

# Epolene<sup>®</sup> Polymers

## Emulsifiable Waxes

- **Epolene E-10**

An oxidized homopolymer developed for water-emulsion floor polishes, *Epolene*<sup>®</sup> E-10 imparts excellent slip resistance, outstanding toughness, and good durability to polish films. These properties are often apparent at low wax concentrations; however, they are best observed where *Epolene* E-10 wax represents 20% or more of the total solids in the polish.

Emulsions of *Epolene* E-10 wax may be used as finishing agents for cotton and synthetic fabrics, and as textile softeners in conjunction with wash-and-wear finishing waxes.

Emulsions prepared with *Epolene* E-10 may be used as lubricants in clay coatings for paper to reduce dusting during calendering.

- **Epolene E-14**

This is an oxidized homopolymer with lower density and softening point than *Epolene* E-10 wax. These properties contribute greatly to its versatility and ease of emulsification by the wax-to-water or pressure emulsification methods.

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

*Epolene* E-14 and E-14P are effective internal lubricants for PVC pipe extrusion, including pipe meeting National Sanitary Foundation requirements for potable water.

- **Epolene E-20**

*Epolene* E-20 wax is a low-molecular-weight, medium-density, oxidized polyethylene wax with exceptional hardness and low color. This product has a low softening point and low viscosity that give it the desirable emulsification properties of a low-density wax.

*Epolene* E-20 wax is an excellent performer in high-speed, buffable floor polish, textile lubricant/softener, and fruit coating applications. In powder form, it is also useful as an extrusion lubricant for clear, rigid PVC compounds.

The higher density and softening point of *Epolene* E-20 wax make it particularly attractive for use in emulsions for coating citrus fruit. These properties contribute to the hardness, short drying time, and excellent gloss of the coatings.

- **Epolene E-43**

*Epolene* E-43, a chemically modified polypropylene with the greatest hardness and highest softening point of all the emulsifiable *Epolene* waxes, imparts outstanding slip resistance to floor polishes.

*Epolene* E-43 is also used as a coupling additive for filled polypropylene to increase tensile, modulus, and heat deflection temperature of molded parts. Because of its polarity and available anhydride functionality, *Epolene* E-43 is useful as a compatibilizer in many plastic alloy systems. For the same reasons, *Epolene* E-43 acts as a pigment dispersant and processing aid for single plastic systems, such as ABS.

# Nonemulsifiable Waxes

- ***Epolene N-10***

A nonemulsifiable, medium-density, relatively low melting point homopolymer, *Epolene N-10* wax is easily 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, *Epolene N-10* increases paraffin wax mileage and provides a glossy, scuff-resistant finish. *Epolene N-10* is used in printing inks to improve resistance to scuffing and rub-off. The low coefficient of friction characteristics and good wetting properties enable *Epolene N-10* to act as a processing aid and pigment dispersant for polyolefin color concentrates.

- ***Epolene N-11, Epolene N-14, and Epolene N-34***

These *Epolene N* Waxes are lower in molecular weight and density than *Epolene N-10*. Their applications are similar to those for *Epolene N-10* wax, but they offer advantages where wax modifiers with lower viscosities and cloud points are needed.

*Epolene N-11, N-14, and N-34* waxes are also used as mold release additives and lubricants in rubber processing and as extrusion and calendering aids for vinyl. Powder forms are used as dispersing aids for color concentrates going into plastic applications.

- ***Epolene N-15***

*Epolene N-15* is also used in color concentrates and reprographic toner compounds. Its good compatibility with plastic-grade polypropylene provides improved pigment dispersing properties, especially for polypropylene fiber applications.

- ***Epolene N-21***

This higher-density *Epolene N* wax exhibits higher softening points, improved resistance to solvents and oils, and good hardness. Such properties make them useful in cosmetics, hot-melt adhesives, dispersing aids for color concentrates, cable filling compositions, slip additives for printing inks, and modifiers for hot-melting highway marking.

## Coatings Waxes

- ***Epolene C-10 and Epolene C-15***

These low-density waxes were developed for use in hot-melt coatings for paper and packaging materials. Coatings produced with *Epolene C-10/C-15* waxes or blends containing these waxes exhibit high gloss, low moisture vapor transmission rates, good grease resistance, and good heat seal-ability. *Epolene C-10* or *C-15* can also be used as a paraffin modifier in slush molding, cast molding, candles, oil-based inks, hot-melt adhesives, and investment castings.

The low density, low softening point, and good lubricating properties allow *Epolene C-10* and *C-15* waxes to be widely used as low-cost processing aids for rubber compounding. These same properties also provide dispersing and processing advantages in color concentrates.

- ***Epolene C-13 and Epolene C-17***

These waxes were developed for use in combination with the other *Epolene* waxes or in blends containing lower-molecular-weight materials. As paraffin wax modifiers, these two *Epolene* waxes increase blend viscosity, which is important for controlling penetration of the coating into paper substrates.

Blends of these *Epolene* waxes with paraffin wax offer improved grease resistance, higher blocking temperatures, better scuff resistance, and improved gloss. Other uses are as additives for inks and ingredients in hot-melt adhesives. These medium-to-high-molecular-weight, low-density polyethylenes are used extensively as base polymers for color concentrates. In fact, *Epolene C-17P* has replaced granular linear-low-density polyethylene (LLDPE) as the base polymer in many color concentrates because of easier processing and higher output rates.

- ***Epolene C-16 and Epolene C-18***

*Epolene C-16 and C-18 waxes are graft polymers of polyethylene and maleic anhydride with low amount of functionality. As a hot-melt coating for paper, *Epolene C-16 and C-18 waxes provide a glossy barrier coating that may be readily heat-sealed to most paper products, metal foils, and polyolefin films.**

In paraffin wax coating formulations, *Epolene C-16 and C-18 waxes provide good gloss retention, scuff resistance, and in certain formulations, heat seal-ability. As an additive in paraffin-copolymer coatings, *Epolene C-16 and C-18 can provide increased hot tack, scuff resistance, and gloss stabilization. Because of their functionality, these waxes provide good wetting and dispersing properties for highly filled compositions. *Epolene C-18 is also useful as an additive in basecoat/clearcoat automotive paints to impart improved metal flake orientation.***

## **Better Processes and Products with *Epolene Waxes***

- **Viscosity Modification**

*Epolene waxes include a broad range of products with a low, medium, or high melt viscosity. This makes them excellent viscosity modifiers for plastics, adhesives, elastomers, and natural or synthetic wax blending.*

- **Barrier Properties**

*Epolene waxes are insoluble in water and resistant to greases and many chemicals. They can be used in hot melts, aqueous emulsions, and/or as solution/solvent dispersions.*

- **Surface Appearance**

*Addition of selected *Epolene waxes to formulated or compounded plastics improves gloss and surface appearance of the finished products.**

- **Antiblocking Action**

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

- **Lubricity Improvement**

*Because of a low coefficient of friction and a wide range of compatibility, *Epolene waxes are often added to formulated or compounded materials to improve surface lubricity, slip and release properties.**

- **Abrasion Resistance**

*Outstanding toughness and the low coefficient of friction of *Epolene waxes make them excellent additives to improve abrasion resistance for a wide variety of formulated coating materials.**

- **Additive Dispersion**

*Low melt viscosity and good compatibility of *Epolene waxes improve dispersion of pigments, fillers, and other additives in plastics and rubber formulations.**

- **Solvent and Oil Gelation**

*Epolene waxes offer excellent gelling and solvent retention properties with a wide variety of fats, oils, waxes, and solvents.*

- **Coatings**

In coatings *Epolene* waxes are useful as:

Hot-melt coatings 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 to include winding of fiber drums.

Components in hot-melt coatings that are more durable than paint for marking highway surfaces.

Temporary protective coatings for metal parts.

Scuff-resistant emulsion coatings for glass bottles.

Flatting agents for lacquers and enamel paints.

Ingredients in sprayable herbicide and insecticide formulations used on foliage; emulsions of *Epolene* wax improve the wetting and spreading characteristics.

- **Hot-Melt Adhesives**

Base polymers for hot-melt adhesives, C-type *Epolene* waxes produce bonds with excellent high and low temperature resistance. The adhesives may be formulated to exhibit excellent machinability properties with most hot-melt adhesive application systems and to have excellent bond-peel strength properties.

- **Inks**

Dispersions and emulsions of *Epolene* wax 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.

- **Plastics Additives**

As dispersion aids, *Epolene* waxes have unique wetting and dispersion characteristics for highly filled compositions and color concentrates.

Chemically modified *Epolene* E-43 wax functions as a coupling agent for many filled or reinforced plastics to improve processability and surface characteristics. This highly functional polymer is also useful as a compatibilizer for various polymer alloy systems.

As a processing aid for linear-low-density polyethylene (LLDPE), *Epolene* N-34 increases throughput of LLDPE with conventional LDPE extrusion equipment.

*Epolene* waxes function as external and/or internal lubricants for rigid and flexible PVC (polyvinyl chloride) to include the extrusion of rigid PVC pipe for potable water.

- **Paper**

As a lubricant for clay coatings applied to paper, *Epolene* E waxes outperform many calcium stearate dispersions by providing increased lubricity during calendering. The use of *Epolene* wax dispersions in clay coatings allows for higher processing speeds, less dusting, and higher gloss.

- **Personal Care Products**

By offering high-temperature properties, chemical resistance, water resistance, and inertness, *Epolene* waxes are functional in a variety of cosmetic and personal care products.

- **Polishes**

**Liquid Floor Polish.** Emulsions based on *Epolene* E waxes may be used in industrial or household floor polish formulations to selectively improve slip resistance, hardness, scuff resistance, durability, gloss, water resistance, leveling, buffability, and color.

**Vinyl Car Top Polish.** An emulsion of *Epolene* E wax added to polishes for vinyl car tops gives added luster or sheen and long-lasting protection to the vinyl surface.

**Detergent-Resistant Polish for Automobiles.** These creamy polishes clean and wax weathered finishes in a single application. Excellent gloss and film hardness are imparted by the addition of a relatively small quantity of *Epolene* E wax.

**Spray-and-Wipe Furniture Polish.** Developed for use in manually operated, pump-type dispersers, a spray-and-wipe furniture polish based on *Epolene* E wax is easy to apply, imparts excellent luster, and serves as a good dusting aid.

- **Rubber**

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

- **Textiles**

Emulsions based on *Epolene* E waxes are effective as softeners and lubricants for natural and synthetic fibers and improve abrasion resistance, tear resistance, hand, and sewing lubricity of both resin and nonresin finished fabrics.

- **Wax Blends**

As an additive for candles and crayons, *Epolene* waxes provide gloss, sheen, opacity, and good mold release properties.

Petroleum wax coating formulations may be modified with *Epolene* waxes to provide gloss retention, scuff resistance, improved “hold-out,” and in certain formulations, heat seal-ability. Specific applications include coatings for corrugated board, folding cartons, carbon paper, and a variety of other paper products.

As an ingredient in cable filling formulations, *Epolene* waxes increase the melting point and hardness.

- **High Softening Point**

The wide selection of *Epolene* waxes have softening points ranging from 100° to 163°C.

- **Hardness**

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

- **Melt Viscosity**

*Epolene* waxes offer a broad selection of low-medium-, and high-viscosity. Each product is manufactured under a narrow viscosity range specification.

- **Toughness**

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

- **Compatibility**

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

- **Lubricity**

In a variety of plastics and chemical processes, *Epolene* waxes function as internal and/or external lubricants.

- **Moisture and Grease Resistance**

*Epolene* waxes are insoluble in water which results in good moisture resistance. They are also resistant to grease and many other chemicals.

## Emulsifiable Waxes

	E-10	E-14	E-14E	E-20	E-43
Ring and ball softening point, °C	106	104	104	111	157
Penetration hardness, 100 g/5 sec/ 25°C, tenths of mm	2	4	4	<0.5	<0.5
Density, g/cc @25°C	0.942	0.939	0.939	0.960	0.934
Acid number	17	17	17	17	45
Brookfield Thermosel viscosity, <sup>a</sup> cP (mPa•s)					
@ 125°C (257°F)	800	375	225	1,500	— <sup>b</sup>
140°C (284°F)	525	260	160	900	— <sup>b</sup>
150°C (302°F)	—	—	—	—	— <sup>b</sup>
190°C (374°F)	—	—	—	—	350
Color, Gardner scale	1	1	1	1	9
Molecular weight, GPC					
M <sub>w</sub>	4,750	3,226	2,765	5,550	15,790
M <sub>n</sub>	1,150	880	825	1,300	7,100

<sup>b</sup>Solid at this temperature

## Availability of Powdered Waxes

*Epolene* E-14, E-14E, E-43, C-13, C-16, C-17 and most N-type *Epolene* waxes are available in powdered form. For specific information about powdered *Epolene* waxes, contact your Westlake representative.

## Nonemulsifiable Waxes

	N-10	N-11	N-14	N-15	N-21	N-34	C-10	C-13	C-15	C-16	C-17	C-18	C-19
Ring and ball softening point, °C	108	107	108	163	120	103	104	110	102	106	133	102	101
Penetration hardness, 100 g/5 sec/ 25°C, tenths of mm	2	2	3	0.6	<0.1	5	3	3	4	3	2	4	4
Density, g/cc @25°C	0.925	0.921	0.920	0.902	0.950	0.910	0.906	0.913	0.906	0.908	0.917	0.905	0.903
Acid number	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	2.5	<0.05	2.5	5
Brookfield Thermosel viscosity, <sup>a</sup> cP (mPa•s)													
@ 125°C (257°F)	1,500	350	150	— <sup>b</sup>	—	450	—	—	—	—	— <sup>d</sup>	—	—
150°C (302°F)	—	—	—	— <sup>d</sup>	350	—	7,800	—	3,900	8,500	—	4,000	4,700
190°C (374°F)	—	—	—	600	—	—	—	—	—	—	—	—	—
Melt index (@ 190°C)	—	—	—	—	—	—	2,250	200	4,200	1,700	20	4,200	4,200
Color, Gardner scale	1	1	1	1	1	1	1	1	1	1	1	1	1
Molecular weight, GPC													
M <sub>w</sub>	10,000	5,400	4,000	22,000	6,500	6,200	35,000	76,000	17,000	26,000	100,000	15,000	13,200
M <sub>n</sub>	3,200	1,400	1,700	10,000	2,800	2,200	7,700	12,000	6,700	5,600	14,000	5,700	4,500
Cloud point, °C	82	80	80	104	87	76	77	81	75	78	81	71	—

<sup>c</sup>2% in 130°F paraffin   <sup>d</sup>Solid at this temperature

**Note:** Reported for information only. These figures are average values for typical production material and should not be construed as specifications.

## Packaging

*Epolene* waxes are supplied as free-flowing pellets, packaged in multiwall paper bags with a polyethylene-coated inner liner [22.67 kg (50 lb) net weight]. The bags are palletized and stretch-wrapped to prevent contamination during storage and shipment. *Epolene* waxes are also shipped in a variety of bulk containers. Several *Epolene* waxes are offered in powder form.

For specific information about bulk shipments or *Epolene* waxes available in powder form, contact your Westlake representative.



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The C- and N-type *Epolene* waxes are compatible with many natural and synthetic waxes and resins. These values were obtained from melt-blend studies. The major component of the blend was melted at 149°C (300°F), and the minor component was added slowly with agitation. Incompatibility was evidenced by the formation of a hazy melt or a phase separation on cooling.

### Compatibility of Epolene Waxes with Various Resins and Waxes

Wax or Resin	Type	Ratio of <i>Epolene</i> N Waxes to Wax or Resin			Ratio of <i>Epolene</i> N Waxes to Wax or Resin		
		1:3	1:1	3:1	1:3	1:1	3:1
<i>Acrawax</i> "C"	Synthetic wax	I <sup>a</sup>	I	C	I	I	C
<i>Acryloid</i> B-72	Polyacrylate	I	I	I	I	I	I
<i>Amberol</i> 750	Fortified rosin	I	I	I	I	I	I
Bayberry	Vegetable wax	C	C	C	C	C	C
Beeswax	Insect wax	C	C	C	C	C	C
Candelilla	Vegetable wax	H	H	H	H	H	H
<i>Carbowax</i> 6000	Polyethylene glycol	I	I	I	I	I	I
Carnauba	Vegetable wax	C	C	C	C	C	C
<i>Cellolyn</i> 104	Pentaerythritol ester of rosin	I	I	I	I	I	I
<i>Chlorowax</i> 70	Chlorinated paraffin	I	I	C	I	I	C
<i>Crown</i> 1035	Microcrystalline wax	C	C	C	C	C	C
<i>Eastotac</i> H-100	Hydrocarbon resin	C	C	C	C	C	C
<i>Eastotac</i> H-115	Hydrocarbon resin	C	C	C	C	C	C
<i>Eastotac</i> H-130	Hydrocarbon resin	C	C	C	C	C	C
<i>Epolene</i> C	Polyolefin wax	C	C	C	—	—	—
<i>Epolene</i> E	Polyolefin wax	C	C	C	C	C	C
<i>Epolene</i> N	Polyolefin wax	—	—	—	C	C	C
Ester gum 8L	Glycerol ester of rosin	I	I	I	I	I	I
Japan wax	Vegetable wax	C	C	C	C	C	C
<i>Lewisol</i> 33	Maleic alkyd-modified rosin wax	I	I	I	I	I	I
Mineral oil	Hydrocarbon oil	C	C	C	C	C	C
Montan	Mineral wax	C	C	C	C	C	C
<i>Neville</i> R-29	Coumarone-indene	C	C	C	C	C	C
<i>Neville</i> R-52	Styrenated coumarone-indene	I	I	I	I	I	I
<i>Neville</i> LX-1000	Hydrocarbon	C	C	C	C	C	C
Oleic acid	Aliphatic acid	C	C	C	C	C	C
Oronite 128	Polybutene	H	C	C	H	C	C
Ouricury	Vegetable wax	I	I	I	I	I	I
Ozokerite	Mineral wax	C	C	C	C	C	C
<i>Paracin</i> 1C	Ethylene glycol monomethyl ether ricinoleate	I	I	I	I	I	I
Paraffin	Petroleum wax	C	C	C	C	C	C
<i>Piccopale</i> 100	Hydrocarbon	C	C	C	C	C	C
<i>Pliolite</i> S-5	Styrene-butadiene	I	I	I	I	I	I
Stearic acid	Aliphatic acid	C	C	C	C	C	C
<i>Staybelite</i>	Hydrogenated rosin	C	C	C	C	C	C
Sugar cane	Vegetable wax	C	C	C	C	C	C
<i>Uformite</i> F-240	Urea-formaldehyde	I	I	I	I	I	I
<i>Uformite</i> MM55	Melamine-formaldehyde	I	I	I	I	I	I
<i>Vinsol</i>	Wood rosin fraction	I	I	I	I	I	I