



Westlake Chemical Corporation

***EPOLENE®* Polymers**

Westlake Chemical Corporation offers a series of medium to low molecular weight polyethylene or polypropylene polymers under the Epolene® polymers trade name.

They are useful in the plastics industry as lubricants for PVC, processing aids, mold release agents, dispersion aids, and coupling agents. They are also widely used as base polymers for hot melt adhesives and pavement-stripping compounds as well as petroleum wax modifiers for use in candles, investment casting, cable filling, and various paperboard coatings. Numerous types of Epolene polymers are available, and properties can be selected to fit various processing operations. Many of these polymers meet U.S. FDA food additive regulations for various indirect food contact applications.

Primary Applications

Candles

Using 1%-5% Epolene N-11, N-34, C-10, and C-15 polymers is common to improve shrinkage, mold-release properties, gloss, sheen, opacity, and color dispersion in petroleum wax based candles. These additives are virtually odorless and smokeless when the correct wick size, candle shape, and additive concentration are used, plus with excellent melt and color stability, they can produce brighter, more reproducible colors when compared to stearic acid modified candles. Epolene N-11 and N-34 polymers are suggested when very low melt viscosities are preferred.

Coatings

Epolene polymers are useful as:

- Hot-melt or emulsion coatings on paper, providing high gloss and excellent barrier properties.
- High-gloss emulsion coatings for citrus fruits to maintain freshness and flavor of the fruit by reducing moisture loss and shrinkage.
- Coatings/laminations of paper for packaging materials used in manufacturing spiral-wound fiber drums.
- Components in hot melts for improved durability as compared with paint for marking highway surfaces.

- Temporary protective coatings for metal surfaces.
- Scuff-resistant emulsion coatings for glass bottles.
- Flattening agents for lacquers and enamel paints.
- Ingredients in sprayable herbicide and insecticide formulations for improved wetting and spreading characteristics.

Hot Melt Adhesives

Epolene C-type polymers are useful as base polymers for hot-melt adhesives, producing bonds with low color, low density for high mileage, high char resistance, relatively high elevated temperature resistance, and excellent compatibility with various tackifying resins. Because of its relatively low viscosity and high softening point, Epolene N-21 polymer can be useful as an additive for improving set speed.

Inks

Dispersions and emulsions of Epolene polymers are added to solvent and waterborne inks to improve resistance to rub-off, increase slip to the printed surface, and reduce offset. The emulsions are compatible with many acrylic polymers used in formulating inks for the water-based market.

Paper

As a lubricant for clay coatings applied to paper, Epolene E-type polymers tend to outperform many calcium stearate dispersions by providing increased lubricity during calendaring. Epolene polymer dispersions in clay coatings allow for higher processing speeds, less dusting, and higher gloss.

Personal Care Products

By improving elevated-temperature resistance, chemical resistance, and inertness, Epolene polymers find use in a number of cosmetic and personal care products.

Petroleum Wax Blends

As a paraffin wax modifier in candles and crayons, Epolene polymers provide desirable gloss, sheen, opacity, and good mold release properties. Petroleum wax coating formulations can be modified with Epolene polymers to provide gloss retention, scuff resistance, improved hold-out and, in certain formulations, heat sealability. Specific applications include coatings for corrugated kraft board, folding cartons, carbon paper, and a variety of other paper products.

Plastic Additives

As dispersion aids, Epolene polymers have unique wetting and dispersion characteristics for highly filled compositions and color concentrates. The maleic-anhydride modified Epolene polymers function as coupling agents for many filled or reinforced plastics to improve processability and surface characteristics. These functionalized polymers are also useful as compatibilizers for various polymer alloy systems.

Epolene polymers can be used as external lubricants for rigid and flexible PVC (polyvinyl chloride), including the extrusion of rigid PVC pipe for potable water. As a processing aid for linear low density polyethylene (LLDPE), Epolene N-34 polymer has been found to increase the throughput of LLDPE with conventional extrusion equipment.

Polishes

Epolene E-type polymers are used in a number of polish applications:

- Emulsions based on Epolene E-type polymers may be used in industrial or household liquid floor polishes to improve slip resistance, hardness, scuff resistance, durability, gloss, water resistance, leveling, buffability, and color.
- Epolene E-type polymer emulsions can be added to vinyl car top polishes to improve luster or sheen and for long-lasting protection.
- Small additions of Epolene E-type polymers have been found to impart excellent gloss and film hardness in creamy automobile polishes, which are used in a single application to clean and wax weathered automobile finishes.
- Epolene E-type polymers are used in spray-and-wipe furniture polishes as typically applied using manual, pump-type dispensers to impart excellent luster and serve as a good dusting aid.

Processing Aids

The addition of small amounts of Epolene polymers can substantially improve the processability of many plastics.

Rubber

As a processing aid for nitrile, butyl, SBR, EPDM, and neoprene rubber, Epolene polymers improve mixing of recipe ingredients, help reduce shrinkage, and reduce tackiness during processing.

Textiles

Emulsions based on Epolene E-type polymers are effective as softeners and lubricants for natural and synthetic fibers, improving abrasion resistance, tear resistance, and hand and sewing lubricity.

Physical Properties

Additive Dispersion

Low melt viscosity and good compatibility with a variety of materials enable Epolene polymers to improve the dispersion properties of pigments, fillers, and other additives in a variety of plastics and rubber formulations.

Antiblocking Action

Epolene polymers are added to a variety of coating formulations to prevent parts that are coated with the formula from sticking together.

Barrier Properties

Based on polyolefins, Epolene polymers are resistant to water, grease, and many chemicals. They can be used in hot melts, aqueous emulsions and/or as solution/solvent dispersions.

Color

Most Epolene polymers have very low color (Gardner color scale values in the 1 to 2 range).

Compatibility

Epolene polymers are compatible with many polymers, resins, and natural and synthetic waxes.

Hardness

Penetration hardness values for Epolene polymers range from 0.1 to 7.0 tenths of a mm at 25°C. Epolene polymers tend to retain more hardness at elevated temperatures than most natural and paraffin waxes.

Lubricity

Because of their low coefficient of friction and range of compatibility, Epolene polymers are often added to formulated or compounded materials to improve surface lubricity, slip, and release properties. Epolene E-type polymers are frequently used as external lubricants in the extrusion of rigid PVC for such applications as pipe, siding, and profiles. Epolene C-type and N-type polymers can be used as external lubricants for flexible PVC. Epolene C-type and N-type polymers can be used as lubricants for high density polyethylene as well.

Melt Viscosity

Epolene polymers are available in a broad selection of low, medium, and high viscosities. Each product is manufactured with a narrow viscosity range.

Moisture and Grease Resistance

Epolene polymers are insoluble in water, which results in high moisture resistance. They are also quite resistant to grease and many other chemicals.

Softening Point

Epolene polymers are available with a wide range of softening points ranging from 100° to 163°C.

Solubility

Epolene polymers tend to have limited solubility in solvents and oils at room temperature, but at elevated temperatures, they are soluble to varying degrees. Using cloud point, it has been found that the Epolene E-type polymers tend to be more soluble in aliphatic solvents than the Epolene C-type and N-type polymers,

with the Epolene C-type polymers tend to be more soluble than the Epolene N-type polymers.

Furthermore, the lower density products tend to be more soluble than the higher density products, and the lower molecular weight products tend to be more soluble than the higher molecular weight products. Solubility tends to be best in nonpolar solvents such as toluene, xylene, mineral spirits, and naphtha. They tend to be insoluble in such solvents as n-butyl alcohol, n-propyl acetate, and ethyl alcohol.

Surface Appearance

The addition of Epolene polymers to formulated or compounded plastics can improve gloss and surface appearance of finished products.

Toughness

Epolene polymers are tougher than most natural and many synthetic waxes.

Viscosity Modification

A broad range of Epolene polymers exist with low, medium, and high viscosities, making them excellent viscosity modifiers for plastics, adhesives, elastomers, and natural and synthetic waxes.

Emulsifiable (E-type) Polymers

Epolene E-10 polymer

An oxidized polyethylene developed for water-emulsion floor polishes, Epolene E-10 polymer imparts excellent slip resistance, outstanding toughness, and good durability to polish films. These properties are often apparent at low polymer concentrations, but they are best observed where E-10 comprises 20% or more of the total solids in the polish. It can be used in both atmospheric polymeric wax-to-water and pressure emulsification methods.

Emulsions of E-10 are also used as finishing agents for cotton and synthetic fabrics and as textile softeners in conjunction with wash-and-wear finishing waxes. They are also used as lubricants in clay coatings on paper to reduce dusting during calendering.

Epolene E-14E polymer

Epolene E-14E is oxidized polyethylene polymer that has lower densities and softening points than Epolene E-10. Such properties contribute to their versatility and ease of emulsification in both wax-to-water and pressure emulsification methods.

E-14E has a lower molecular weight than E-10, which allows for more forgiveness in atmospheric emulsification. E-14E is commonly used to impart excellent slip resistance to floor polish films. The best results tend to occur when used in

concentrations of 20% or less solids or in polishes containing both natural and synthetic waxes.

Epolene E-14 polymer

Epolene E-14 in powdered form (Epolene E-14P) is useful as a lubricant in processing rigid and flexible polyvinyl chloride and as a pigment dispersing aid in color concentrates.

Along with E-10 and E-20 polymers, E-14 is lawful for use (21 CFR 175.125) in formulating pressure-sensitive adhesives for use in food-contact surfaces of tapes and labels used in dry food and processed, frozen, dried, or partially dehydrated fruits and vegetables.

They can also be lawful for use in manufacturing food-contact articles as defined under regulation 21 CFR 177.1620 and as adjuvant substances on textiles and textile fibers intended for use in contact with food in amounts not exceeding those required to achieve their intended effect (21 CFR 177.2800). Other applications for these Epolene polymers include use as coatings or as a component of coatings for various fruits and vegetables as noted under 21 CFR 172.260.

Epolene E-14 has a higher viscosity than Epolene E-14E and complies with the National Sanitation Foundation / ANSI 14 standard for potable water.

Epolene E-16 polymer

Epolene E-16 is a low-density, oxidized polyethylene polymer having properties between those of E-10 and E-14E. It is commonly used to provide stable, low-color emulsions by both atmospheric and pressure emulsification methods for such end uses as textiles, floor polishes, inks, and paint rheological additives.

Epolene E-20 polymer

Epolene E-20 is a low molecular weight, medium-density oxidized polyethylene with exceptional hardness and low color. It has a low softening point and low viscosity that help it provide the desirable emulsification properties of a low density polymer. Epolene E-20 is commonly used as a lubricant for bottle molding PVC and in pipe extrusion of rigid PVC and HDPE.

E-20 is an excellent performer in high speed, buffable floor polish, textile lubricant/softener, and fruit coating applications. In powder form, it is used as an extrusion lubricant for clear, rigid PVC compounds. Its higher density and softening point make it particularly attractive for use in citrus fruit coating emulsions. These properties contribute to the hardness, short drying time, and excellent gloss of the coatings.

Epolene E-43 and E-25 polymers

Epolene E-43 is a relatively low molecular weight, maleic anhydride modified polypropylene polymer with the greatest hardness and highest softening point of all

the Epolene E-type emulsifiable polymers. It is commonly used to impart outstanding slip resistance to floor polishes. Because of its high melting point, pressure equipment is required for emulsification.

Because of its polarity and available anhydride functionality, E-43 and E-25 are also useful as compatibilizers in many plastic alloy systems. They can also be used as coupling additives for filled polypropylene to increase tensile, modulus, and heat-deflection temperature of molded parts when fillers such as glass, mica, talc, CaCO₃, and wood flour are used with polypropylene. For the same reasons, E-43 and E-25 also act as excellent pigment dispersant and processing aids for single plastic systems such as ABS. Maleic anhydride-modified polymers are especially effective in dispersing polyamide-based fluorescent pigments in polyolefins.

Nonemulsifiable (N-type) Polymers

Epolene N-10 polymer

As a nonemulsifiable, medium density, relatively low melting point polyethylene homopolymer. Epolene N-10 can easily be melt blended with natural or synthetic waxes to improve tensile strength, abrasion resistance, and adhesion to fibrous substrates. For paper coating applications such as folding cartons, N-10 can be used to improve paraffin wax mileage and provide a glossy, scuff-resistant finish. It is also commonly used in printing inks to improve resistance to scuffing and rub-off. Its low coefficient of friction and good wetting properties enable N-10 to act as a processing aid and pigment dispersant for polyolefin color concentrates.

Epolene N-11, N-14, N-30, N-34, and N-35 polymers

Epolene N-11, N-14, N-30, N-34, and N-35 are lower in molecular weight and density than N-10 and differ primarily in viscosity. They are used in many of the same applications as N-10 but offer advantages where lower viscosities are desired.

They are also useful as mold release additives and lubricants in rubber processing and as extrusion and calendaring aids for vinyl. In powder form, they are used as pigment-dispersing aids for color concentrates for various plastic applications.

N-14 is used as a mold release agent for solvent systems with urethane and HDPE.

N-34 is commonly used as a processing aid for blown-film extrusion of LLDPE, LDPE, and HDPE polymers. It can also be useful as a pigment dispersion aid or color-flushing medium when preparing color concentrates with polyethylene and polypropylene.

N-35 is slightly higher in viscosity and lower in melt point than N-34.

N-30 is significantly harder and higher in viscosity and melting point relative to N-34 and N-35. N-30 is commonly used as a paraffin wax modifier.

Epolene N-15 polymer

Epolene N-15 is a low-density, low viscosity polypropylene homopolymer. It has a relatively high softening point and exhibits great hardness. These features make it desirable as a paraffin wax modifier to improve blocking, scuff, and abrasion resistance. N-15 is also used in color concentrates and reprographic toner compounds. Its compatibility with plastic-grade polypropylene provides improved pigment dispersing properties, especially for polypropylene fiber applications.

Epolene N-21 polymer

Higher-density Epolene N-21 polymer exhibits a higher softening point, improved solvent and oil resistance, and good hardness properties relative to other low molecular weight polyethylene polymers. Such properties make this polymer useful in cosmetics, cable filling compositions, a slip additive for printing inks and as a modifier for hot-melt highway marking.

Because of its relatively high softening point and relatively low viscosity, N-21 is used as an additive to improve set speed in hot melt adhesives. The higher density of N-21 makes it an excellent pigment dispersing aid for color concentrates used in HDPE.

Coatings (C-type) Polymers**Epolene C-10 and C-15 polymers**

Epolene C-10 and C-15 are low density, highly branched, medium molecular weight polyethylene polymers that are particularly useful as base polymers in hot melt adhesives and coatings for various paper and packaging materials. They differ primarily in their viscosity. Coatings produced using these products exhibit high gloss, low moisture vapor transmission rates, and good heat sealing properties. Both can also be useful as paraffin wax modifiers in slush molding, cast molding, candles, oil-based inks, and investment castings.

The low density, low softening point and good lubrication properties of C-10 and C-15 allow them to be widely used as low cost processing aids in rubber compounding. These same properties also provide dispersing and processing advantages in color and additive concentrates.

Epolene C-13 and C-17 polymers

Epolene C-13 and C-17 differ from C-10 and C-15 primarily in viscosity. They are typically used with paraffin wax and lower molecular weight polymers as viscosity modifiers. Increased viscosity can be of importance for controlling penetration of the coatings into paper substrates and to improve cohesive strength in hot melt adhesives.

Blending these Epolene polymers with paraffin wax offers improved grease resistance, higher blocking temperatures, better scuff resistance, and improved gloss. They can also be used as additives for inks and as base polymers for color concentrates. For example, Epolene C-17 polymer commonly replaces granular, linear low density polyethylene (LLDPE) as the base polymer in many color concentrates due to its ease of processing and improved through put rates.

Epolene C-17 is lawful for use [21 CFR 177.1520(c)(2.1)] in all non cooking, food-contact applications including films, bottles, and coatings. The finished food-contact surfaces are subject to extractability limitations imposed by other regulations pertaining to specific uses. C-17 is also approved for use in manufacturing ion-exchange membranes intended for use in the production of grapefruit juice where the finish membranes must be manufactured as set forth by the regulations and limitations in regulation 21 CFR 173.20.

Epolene C-16 and C-18 polymers

Epolene C-16 and C-18 are maleic anhydride-modified polymers of low molecular weight polyethylene. They differ primarily in their viscosity. When used as hot-melt coatings for paper, they provide a good glossy barrier coating that may be readily heat sealed to many paper products, metal foils, and polyolefin films.

In paraffin wax coating formulations, C-16 and C-18 provide good gloss retention, scuff resistance, improved blocking resistance, superior wet corrugated crush strength and, in certain formulations, good heat sealability. Because of their functionality, these modified polyethylene polymers provide good wetting and dispersing properties for highly filled compositions. Both are also useful as dispersion aids for aluminum pigment concentrates with polyethylene and polypropylene. Epolene C-18 has also been very useful as an additive in basecoat and clearcoat automotive paints to impart improved metal flake orientation.

Because of their maleic anhydride functionality, C-16 and C-18 have a strong affinity for nylon, allowing them to be excellent dispersing aids for amide-based fluorescent pigments used in polyolefin color concentrates. In hot-melt adhesive formulations, their increased functionality allows for improved adhesion, greater filler tolerance, broader compatibilities, and improved aging properties. Unlike conventional polyethylene, these modified polyethylene polymers are compatible with most polyamides used in hot-melt formulations.

Epolene C-19 and C-26 polymers

Epolene C-19 is a higher acid number version of Epolene C-18 useful in application where more specific adhesion or more polarity is desired.

Epolene C-26 is a higher molecular weight linear low density polyethylene with even more maleic anhydride content. This is an excellent coupler for talc, glass, and wood flour in polyolefin matrices.

Packaging

Epolene polymers are supplied as free flowing pellets, packaged in multiwall paper bags with a polyethylene coated inner liner [22.67 kg or 50 lbs net weight]. The bags are palletized and stretch wrapped to prevent contamination during storage and shipment. Many Epolene polymers are also available in bulk packages such as gaylord boxes and super sacks.

Epolene E-43, E-25 and C-26 polymers are available in special foil lined, heat sealed, 50 lb bags.

Epolene C-13, C-15, C-16, C-17, C-18, N-10, N-11, N-15, N-14, N-21, N-34, E-14, and E-43 polymers are also currently available in powder form.

For specific information on bulk packaged shipments or the availability of powder forms, contact your Westlake representative.

For sales inquires contact John Westmoreland, National Accounts Executive at 678-294-5848 or Jwestmoreland@westlake.com.

For technical assistance contact Dr. Dick Stuart, Epolene Technical Service Manager, at 903-242-7682 or rstuart@westlake.com.

Visit www.Epolene.com for additional information of Epolene Polymers