing ingredient that improves performance. It can be incorporated into the water phase, into the oil phase and after the oil is emulsified to provide uniform thickening without neutralization, pre-swelling or pre-heating. The recommended use level is 0.2–2.5% based on solid content.

Rapifloc™ A1-MG

Rapifloc A-1 MG polymer is a high molecular weight anionic polyacrylamide supplied as a free-flowing granular powder. It is completely soluble in water-producing solutions of high viscosity. It is of very high anionic charge.

benefits

- cost-effective
- completely water-soluble
- improved process efficiencies

applications

Rapifloc A-1 MG polymer has found application in a wide variety of mineral processing and civil engineering applications. It is essentially nitrogen-free, and its use in brine clarification does not give rise to the formation of nitrogen trichloride in subsequent electrolysis.

applications include:

- alkaline leach uranium circuits
- civil engineering
- brine clarification

physical properties

Properties	Rapifloc A1-MG
Physical form	Off-white granular solid
Particle size	99% <2000 µm
Bulk density	Approx. 0.85 g/m³
pH (0.5% solution, 25 °C)	Approx. 6.0

Stabileze™ QM polymer

Poly(methylvinylether/maleic anhydride decadiene) crosspolymer

applications

Stabileze rheology modifiers yield clear, aqueous gels that are shear-thinning and slightly thixotropic, having good shear, temperature and UV-A radiation stability. Stabileze crosspolymer is effective as a rheology modifier for:

- thickeners
- coatings and inks
- sealants
- electroconductive gels
- deicing fluids
- pigment dispersants

chemistry

Stabileze QM polymer is produced in a manner similar to that of Gantrez AN copolymer but with the added monomer decadiene present to yield a crosslinked, water-swellable resin. The polymer is a white free-flowing powder with a glass transition temperature of approximately 150 °C. The solid can be dispersed in water without coagulating, and the anhydride function will hydrolyze directly or through the action of base. A neutralized 0.5% solution in water at pH 7 and 25 °C has a viscosity range of 45,000-70,000 cP.

Ashland™ 980 and 981 carbomer

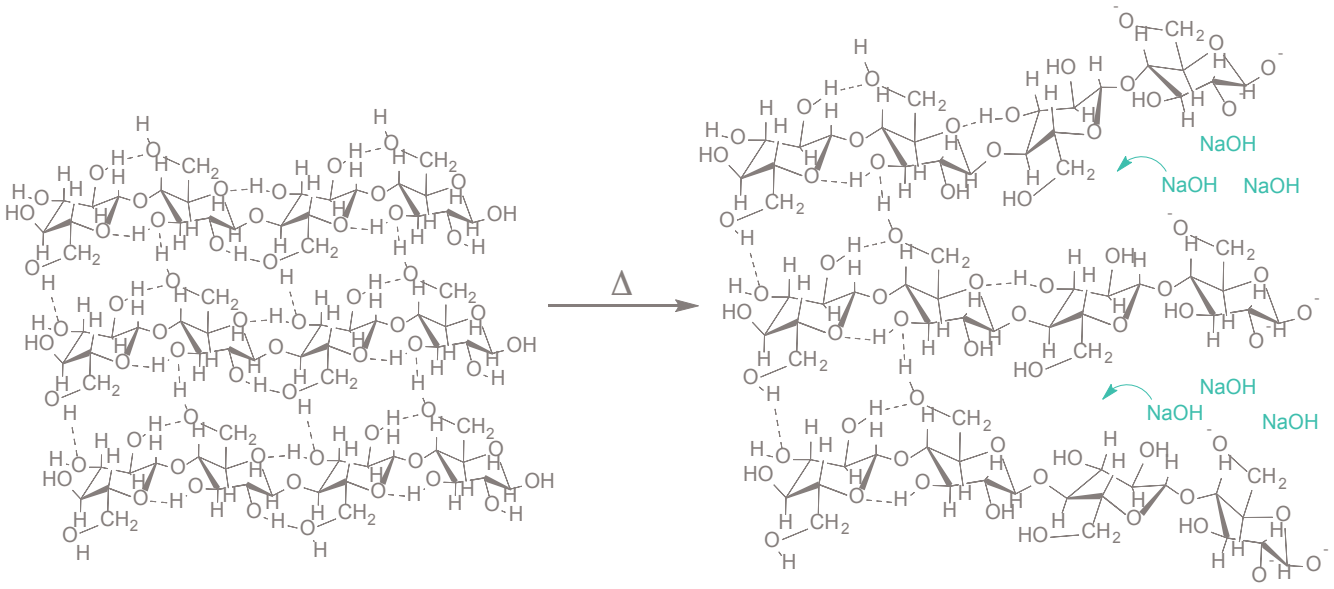
Ashland 980 and 981 carbomers are cross-linked polymers of acrylic acid that are useful thickening, stabilizing and suspending agents used in a wide variety of applications. Typical uses are as a stabilizing polymer in oil-in-water emulsions, as a suspending agent in surfactant-rich systems, and as a thickening agent. They produce a dispersion when added to water with a pH of ~3 and require neutralization with amine or inorganic hydroxide to activate. Ashland 940 and 980 carbomers are odorless and form a crystal-clear gel in water.

physical properties

Properties	Carbomer
Physical form	White powder
Solids content (105 °C)	98.0–100%
Brookfield viscosity (25 °C, 0.2% aqueous gel neutralized)	13,000–30,000 cP
Brookfield viscosity (25 °C, 0.5% aqueous gel neutralized)	40,000–60,000 cP
Clarity, % transmission (neutralized solution at 0.5%, 420 nm)	85%

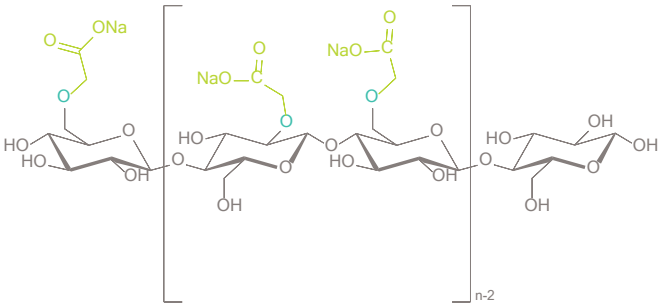
cellulose derivatives

Cellulose is reacted with caustic to unzip all moieties and then reacted to the individual derivatives.



carboxymethylcellulose (CMC)

Blanose™



CMC is a cellulose ether, produced by reacting alkali cellulose with sodium monochloroacetate under controlled conditions. It is an anionic water-soluble polymer.

applications

- batteries/electronics (binder, film former, dispersion); lithium ion batteries carbon dispersant
- civil engineering, building and construction (rheology modifier, suspension agent, binder, extrusion aid, water flow blocking agent)
- mining and extraction (selective flotation depressant, pellet binder, mineral, dispersant); mineral processing, mining
- adhesives and sealants (suspension agent, thickener, film former)
- ceramics (binder, plasticizer and green strength, rheology modifier, controlled water release, suspension agent, film former, green strength additive, suspension agent, water-retention agent)
- foundries and refractories (binder, green strength enhancer, rebound or bumping reducer, stabilization agent)

- housewares and consumer (gel enhancer, rheology modifier, stabilization agent, thickener); freezer gels
- textiles (film former, rheology modifier, sizing agent, thickener)
- tobacco (binder, suspension agent); reconstituted tobacco, leaf glue
- pulp and paper (rheology modifier, suspension and stabilization agent, thickener, water-retention enhancer)

physical properties

Grade	DS Type			Brookfield LVT Viscosity at 25 °C	
	7	9	12	Range (mPas)	conc (%)
L	7UL		12UL	10–25	6
	7EL			35–60	6
	7L1			90–130	6
	7L2			120–280	6
	7L			25–50	2
M	7M1			50–100	2
	7M2			100–200	2
	7M			300–600	2
	7M31	9M31	12M31	1,500–3,100	2
	7M65	9M65		3,000–6,500	2
H	7H			1,500–2,500	1
	7H4	9H4		2,500–4,500	1
	7H9			4,000–9,000	1

It is a derivatized cellulose. These, in turn, are composed of two anhydroglucose units (ß-glucopyranose residues). In this structure, n is the number of anhydroglucose units (which are joined through 1,4 glucosidic linkages), or the degree of polymerization, of cellulose. Each anhydroglucose unit in the polymer contains three hydroxyl groups. By substituting carboxymethyl groups for some of the hydrogens of these hydroxyls, as shown in the figure, sodium carboxymethylcellulose is obtained. The average number of hydroxyl groups substituted per anhydroglucose unit is known as the "degree of substitution," or DS. For example, DS Type "7" has a DS of 0.7. If all three hydroxyls are replaced, the maximum theoretical DS of 3.0 (impossible in practice) results.

Aquasorb™ and Blanose™ SB water absorbers

These products are sodium carboxymethylcellulose based high purity, powdered superabsorbents. They are used in applications where a high absorbant rate is needed for aqueous liquids. The salt tolerance level is higher than for sythetic based superabsorbers.

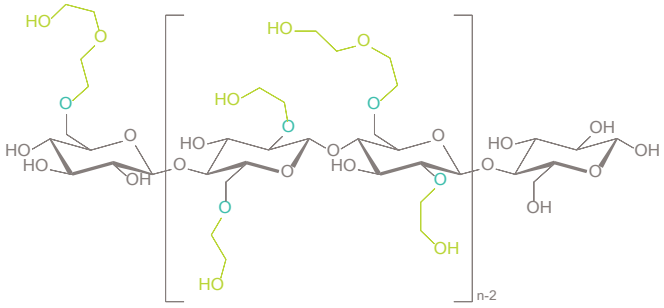
physical properties

Grade	Aquasorb A380	Aquasorb A500	Blanose SB
Purity on dry basis	99.5 min	99.5 min	98 min
Moisture as packed	8%	6%	6%
pH	6.5–8.0	6.5–8.0	6.0–7.5
Product color	White to light tan	White to light tan	White to light tan
PSD sieve opening	1% max. on 0.850 mm 10% max. thru 0.180 mm	0.5% max. on 0.250 mm 80% min. thru 0.075 mm	0.5% max. on 0.160 mm 60% min. thru 0.05 mm

cellulose derivatives

hydroxyethylcellulose (HEC)

Natrosol™ and Natrosol™ B



Natrosol HEC, a nonionic, water- soluble polymer, is a white, free-flowing granular powder. Solutions of Natrosol HEC are pseudoplastic or shear-thinning. Natrosol HEC is easily dissolved in cold or hot water to give crystal-clear solutions of varying viscosities. Furthermore, low to medium molecular weight types are fully soluble in glycerol and have good solubility in hydro-alcoholic systems containing up to 60 percent ethanol. Natrosol HEC is generally insoluble in organic solvents.

applications

- building and construction (bond strengthener, lubricity and workability enhancer, rheology modifier, stabilizer, suspension agent); caulks and sealants, welding rods
- commercial and institutional (formation aid, rheology controller, thickener); fiberglass
- adhesives and sealants (thickening, lubricity, water-binding and solids holdout); wallpaper adhesives, latex adhesives, plywood adhesives
- ceramics (suspension agent)
- suspension polymerization of polystyrene (protective colloid)
- civil engineering (cement extender, filtration control additive, rheology modifier); hydraulic cements cement slurries, completion/workover fluids

physical properties

Natrosol 250 Grades			Brookfield LVT Viscosity at 25 °C	
R	Non-R	B-Types[1]	Range (mPas)	conc (%)
LR	L		100–180	5
ER			25–105	2
GR	G		250–450	2
KR			1,500–2,500	2
MR	M	MB/MBR	4,500–6,500	2
MHR		MHBR	1,000–1,500	1
HR	H	HBR	1,500–2,600	1
		H4BR	2,600–3,300	1
HHR	HH	HHBR	3,400–5,000	1

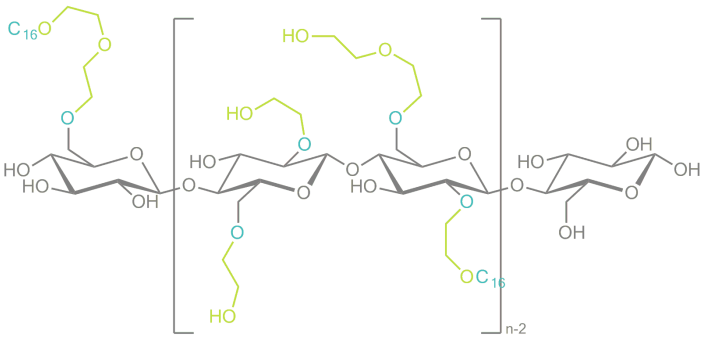
[1]B-biostable grade

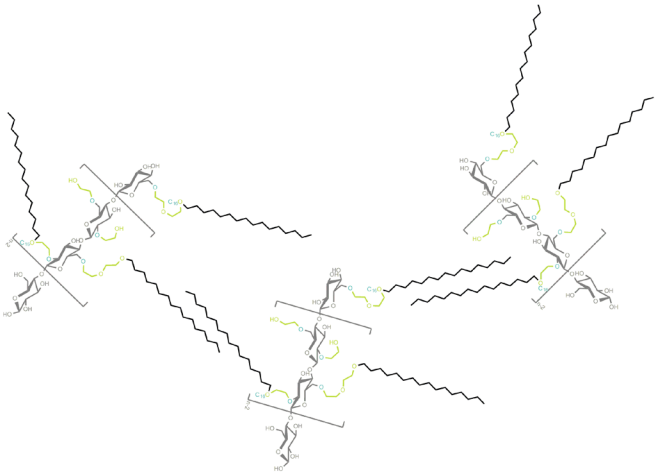
chemistry

The Natrosol HEC polymer is a hydroxyethyl ether of cellulose. The structure of the cellulose molecule shows its chain composed of anhydroglucose units. By treating cellulose with sodium hydroxide and reacting with ethylene oxide, hydroxyethyl groups are introduced to yield a hydroxyethyl ether. B grades are more biostable with enhanced resistance to enzymatic degradation due to their substitution pattern.

hydrophobically modified hydroxyethylcellulose (HMHEC)

Natrosol™ plus, Natrosol Plus 550 and Natrosol HE 10K





Natrosol Plus, Natrosol Plus 550 and Natrosol HE 10K are nonionic water-soluble polymers, HMHEC. The hydrophobic modification consists of long-chain alkyl groups chemically bound to the polymer. The physical properties of unmodified HEC and HMHEC contribute increased solution viscosity and altered rheological properties.

physical properties

grade	Natrosol Plus 330	Natrosol Plus 550	Natrosol HE10K
physical form	white to off-white powder		
moisture, max	5%		
ash max[1]	10%	8%	10%
particle size, on U.S. 40	10%		
viscosity, 1 % solution	150–750 cP	7,000–11,000	9,000–16,000
solution appearance	clear		
solution pH	5.5–8.5		

[1]Calculated as Na_2SO_4

Hydrophobically modified HEC builds viscosity through hydrogen bonding with water molecules (as with traditional cellulosics), chain entanglement and association of the hydrophobic groups. Aqueous solutions of Natrosol Plus, Natrosol Plus 550 and Natrosol HE 10K are highly pseudoplastic (shear-thinning), with Natrosol HE 10K most pseudoplastic as a result of association of the hydrophobes. This association breaks down under shear, and viscosity drops quickly. The amount of pseudoplasticity is greater for Natrosol Plus, Natrosol Plus 550 and Natrosol HE l0K than for Natrosol. Unlike aqueous solutions, aqueous latex systems thickened with Natrosol Plus, Natrosol Plus 550 and Natrosol HE 10K HMHEC have superior rheology and are less pseudoplastic than Natrosol HEC.

- improved rheology
- viscosity stability of latex systems
- color acceptance and development

performance polymers

methylcellulose and its derivatives

Culminal™ and Benecel™

chemistry

Methylcellulose and its derivatives are made under rigidly controlled conditions by reacting alkali-cellulose with methyl chloride, resulting in methylcellulose (MC), ethylene oxide, resulting in methylhydroxyethylcellulose (MHEC), or propylene oxide, resulting in methylhydroxypropylcellulose (MHPC).

properties/features

- cold water solubility
- quality of solution
- higher substitution leads to clearer solutions
- solubility in organic solvents (special substitution)
- water retention
- higher viscosities have better water binding properties
- rheology control/thickening/stabilizing effect
- thermo-gelling
- higher methoxyl substitution leads to a lower thermos-gelling temperature
- higher methoxyl substitution causes a higher thermo-gel strength
- binding
- protective colloid/suspension/emulsion effect
- adhesive power
- lower viscosities giver better adhesion than higher viscosities
- lower substitution level types give more adhesion
- film formation
- controlled release properties

physical properties

Grade	Culminal	Benecel
Active content on dry basis		98% min.
Moisture, max.	8%	5%
Ash content[1]	1.5% max.	0.8% max.
Bulk density	200–500 g/l	200–500 g/l
PSD Regular, S and R-types: Type MHPC 724 P, PR and P1-types PF, PFR, PFF and PFS-types P1R-types	 Dv50: 250 min.-450 max. Dv50: 80 max. Dv90: 255 min.-330 max. Dv90: 170 min.-295 max. Dv90: 275 min.-340 max.	Dv90 170-250 µm

[1]Calculated as Na_2SO_4

chemistry

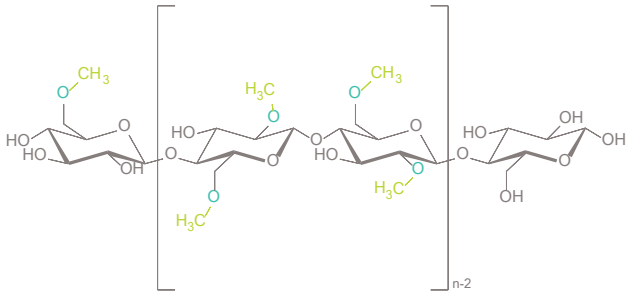
Culminal substitutions are not generally specified, while Benecel products are specified as A (pure MC with 30% OCH_3), E (MHPC with 29% OCH_3 and 10% POOH) and K (MHPC with 22% OCH_3 and 8% POOH). These designations are followed by a viscosity number, as listed below, designated milling grad and "R"-types have retarded solubility.

applications

- adhesives (adhesive, binder, film former)
- emulsions (rheology modifier, stabilization agent)
- ceramics (extrusion aid, binder, rheology modifier, stabilization agent)
- metal processing (rheology modifier, stabilization agent)
- mineral slurries (rheology modifier, stabilization agent)
- mining (rheology modifier, stabilization agent)
- paint removers (rheology controller, thickener, film former)
- paper coatings (rheology modifier, stabilization agent, film former)
- pulp & paper (rheology modifier, stabilization agent)
- suspension polymerization (protective colloid, rheology modifier, stabilization agent)
- tobacco (adhesive, binder, rheology modifier, stabilization agent)

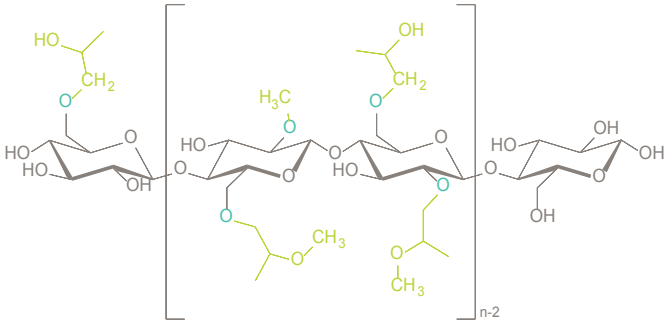
Benecel™ MC

Methylcellulose (MC)



Culminal™ and Benecel™ MHPC

Methylhydroxypropylcellulose (MHPC)



Designed for use as water retention aids, thickening and film-forming agents, protective colloids, and suspending and emulsifying agents. Thermo-gelling properties (temperature lower than MHPC and MHEC).

physical properties

Grade	Viscosity[1]	Substitution[2] OCH_3
Benecel A4C	415–535	High
Benecel A15C	1,475–1,850	High
Benecel A4M	3,350–4,350	High

[1]2% Brookfield RVT (mPas)/20 °C
[2]Amount of substitutents in %

culminal™ MC

Methylcellulose (MC)

physical properties

Grade	Viscosity[1]	Substitution[2] OCH_3	EOOH
Culminal MC2000S	2,100–2,900	High	Low
Culminal MC3000P	3,500–4,700	High	Low

[1]2% Brookfield RVT (mPas)/20 °C
[2]Amount of substitutents in %

Designed for use as adhesives, binders, extrusion aids, plasticizers, protective colloids, rheology modifiers, stabilization agents, thickeners and water-retention agents. Thermo- gelling properties depending on the substitution pattern.

physical properties

Grade	Viscosity[1]	Substitution[2] OCH_3	POOH
Culminal MHPC400R	400-550	High	Low
Culminal MHPC500PF	400-600	High	Low
Culminal MHPC3000P1R	3,500-4,700	High	Low
Culminal MHPC724	15,000-22,000	High	Medium
Culminal MHPC20000P	20,000-27,500	High	Low
Culminal MHPC20000R	20,000-27,500	High	Low
Culminal MHPC20000S	20,000-27,500	Very high	Low
Benecel E4M	3,075-5,175	High	High
Benecel E10M	5,700-7,800	High	High
Benecel K4M	3,350-4,350	Low	High
Benecel K15M	8,600-12,500	Low	High
Benecel K35M	14,700-25,000	Low	High
Benecel K100M	28,500-40,500	Low	High
Benecel K200M	50,000-73,000	Low	High

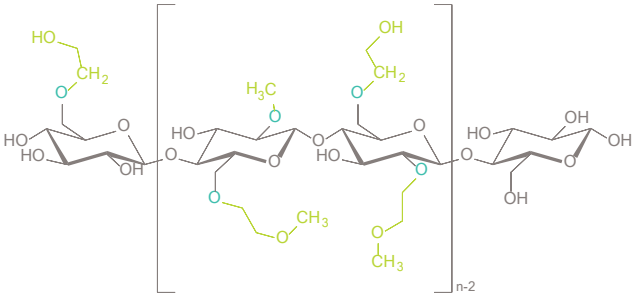
[1]2% Brookfield RVT (mPas)/20 °C
[2]Amount of substitutents in %

performance polymers

cellulose derivatives

Culminal™ and Benecel™ MHEC

Methylhydroxyethylcellulose (MHEC)



Designed for use as adhesives, binders, extrusion aids, plasticizers, protective colloids, rheology modifiers, stabilization agents, thickeners and water-retention agents. Thermo-gelling properties depending on the substitution pattern (higher than MHPCs).

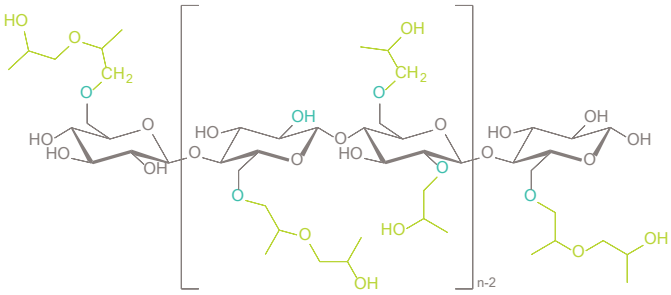
physical properties

Grade	Viscosity[1]	Substitution[2] OCH_3	EOOH
Culminal MHEC6000PFS	6,500–8,000	Low	High
Culminal MHEC6000PR	6,500–8,000	High	Low
Culminal MHEC8000	8,500–11,500	Low	High
Culminal MHEC15000PFF	18,000–24,000	Low	High
Culminal MHEC15000PFR	15,000–20,500	Low	High
Culminal MHEC15000PFS	12,750–17,250	Low	High
Culminal MHEC25000PFF	26,000–34,000	Low	High
Culminal MHEC35000P1R	35,000–48,000	Low	High
Culminal MHEC40000PF	38,000–51,500	Low	High
Culminal MHEC70000PF	65,000–85,000	Low	High
Benecel ME 233P	3,600–5,800	Low	Low

[1]2% Brookfield RVT (mPas)
[2]Amount of substitutents in %

hydroxypropylcellulose (HPC)

Klucel™



chemistry

Klucel HPC is a nonionic water-soluble cellulose ether with a unique combination of properties, soluble in cold water and polar organic solvents, surface active, forms films of exceptional flexibility without addition of plasticizers and is a thermoplastic polymer that can be extruded or injection molded.

applications

- printing and inks (lithography – alcohol replacement water and solvent inks – thickener)
- suspension polymerization (pvc secondary protective colloid, controls porosity)
- injection molding (formation of intricate parts, binder for filler or active material)
- ceramics (processing aid, water retention, green body strength)
- tobacco (binder, film former, processing aid for reconstituted tobacco)
- paint removers (thickener, retard solvent loss, cling on vertical surface)
- adhesives (solvent-based systems or hot melts)
- encapsulation (stabilizer, wall-forming polymer)

physical properties

Klucel Grade	Brookfield LVT Range (mPas)	Viscosity at 25 °C conc (%)
E	250–800	10
L	65–175	5
J	125–450	5
G	125–400	2
M	3,500–7,500	2
H	1,275–3,500	1
MS	4,000 –7,000	2

chemistry

Hydroxypropylcellulose is manufactured by reacting alkali cellulose with propylene oxide at elevated temperatures and pressures. The propylene oxide can be substituted on the cellulose through an ether linkage at the three reactive hydroxyls present on each anhydroglucose monomer unit of the cellulose chain. Published information suggests that etherification takes place in such a way that hydroxypropyl substituent groups contain almost entirely secondary hydroxyls. The secondary hydroxyl present in a side chain is available for further reaction with the oxide, and chaining out may take place. This results in formation of side chains containing more than one mole of combined propylene oxide.

solvent compatibility

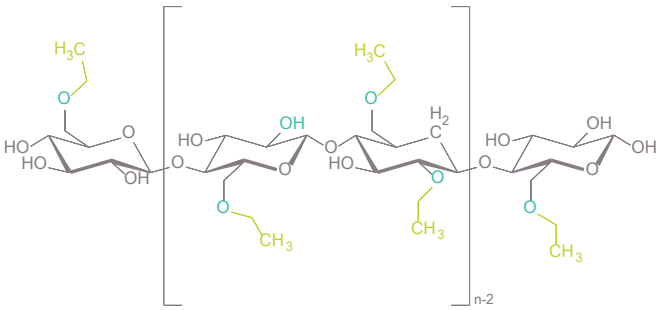
Solvents were tested using G viscosity types at 2% solids concentration by weight. All ratios indicated in this table are on a by-weight basis.

Clear and Smooth	
Acetic acid (glacial)	Isopropyl alcohol (95%)
Acetone: water (9:1)	Methanol
Benzene: methanol (1:1)	Methyl Cellosolve™
Cellosolve™	Methylene chloride: methanol (9:1)
Chloroform	Morpholine
Cyclohexanone	M-Pyrol™
Dimethyl formamide	Propylene glycol
Dimethyl sulfoxide	Pyridine
Dioxane	t-Butanol: water (9:1)
Ethyl alcohol	Tetrahydrofuran
Ethylene chlorohydrin	Toluene: ethanol (3:2)
Formic acid (88%)	Water
Glycerin: water (3:7)	
Moderately Granular and/or Hazy	
Acetone	Methyl acetate
Butyl acetate	Methyl ethyl ketone
Butyl Cellosolve™	Methylene chloride
Cyclohexanol	Naphtha: ethanol (1:1)
Isopropyl alcohol (99%)	Tertiary butanol
Lactic acid	Xylene: isopropyl alcohol (1:3)
Insoluble	
Aliphatic hydrocarbons	Methyl chloroform
Benzene	Mineral oil
Carbon tetrachloride	Soybean oil
Dichlorobenzene	Toluene
Kerosene	Gasoline
Trichloroethylene	Glycerin
Xylene	Linseed oil

cellulose derivatives

ethylcellulose (EC)

Aqualon™ EC



Aqualon EC is a cellulose ether distinguished by its versatility. As a unique product with wide-ranging solvent solubility and film flexibility at low temperatures, ethylcellulose is frequently used in electronics in addition to a variety of other applications. EC provides high solution clarity, good thermal stability and even burnout and has very low decomposition temperatures.

Aqualon EC is a key binder for gravure printing inks as well as a thickening binder in flexographic and screen printing inks. In these applications, Aqualon EC polymers provide scuff resistance, adhesion, fast solvent release, film formation and outstanding rheology control.

Aqualon EC is soluble in a wide range of organic solvents, but is not water-soluble.

applications

- electronics (binder, film former, rheology modifier, thickener); solar cells, plasma display panels, circuits
- packaging, converting and printing (binder, film former, rheology modifier, thickener); inks
- coatings (thickener, film former); specialty, glass conductive
- adhesives (rheology modifier, adhesion, flexibility); solvent-based adhesives, hot melts
- pigments (rheology modifier, binder, colloid); solvent-based slurries
- wood finishing (rheology modifier, hardness, low-water pickups, low ash); lacquers, varnishes
- plastics (handling, toughness); thermoplastics
- inks (film former, rheology binder); solvent-based inks, printed circuit boards

physical properties

Viscosity Types[1] Designation	Ethoxyl Grade[2] and Ethoxyl Percent			
	Limits (cps)	N-Grade 48.0-49.5	T-Grade 49.6-51.5	X-Grade 50.3-53.8
4	3.0–5.5	X	—	—
7	5.6–8.0	X	—	—
10	8–11	X	X	—
14	12–16	X	—	—
20/22	18–24	X	—	X[3]
50	40–52	X	X	—
100	80–105	X	X	—
200	150–250	X	X	—
300	250–350	X	X	—

[1]5% solution at 25 °C. Viscosity is determined in 80:20 toluene:ethanol by weight on oven-dried EC sample
[2]Types produced are designated X
[3]Viscosity is 18–35 cP

chemistry

Ethylcellulose is a cellulose ether made by the reaction of ethyl chloride with alkali cellulose, as expressed by the reaction RONa + C_2H_5Cl ROC_2H_5 + NaCl, where R represents the cellulose moiety. The structure for the cellulose molecule is a chain of ß anhydroglucose units joined together by acetal linkages. This is indicated in the figure above. These long, oxygen-linked anhydroglucose-unit chains have great strength, which is passed on to cellulose derivatives such as ethylcellulose. The properties of flexibility and toughness in these derivatives are directly attributable to this long-chain structure. The commercial product has a substitution value between 2.46 and 2.70 ethoxyl groups per anhydroglucose unit, or 48–52% ethoxyl content.

water-soluble polymers

Ambergum™ water-soluble polymers

Ambergum water-soluble polymers are low molecular weight cellulose polymers supplied as either powder or aqueous solution. They provide viscosity control and wetting uniformity. In addition, the anionic versions of Ambergum water-soluble polymers show dispersion properties useful in many applications to stabilize particles.

applications

- Lithographic fountain solutions: Ambergum water-soluble polymers are a cost-effective alternative to gum arabic to provide clean viscosity control and unique rheology in gumming and fountain solutions. They function as wetting agents and can replace isopropyl alcohol in some systems. Ambergum water-soluble polymers are produced from reliable and stable raw material sources. When used in fountain solutions, they can help prevent emulsification and bleeding of the ink and can provide more uniform wetting of the printing plate.
- Civil engineering: Ambergum 1221 water-soluble polymer provides rheology control and enhances fluid loss control when used with bentonite in tunneling and drilling applications.

physical properties

Grade	Charge	Physical State	% Actives
Ambergum 1221	Anionic	Free flowing prowder	100
Ambergum 3021	Anionic	Pale amber liquid	30
Ambergum 3085	Nonionic	Pale yellow-green liquid	40

Soteras™ MSi lithium ion battery anode binder

Soteras™ MSi is a novel anode binder specifically for use with silicon to increase the capacity of lithium ion batteries by as much as 30 percent.

It is a two component system for aqueous processing using standard industry practices. Suggested dosage is 2.5-5wt% of anode active material, depending on target capacity. The recommended ratio for the two components is 95% Soteras™ MSi-A to 5% Soteras™ MSi-B Soteras™ MSi controls swelling, resulting in superior cycle performance at capacities greater than 400 mAh/g when used with silicon oxide (SiOx), silicon composite (SiC), silicon oxide composite (SiOxC), or silicon graphene (Si-Gr) technologies.

Furthermore, Soteras MSi provides good adhesion to the current collector and demonstrates improved performance at high charge rates.

physical properties

Grade	Appearance	Viscosity	pH	% moisture
Soteras MSI-A	White powder	7,000–11,000 (2% solution)	6.5–8.5	10 max.
Soteras MSI-B	Clear liquid	1,550–21,500 (100% solution)	NA	NA

water-soluble polymers

Admiral™, Liberty™ and Natrosol™

Fluidized Polymer Suspensions (FPS)

Ashland offers a series of fluidized polymer suspensions (FPS) of hydroxyethylcellulose (HEC) and carboxymethylcellulose (CMC) that are easily dispersed and dissolved in cold or hot water to produce solutions of varying viscosities. Ashland FPS formulations vary in active content from 15 to 45%. Hydroxyethylcellulose and carboxymethylcellulose FPS suspensions are used as fluid rheology modifiers, fluid loss reducers, suspending agents or lubricants, particularly in applications where powdered products cannot be handled.

benefits

- easy to handle and meter
- low viscosity, pumpable
- quick and complete dissolution
- eliminates filtration problems
- addition of higher MW polymers

physical properties of example FPS grades

Grade	Cellulose base	Carrier	MW
Admiral MO1030	CMC	Oil	High
Natrosol 250 MHB FPS	HEC	Water	Medium
Natrosol Liquid MR	HEC	Oil	Medium
Polymer Slurry SC-50™	CMC	Oil	High

applications

- drilling muds/civil engineering
- paper coatings
- cement slurries
- completion/workover fluids
- spacers/flushers
- gravel packing
- cuttings injection

AquaVIS™

AquaVIS is a special product series for dedicated civil engineering applications. Ashland's water-soluble polymers are used extensively as additives in these applications to boost the performance of bentonite through water retention, stabilization of the mud suspension and increased shear thinning (increased pumpability).

functions

Filtration rate control—reduces api filtration rate of:

- low solids muds/flocculated systems/contaminated muds

Improves filter cake characteristics by:

- reducing wall cake thickness, increasing cake toughness/increasing cake lubricity
- improves support of the wall or of the working face by application of a uniform hydrostatic pressure
- protective colloid

Inhibits the swelling and disintegration of:

- cuttings/shales and claystones, water sensitive solids, rheology control (viscosity, yield point and gels)

Increases and improves rheology of:

- low solids muds
- solids free brine waters
- native muds
- stabilizes the fluid rheology in the presence of contaminants
- lubrication/friction reduction

Reduces friction during the operation:

- lubricates solids in the system
- improves wall cake characteristics
- reduces the potential of stuck cutting knife
- reduces the rotation torque of the tunneling machine

	AquaVIS 633	AquaVIS HYB 4706	AquaVIS R2E	Rapifloc™ A1MG
Viscosity	> 3000 cPs at 1%	> 5000 cPs at 1%	> 5000 cPs at 1%	
Primary Functions	Rheology control	Rheology control	Rheology control	Rheology control
Secondary Functions	Fluid loss control Protective colloid Bentonite extender			Bentonite extender Shale inhibition
Applications	Special foundations—Diaphragm walling/piling Tunneling Water well drilling			

performance polymers

specialty chemicals

overview

ultraviolet absorbers

The Escalol™ family of UV absorbers are high-boiling, water insoluble liquid esters with broad absorption in the UV radiation region depending on the product (250 to 360 nm).

carbonyl iron powder

Micropowder™ iron powders are characterized as fine, high-purity, micron-size spherical particles with superior electronic and magnetic properties.

foam control agents

Drewplus™ defoamers comprise a range of proprietary products that effectively control foam and entrained air in industrial processes and wastewater systems.

In addition to collapsing or breaking down existing foam, the products remain on the water's surface to prevent the formation of future foam. Ashland offers a range of highly efficient, hydrocarbon-, vegetable oil-, polysiloxane- and polyglycol-based antifoaming agents.

rheology modifiers

Aquaflow™ nonionic synthetic associative thickeners (NSATs) are efficient thickeners for high-performance waterborne formulations, adhesives and specialty coatings. These easy-to-handle liquids build rheology through self- association and interaction with other ingredients. Aquaflow rheology modifiers are based on hydrophobically modified polyacetalpolyether (HM-PAPE) chemistry and are designed to function as drop-in replacements for urethane-type (HEUR) thickeners.

UV absorber

Escalol™ UV filters

Ashland offers a number of UV absorbers for industrial applications under the Escalol trademark. The three octyl- esters, Escalol 557, 587 and 597 UV absorbers, are high- boiling, water-insoluble liquids, have strong and broad absorption in the UV-B region between 290–320 nm and refractive indices in the range of 1.50-1.55. The benzophenone derivatives, Escalol 567 and 577 UV absorber, are solids also having absorbance in the UV-B region.

physical properties

Grade	Chemical Name	Boiling or Melting point
507	2-Ethylhexyl-pdimethylaminobenzoate	Bp 362 °C
517	1-(4-Methoxyphenyl)-3-(4-terbutylphenyl) propan-1,3-dione	Mp -81-86 °C
557	2-Ethylhexyl-p methoxycinnamate	Bp 198-200 °C
567	2-Hydroxy-4-methoxybenzophenone	Mp 62 °C min.
577	5-Benzoyl-4-hydroxy-2-methoxybenzene sulfonic acid	Mp >120 °C
587	2-Ethylhexyl salicylate	Bp 150 °C at 3 mmHg
597	2-Ethylhexyl 2-cyano-3,3-diphenylacrylate	Bp 218 °C at 1.5 mmHg
HMS	Homosalate	
S[1]	2,2-[6-(4-methoxyphenyl)-1,3,5-triazine-2,4-diyl] bis {5-[(2-ethylhexyl)oxy]phenol}	Mp–80 °C

[1]Material is not listed on the US EPA TSCA inventory

pH neutralizing additive

pHLEX™

pHLEX neutralizing additive is a proprietary organoamine blend that raises pH and provides buffering effects to waterborne paints and coatings. It is designed as a functional drop-in replacement that is an economic alternative to other common amine-based neutralizers, but also offers a low-odor stabilizing alternative to ammonia, NaOH and other common bases.

pHLEX neutralizing additive also offers reduced VOC compared to other organoamine neutralizers and lower odor levels for in-plant handling benefits.

product benefits

- effective ph neutralizer
- provides ph stability over time
- inhibits metal corrosion
- helps prevent flash rusting
- lower odor product for handling and manufacturing
- can reduce odor of waterborne formulations
- can reduce demand of anionic dispersant

physical properties

Grade	Appearance	Viscosity (cps)	Specific gravity at 25 °C	pH (1.0 wt% solution)
pHLEX 400	Clear to light yellow liquid	~15	1.052	11–11.5
pHLEX 410	Clear to light yellow liquid	~15	1.055	11–11.5

carbonyl iron powder (CIP)

Micropowder™ iron

applications

CIP is manufactured by the chemical de- composition of iron pentacarbonyl. The resulting iron particles are uniform gray microscopic spheres with only traces of carbon, oxygen and nitrogen. Over 25 different grades of iron powder are manufactured through this process and marketed under the trade name Micropowder. Specific applications include:

- radar absorbing materials (RAM)
- precision electronic cores
- electromagnetic interference shielding products (EMI/RF)
- metal injection molding (MIM)
- high-performance powder metallurgy products
- magnetic fluids
- halogen solvent waste remediation

physical properties

The fine size and high purity of the carbonyl iron powders are the principal reasons for their superior properties compared to other forms of elemental iron powders. Distinct characteristics of the Micropowder Iron products include:

- very fine spherical size
- submicron to 10 micron particle diameter
- high purity with up to 99.5% iron content
- unique onionskin structure with cubic crystalline lattice
- superior electromagnetic properties
- uniform particle size distribution

chemistry

In terms of fundamental properties, there are two product families, the "S" grades and "R" grades. The S grades are standard iron grades with a purity level of approximately 97.5%. The impurity is comprised of carbon, oxygen and nitrogen and is the cause of the iron particle's unique onionskin structure. R grades are higher purity iron grades with an average purity of 99.5%. Through a hydrogen reduction process, most of the residual carbon and nitrogen have been removed from the iron particle, producing a higher purity iron grade that is lower in durometer hardness and lacking the unique onionskin structure.

Carbonyl Iron Grades	Properties			Applications		
	Average Diameter (Microns)	% Iron	Additive	Powder Metallurgy	Electronics	Electronics Aerospace & Defense
S-1000	7–9	>97	No Silica	X		
S-1100	4–6	>97	No Silica	X		
S-1281	4–6	>97	Silica			
S-1640	3–5	>97	No Silica	X		
S-1641	3–5	>97	Silica	X		
S-1651	3–5	>97	Silica		X	
S-2101	2–4	>97	Silica		X	
S-2701	2–4	>97	Silica	X		
S-3000	1–3	>98	No Silica		X	
S-3001	1–3	>97	Silica		X	
S-3700	1–3	>97	No Silica	X		
S-5000	6–7	>97	No Silica			X
S-5641	3.4–5.0	>97	Silica			X
R-1470	5–8	>99.5	No Silica	X		
R-1480	7–9	>99.5	No Silica		X	
R-1511	4–6	>98.5	Silica		X	
R-1521	4–6	>98.5	Silica	X		
R-2410	4–7	>99.5	No Silica	X		
R-2430	4–6	>99.5	No Silica	X		
MIL-E	3.3–5.7	>97	Silica			X

foam control agents

Drewplus™ defoamers

Ashland's foam control agents are economical to use and versatile. They have been developed for use in a variety of water-based industrial applications to provide superior anti- foam performance activity and compatibility. They are readily dispersible, provide excellent long-term foam control persistency, highly effective on entrained, surface macro-foam and micro-foam, and offered in a wide range of chemistries (silica, silicone, organophically modified silicones, mineral oil, wax, etc.).

Drewplus™ foam control agents are widely used for industrially applied coatings for various substrates. Drewplus technologies are tailored for optimal performance in spray, curtain, vacumat or flow-coating processes.

Drewplus products provide excellent foam control in water- based (gravure) coater-ready pressure-sensitive adhesive and other specialty applications.

Below list represents the most recommended types. For regulatory information please contact us.

key benefits

Industrial Coatings

- suitable for clear and pigmented coating systems
- excellent balance of compatibility and defoaming activity
- prevents both macro- and micro-foam

Polymerization

- reduces risk of agglomeration and helps maintain desired particle size distribution
- effective in a wide range of polymer dispersions
- self-emulsifying characteristics enable pre-dilution with water, optimizing handling and dosing

Adhesives

- delivers micro-foam control even at high coating speeds
- preserves desired tack and peel properties, as well as clarity and transparency of the dry adhesive

Application	Detailed area of use	Oil-Based	Polysiloxane- and Polymer-Based
General Industry	General	L-1700; T-1201-E; T-2200; T-3211	S-4287; 210-862; TS-4385; TS-4387
Metal Coatings	Anti-Corrosion Primers	T-4201-E	210-886; S-4480; TS-4481; TS-4384; TS-4385
	Basecoats		210-886; S-4480; TS-4481; TS-4384; TS-4385
	Topcoats		210-886; S-4480; TS-4481
Plastic Coatings	Primer		S-4288; S-4287; S-4386; 210-886; S-4374; S-4480
	Topcoat		S-4288; S-4287; S-4386; 210-886; S-4374; S-4480
Graphic Arts	Pigment Dispersions	L-1700	S-4386; S-4480; TS-4481; 210-862; TS-4387; TS-4582
	Inks (Flexo; Screen; OPV)	T-4201-E; T-4202-E; T-4303	S-4386; S-4480; TS-4481; 210-862; S-4273; TS-4387; TS-4582
	Inks (Gravure)		S-4480; TS-4481; 210-862
	Fountain Solutions		S-4273
Adhesives	PSA, Natural, Synthetic	T-3200; T-3211	TS-4582
	PVA-based	T-1201-E; T-3211	
Polymerization Process	(X)-SBR	T-2200; T-3200; T-4202-E	210-886
	Dispersion PVC, PUR	T-3200	
	Emulsion PVC/PVDC; ABS/ SAN; PVA; Acrylic	T-2200; T-3200	210-886
Other	Powder Defoamer: Silipur RV2971; Drew RE5500; Drew210-871		

hydrophobically modified polyacetal-polyethers

Aquaflow™

Aquaflow rheology modifiers are nonionic synthetic associative thickeners. Thickening results from self-association and association with the latex particles. They are surface active, stable over a broad pH range (4-12), and more salt tolerant than commercial HEURs (hydrophobe-modified ethoxylated urethanes). The Aquaflow product line contains both highshear and low-shear nonionic thickeners.

applications

- water-based adhesives
- water-based inks
- water-based latexes

chemistry

Aquaflow polymers have poly(acetal- or ketal-polyether) backbones that are either linear or branched. The polyethers (as precursors for the final polymer) are water- soluble polyalkylene oxide or copolymers of polyalkylene oxides. The hydrophobes are chosen to balance rheological properties and hydrophobic/ hydrophilic interactions.

Physical properties

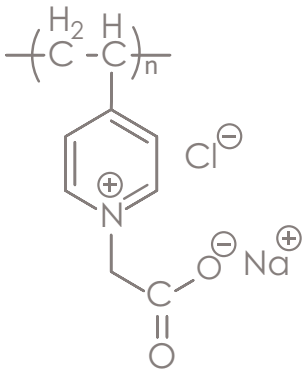
Aquaflow™ product	shear effect BF KU ICI	active solids %	solvent free?	value
XLS-500E XLS-525E		25% 20%	yes yes	• improved sag/leveling balance • increased brookfield viscosity
XLS-530E		20%	yes	• improved sag/leveling balance • increased brookfield viscosity
NLS-210		25%	no	• low and mid-shear effective
NLS-200 NLS-220E		25% 20%	no yes	• original Aquaflow™ KU builder • excellent flow and leveling
NMS-460E		27%	yes	• balance of KU & ICI viscosity, true mid-shear rheology modifier
NMS-450E		19%	yes	• balance of KU & ICI viscosity • efficient high-shear driver in difficult-to-thicken latex systems
NHS-350E		17.5%	yes	• high-shear effiective with sime KU build • excellent application properties
NHS-300E NHS-360*		20% 20%	yes yes	• Aquaflow™ ICI builders

* Aquaflow NHS-360 may act, depending on the paint system, as a mid/high NSAT

specialty chemicals

dye-complexing polymer

Chromabond™ S-100



applications

- dye transfer inhibitors

physical properties

Properties	Chromabond polymers
Physical form	Aqueous solution
% Solids	38–42%
Viscosity	850 cP
Molecular weight	35,000
pH (5% solution)	4–7

chemistry

Chromabond polymer contains betaine functionalities. Chromabond dye-complexing polymer is a premium dye transfer inhibitor (DTI), developed and used in color-safe laundry detergents. Chromabond polymer demonstrates superior complexing of fugitive dyes at cost-effective levels under different temperatures and surfactant environments. Its chemical structure promotes dye complexation up to 60 °C, while resisting interaction with anionic surfactants. Chromabond polymer is soluble in water and water-alcohol mixtures but insoluble in most other solvents.

polyethylene glycol polyester copolymer

Sorez™ 100 copolymer

applications

Soil release agent in textile detergents, fabric softeners and pre- and post-wash stain removers

physical properties

Properties	Chromabond polymers
Physical form	Slightly turbid amber liquid
% Solids	75-77%

chemistry

A modified polyester copolymer concentrate in water-soluble form. The product imparts wicking properties to hydrophobic textiles. It provides soil release and anti-redeposition properties while reducing the electrostatic charge of treated polyester. The polymer forms a thin film on the substrate, enabling effective soil removal during subsequent wash cycles.

specialty chemicals

chemical/product trade name cross-reference

Chemical Name	Ashland Brand
2-Pyrol™ (2-Pyrrolidone)	γ-butyrolactam
Acrylate polymer sodium salt	RheoThix™ 601, Rapifloc A1-MG
Acrylic acid homopolymers and copolymers	Jaypol™, Carbomer
Acrylic acid/VP crosspolymer	UltraThix™
BLO™ / GBL (gamma-butyrolactone)	1-oxa-cyclopentan-2-on
Butanediol	1,4-butanediol
Carbonyl iron powders	Micropowder™ Iron
Carboxymethylcellulose	Blanose™
CHP™ Solvent	N-cyclohexyl-2-pyrrolidone
Esters and hydroxyesters	Ceraphyl™, Cerasynt™
Ethylcellulose	Aqualon™ EC
Foam Control (defoamers and anti-foam)	Drewplus™
HEP™ Solvent	N-hydroxyethyl-2-pyrrolidone
Hydrophobically modified polyacetal-polyethers	Aquaflow™
Hydroxyethylcellulose	Natrosol™
Hydrophobically modified hydroxyethylcellulose	Natrosol Plus
Hydroxypropylcellulose	Klucel™
Isobutylene/maleic anhydride copolymer	I-Rez™
Isobutylene/ethylmaleimide/hydroxyethylmaleimide copolymer	Aquaflex™
M-Pyrol™ (NMP)	N-methyl-2-pyrrolidon
Methylcellulose	Culminal™, Benecel™
Methylhydroxyethylcellulose	Culminal, Benecel
Methylhydroxypropylcellulose	Culminal, Benecel
Methylvinylether/maleic anhydride copolymer	Gantrez™ AN
Methylvinylether/maleic acid copolymer	Gantrez S
Methylvinylether/maleic acid half esters copolymer	Gantrez ES
N-dodecyl-2-pyrrolidone	Surfadone™ LP-300
N-octyl-2-pyrrolidone (NOP)	Surfadone LP-100
Polyethylene glycol polyester copolymer	Sorez™ 100
Poly (methylvinylether/maleic anhydride decadiene) crosspolymer	Stabileze™ QM polymer
Polyvinylpolypyrrolidone	PVP
Polyvinylpyrrolidone alkylated	Ganex™/Antaron™
Polyvinylpyrrolidone/polystyrene	Polectron™/Antara™
Polyvinylpolypyrrolidone (PVPP)	ViviPrint, Disintex™, PolyClar™
Pyridine, 4-ethenyl-, homopolymer, sodium chloroacetate quaternized	Chromabond™
Surfactants, emulsifiers, wetting agents	Easy-Wet™, Dextrol™, Strodex™, Surfadone
THF (Tetrahydrofuran)	1,4-epoxybutan
Ultraviolet absorbers	Escalol™
Vinyl caprolactam (VCP)	V-Cap™
Vinylpyrrolidone (NVP)	V-Pyrol™
Vinylpyrrolidone/vinyl acetate copolymers	PVP/VA polymers
Vinylpyrrolidone/dimethylaminoethylmethacrylate	Sorez™, Gafquat™
Vinylpyrrolidone/dimethylaminopropylmethacrylamide copolymer	Styleze™, ViviPrint, Setleze™
Vinylpyrrolidone/methacrylamidopropyl trimethylammonium chloride	Gafquat
Vinylpyrrolidone/dimethylaminopropylmethacrylamide/ methacryloylaminopropyllauryl dimethyl ammonium chloride terpolymer	Styleze
Vinylpyrrolidone/acrylic acid/lauryl methacrylate terpolymer	Styleze, Acrylidone™
Vinylpyrrolidone/vinylcaprolactam/dimethylaminoethylmethacrylate terpolymer	Gaffix™
Vinylpyrrolidone/vinylcaprolactam copolymer	Inhibex™
Vinyl caprolactam/vinylpyrrolidone/dimethylaminopropylmethacrylamide terpolymer	Aquaflex™
Vinylpyrrolidone/vinyl caprolactam/dimethylaminopropylmethacrylamide and methacryloylaminopropyl lauryl dimethyl ammonium chloride tetrapolymer	Aquastyle™

product index

products by property

adhesive
PVP, PVP/VA, Gaffix, Aquaflex, Aquastyle, RheoThix, Gantrez, Jaypol, Blanose, Natrosol, Aqualon EC, Klucel, Culminal, Benecel

anti-agglomerant
Rapifloc

anti-soil redeposition
PVP, Sorez, Gantrez, Jaypol, Blanose

anti-static
Gafquat

binder
PVP, PVP/VA, Gantrez, Blanose, Natrosol, Klucel, Culminal, Benecel

bio-adhesive
Gantrez, Klucel

chemical intermediate
V-Pyrol, V-Cap, Gantrez

cohesive
PVP, PVP/VA, Polectron/Antara, Gafquat, Gaffix, Aquaflex, Aquastyle, RheoThix, Gantrez, Blanose, Natrosol, Aqualon EC, Klucel, Culminal, Benecel

complexes
PVP, Sorez, Jaypol, Blanose

corrosion inhibitor
Dextrol, Strodex, PVPP, Gantrez, pHLEX

cross-linker
PVP, Gafquat, Styleze, Gantrez, Natrosol, Blanose, Aqualon EC, Klucel

crystal inhibitor
PVP, Antaron/Ganex, Gaffix, Jaypol

defoamer
Drewplus

detergent
Surfadone, Easy-Wet, Dextrol, Strodex, Gantrez, Blanose, Natrosol, Ceraphyl, Cerasynt

disintegrant
Disintex, Aquasorb

dispersant
Surfadone, Dextrol, Strodex, PVP, PVP/VA, Sorez, Gantrez, Jaypol, Blanose, Ambergum, Ceraphyl

dye fixative
Gafquat, Chromabond

dye transfer inhibitor
PVP

emulsifier
Surfadone, Easy-Wet, Dextrol, Strodex, Antaron/Ganex, Ambergum, Ceraphyl, Cerasynt

encapsulation
Gantrez

film former
PVP, Antaron/Ganex, PVP/VA, Polectron/Antara, Gafquat, Styleze, Acrylidone, Gaffix, Aquaflex, Aquastyle, Gantrez, Jaypol, Blanose, Natrosol, Aqualon EC, Klucel, Culminal, Benecel, Ambergum

flexible film former
Gaffix, Aquaflex, Aquastyle, Klucel

flocculant
Jaypol, Blanose

flow controller
RheoThix, Blanose

fluid loss additive
Blanose

activity inhibitor
PVP, Gaffix, pHLEX, Drewplus

lubricant
Dextrol, Strodex, PVP, Antaron/Ganex, RheoThix, Blanose, Natrosol, Culminal, Benecel, Ambergum, Ceraphyl, Cerasynt

metal sequestrant
Gantrez, Jaypol

oil solubility
Antaron/Ganex, Aqualon EC, Escalol, Ceraphyl, Cerasynth

opacifier
Polectron/Antara, Ceraphyl

plasticizer
Butanediol, Surfadone, Ceraphyl

rheology modifier
PVP, PVP/VA, Acrylidone, UltraThix, RheoThix, Aquaflow, Gantrez, Jaypol, Rapifloc, Blanose, Natrosol, Aqualon EC, Klucel, Culminal, Benecel, Ambergum

sizing agent
Blanose

soil release agent
Sorez, Blanose

solvent
Surfadone, V-Pyrol, V-Cap, PVP, Aqualon EC, Klucel, Ceraphyl, THF, HEP, CHP, M-Pyrol, 2-Pyrol, BLO

stabilizes
PVP, Blanose, Natrosol, Klucel, Culminal, Benecel, Ambergum

substantitive
Gafquat, Styleze, Acrylidone, Gaffix, Aquaflex

surface active
Surfadone, Easy-Wet, Dextrol, Strodex, Antaron/Ganex, Acrylidone, Gaffix, Klucel, Ambergum, Ceraphyl, Cerasynt, Drewplus

suspending agent
UltraThix, RheoThix, Gantrez, Jaypol, Blanose, Natrosol, Klucel, Culminal, Benecel

tack modifier
PVP, PVP/VA

thermoplastic
PVP/VA, Aqualon EC, Klucel, Culminal

thickener
PVP, UltraThix, Aquaflow, Gantrez, Jaypol, Rapifloc, Carbomer, Blanose, Natrosol, Aqualon EC, Klucel, Culminal, Benecel, Ambergum

UV absorber/potector
Escalol

UV coater
V-Pyrol, V-Cap

water resistor
Antaron/Ganex, Acrylidone, Aqualon EC

water-holding
Blanose, Natrosol, Klucel, Culminal, Benecel,

wax inhibitor
Antaron/Ganex

products by application

adhesives
Surfadone, Dextrol, Strodex, V-Pyrol, V-Cap, Drewplus, PVP, PVP/VA, Polectron/Antara, Gafquat, RheoThix, Gantrez, Jaypol, Rapifloc, Blanose, Natrosol, Aqualon EC, Klucel, Culminal, Benecel

advanced ceramics/ceramics
Drewplus, PVP, Blanose, Natrosol, Klucel, Culminal, Benecel

batteries
PVP, Blanose, Soteras

cables
Blanose

civil engineering
Rapifloc, Blanose, AquaVis, Natrosol

electronics
Surfadone, V-Pyrol, PVP, PVP/VA, Gantrez, Aqualon EC, Klucel, Culminal, Benecel

emulsions
Dextrol, V-Pyrol, Drewplus, PVP, Natrosol, Klucel

explosives
Blanose, Culminal

inks and printing
Surfadone, Easy-Wet, Dextrol, Strodex, V-Pyrol, V-Cap, pHLEX, Escalol, Drewplus, PVP, Antaron/Ganex, PVP/VA, Polectron/Antara, Gafquat, Gaffix, Aquaflow, Gantrez, Jaypol, Rapifloc, Blanose, Natrosol, Aqualon EC, Klucel, Culminal, Benecel

membranes
PVP, PVP/VA, Gafquat, Acrylidone, Gaffix

metal processing
Surfadone, Easy-Wet 20, Dextrol, Strodex, pHLEX, Cerasynt, Drewplus, PVP, Setleze, Ulrathix, Sorez, Jaypol, Blanose

mineral slurries
Dextrol, Strodex, Jaypol, Rapifloc, Blanose, Natrosol

mining
Rapifloc, Culminal, Blanose

paint removers
Klucel, Culminal, Natrosol

paper coatings
Drewplus, PVP, Disintex, Gafquat, Blanose, Natrosol, Culminal

plastics
Surfadone, Ceraphyl, Klucel

pulp and paper
Drewplus, Blanose

refinery additives
Surfadone, V-Pyrol

specialty coatings
Easy-Wet 20, Dextrol, Strodex, V-Pyrol, V-Cap, pHLEX, Escalol, Drewplus

suspension polymerization
Drewplus, PVP, Natrosol, Culminal, Benecel

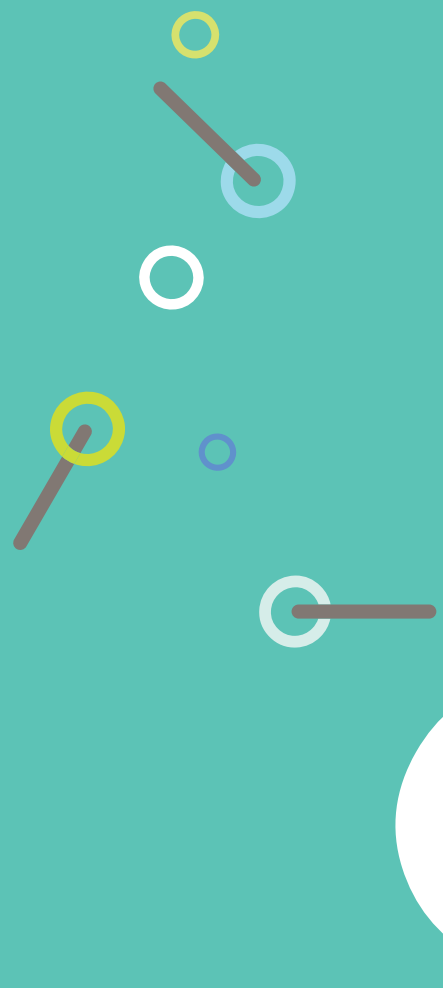
textiles and leather
Drewplus, PVP, Sorez, Chromabond, Blanose,

tissues and towels
Blanose

tobacco
Blanose, Aqualon EC, Klucel, Natrosol, Culminal, Benecel

welding rods
Blanose, Natrosol

always solving™



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