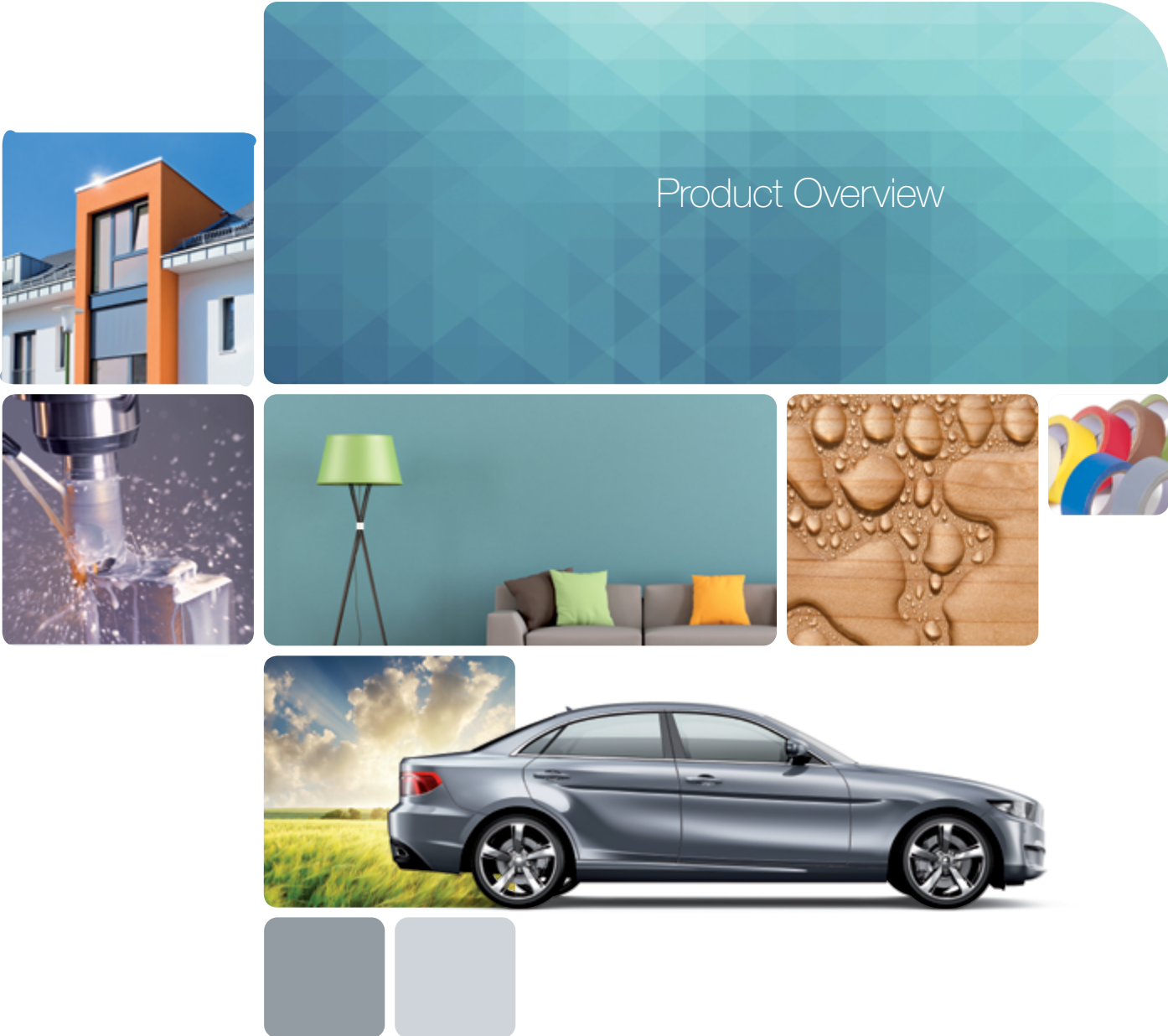


Versatic[™] Acids and Derivatives



Product Overview

Hexion is the number one global supplier of Versatic acids and derivatives, primarily to the polymer, paints, coatings, construction and adhesives markets.

All Versatic acids and derivatives contain a unique highly branched non-polar alkyl group. The basic structure of Versatic acids can be modified with different chemical groups. This allows the incorporation of the Versatic group into a variety of polymers and compounds.

The bulky, highly branched, aliphatic Versatic acid structure improves hydrophobicity, hydrolytic stability, alkaline resistance, UV stability and chemical resistance. The non-polar nature also brings improved flow, leveling and adhesion to systems using this chemistry.

Several families of compounds based on Versatic acid are available based on the functionality of the reactive group. With glycidyl, vinyl and acid functionality, the versatility of these products is limitless.

While some of these derivatives are commonly used as building blocks, monomers or modifiers for acrylic, polyester, vinyl, urethane and epoxy based resins, others are used as additives, chemical intermediates and reactive diluents. Versatic acid derivatives are suitable for use in aqueous, solvent, powder and other 100% solids systems.

Versatic acid derivatives are excellent building blocks enabling the production of high-performance emulsions and high solids and waterborne resins. These resins, in turn, facilitate the trend towards environmentally compliant finishes.

Versatic acids and their derivatives were developed more than 50 years ago and have a well-established track record of cost-effective performance. Many high-quality industrial and consumer products currently benefit from the use of Versatic chemistry.



Versatic Acids

Versatic acids are key intermediates in the manufacture of products that require excellent hydrolytic stability, heat resistance and resistance to attack from a wide variety of chemical agents. They have excellent solubility in non-polar compounds such as solvents, organic polymers and plastics allowing them to be

utilized in a wide variety of systems. These properties originate from the highly branched alkyl groups that contain a tertiary alpha carbon atom. The improved performance is especially demonstrated in comparison with other linear and secondary acids.

Versatic Acid 10

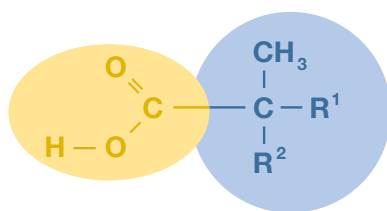
Versatic acid 10 (neodecanoic acid) is a synthetic sterically hindered carboxylic acid with a long highly branched alkyl chemical structure.

Bulky group

- Branched neo structure
- Hydrophobicity
- Low surface tension

Reactive group

- Carboxylic acid functionality
- Low pK_a (acid dissociation constant)
- Polar



$R^1 + R^2 = 7$ carbon atoms

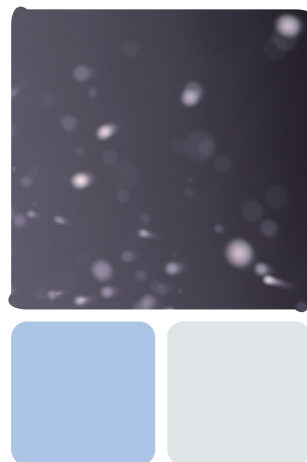
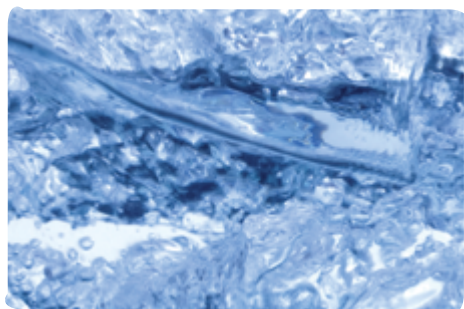
Performance Characteristics

- High resistance to chemicals
- High resistance to oxidative compounds
- High resistance to thermal conditions
- High level of hydrophobicity
- High solubility in non-polar solvents and polymers
- Viscosity modifier
- Lubricity

Typical Applications

Versatic acid 10 can be used as such for metal extraction or as lubricity additive in diesel. However, it is used mainly as an intermediate to manufacture other chemicals used primarily in industrial applications.

- Metals salts
- Amine salts
- Peroxyesters
- Ester derivatives



Versatic Acid 5

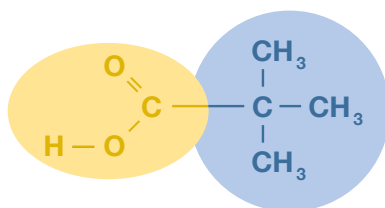
Versatic acid 5 (neopentanoic acid, also called pivalic acid) is a synthetic sterically hindered carboxylic acid with a short highly branched alkyl chemical structure.

Bulky group

- Branched neo structure
- Hydrophobicity

Reactive group

- Carboxylic acid functionality
- Low pK_a (acid dissociation constant)
- Polar



Performance Characteristics

- High resistance to chemicals
- High resistance to oxidative compounds
- High resistance to thermal conditions

Typical Applications

Versatic acid 5 is used primarily as an intermediate to make peroxyesters and chemical products for the pharmaceutical and agrochemical applications.

- Peroxyesters
- Amide derivatives
- Ketone derivatives
- Amine salts
- Ester derivatives



Versatic Acid Derivatives

Versatic acid derivatives are excellent building blocks, enabling the production of high-performance emulsions and high solids solventborne and waterborne resins. These resins, in turn, facilitate the trend towards environmentally compliant finishes.

Veova™ Vinyl Ester

The vinyl esters of Versatic acid, Veova vinyl esters monomers, have highly branched aliphatic structures, which contribute to improving key performance properties of the derived coatings.

Inclusion of the branched Versatic structure in a polymer sterically protects the ester bonds of the adjacent monomer units against hydrolysis, resulting in greatly improved alkali resistance.

Veova monomers improve resistance to water and other polar materials as well. Finally, Veova monomers are not degraded by UV light and therefore do not cause yellowing.

Veova vinyl esters are commonly used in vinyl acetate and acrylic copolymers, where they greatly improve hydrolytic stability, adhesion and water resistance. Emulsion polymers based on Veova vinyl ester show clear improvement in pigment utilization and scrub resistance. Veova vinyl ester based emulsions are

widely used for interior and exterior emulsion paints. They can also be used for solventborne industrial coatings.

Emulsions based on Veova vinyl esters can be easily stabilized with protective colloids or surfactants.

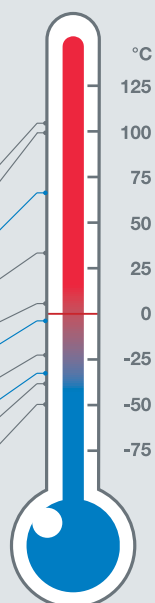
The use of colloid stabilizers makes it possible to produce high viscosity emulsions. It also allows the production of redispersible powders for a variety of mortars and adhesives. The hydrophobicity of Veova monomers can offset the water sensitivity created by hydrophilic additives that are sometimes used.

Three commercial Veova monomers are available; Veova 9, 10 and EH vinyl esters. Their homopolymer Tg's are +70 °C, -3 °C and -36 °C, respectively. Veova EH is also significantly less branched than the two other monomers.



Homopolymer Glass Transition Temperatures

Methyl methacrylate
Styrene
Veova 9
VAM
Methyl acrylate
Veova 10
Ethyl acrylate
Veova EH
Butyl acrylate
2 Ethyl hexyl acrylate



VeoVa 10 Vinyl Ester

VeoVa 10 monomer is the vinyl ester of Versatic acid 10. The VeoVa 10 homopolymer has a relatively low Tg of -3 °C. VeoVa 10 monomer can be used as a modifying comonomer in the preparation of vinyl acetate based polymer latices,

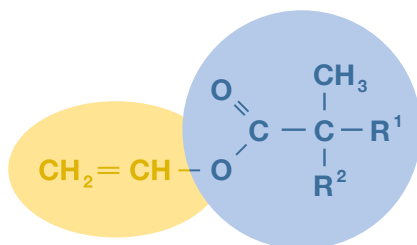
which are used for the manufacture of high-quality emulsion paints. VeoVa 10 vinyl ester is also used as a comonomer with acrylates for the production of emulsion and solution polymers.

Bulky group

- Highly branched aliphatic structure
- Hydrophobic
- UV stable

Reactive group

- Similar reactivity to vinyl acetate
- Excellent reactivity with ethylene
- Good reactivity with acrylate and methacrylate monomers



$\text{R}^1 + \text{R}^2 = 7$ carbon atoms

Performance Characteristics

- Alkali resistance
- Water repellency / Low surface tension
- Reduced water absorption
- Outdoor durability
- Improved adhesion on non-polar substrates

Typical Applications

- Interior and exterior decorative paints
- Wood coatings
- Anti-corrosion primers
- Industrial coatings
- Water repellent coatings
- Redispersible powders and concrete admixtures
- Construction adhesives
- Wood glues
- Pressure-sensitive adhesives
- Textile and non-woven binders



Veova 9 Vinyl Ester

Veova 9 monomer is the vinyl ester of Versatic acid 9. The Veova 9 homopolymer has a relatively high Tg of +70 °C. Veova 9 monomer can be used as a modifying comonomer in the preparation of vinyl acetate based polymer latices, which are used for the manufacture of specialty emulsion paints. Veova 9 vinyl ester is also used as a comonomer with acrylates and methacrylates for the production of emulsion solution polymers.

Bulky group

- Very highly branched aliphatic structure
- Hydrophobic
- UV stable

Reactive group

- Similar reactivity to vinyl acetate
- Excellent reactivity with ethylene
- Good reactivity with acrylate and methacrylate monomers

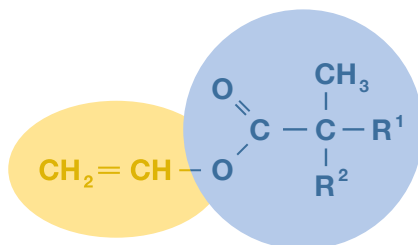
Performance Characteristics

- Alkali resistance
- Water repellency / Low surface tension
- Reduced water absorption
- Outdoor durability
- Improved adhesion to non-polar substrates

Typical Applications

Veova 9 monomer can be used to design polymers for a variety of applications.

- Industrial coatings
- High-performance exterior and interior decorative paints
- Wood coatings



R¹ + R² = 6 carbon atoms



Veova EH Vinyl Ester

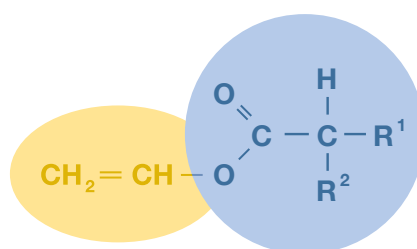
Veova EH monomer is the vinyl ester of 2-ethyl hexanoic acid, a synthetic saturated monocarboxylic acid. The Veova EH homopolymer has a relatively low Tg of -36 °C. Veova EH monomer can be used as a comonomer for the production of vinyl acetate or (meth)acrylic based polymer latices.

Bulky group

- Branched aliphatic structure
- Hydrophobic
- UV stable

Reactive group

- Similar reactivity to vinyl acetate
- Excellent reactivity with ethylene
- Good reactivity with acrylate and methacrylate monomers



R¹ = 4 carbon atoms
R² = 2 carbon atoms

Performance Characteristics

- Alkali resistance
- Water repellency / Low surface tension
- Reduced water absorption
- Outdoor durability
- Improved adhesion to non-polar substrates

Typical Applications

- Low VOC decorative emulsion paints
- Elastomeric paints
- Wood coatings
- Varnishes and coatings for polyolefins
- Pressure-sensitives adhesives
- Construction applications
- Redispersable powders



Cardura™ Glycidyl Ester

Utilized for decades as a building block for automotive OEM, refinish clear coats and CED systems, the glycidyl ester of Versatic acid 10 (Cardura E10P glycidyl ester) exhibits UV stability, acid etch resistance and a unique ability to create high solids low viscosity polymers with good substrate wetting.

The epoxy functionality of Cardura glycidyl ester reacts with amines, acids, alcohols and many other groups to allow Cardura glycidyl ester to be further functionalized for use in acrylic, polyester, star polyester and epoxy based resins as either a building block and / or a reactive diluent.

The relatively high boiling point of Cardura glycidyl ester and its low viscosity make it an ideal reaction medium for high temperature polymerization of acrylic polyol resins.

This feature also allows Cardura glycidyl ester to replace solvents sometimes used as reaction media, thus eliminating the need for solvent stripping and maximizing reactor capacity usage.

Cardura glycidyl ester enables the use of innovative routes that hybridize radical polymerization and esterification reactions in a unique manner.

Low viscosity (ultra) high solid acrylic polyols, optionally combined with star polyesters, can be produced in simple and fast polymerization processes. These ultimately provide low-VOC formulations with improved flow, affording fast-drying high performance topcoats at minimized thickness. The same versatile chemistry also provides very convenient routes for the preparation of polyols for 2K waterborne polyurethane coatings.

Cardura glycidyl ester can be modified with amines to create novel adducts and curing agents for epoxy systems with improved flow and solubility.

When used as a reactive diluent for flooring coatings, the low viscosity and low volatility of Cardura glycidyl ester along with its resistance to crystallization provide unique performance.

Cardura glycidyl ester is the ideal acid scavenger for various types of carboxylic acids.

The unique chemical structure of Cardura glycidyl ester is responsible for its very high reactivity towards acids. Cardura glycidyl ester is therefore widely used to reduce the acid value of polyesters easily and quickly to very low levels.



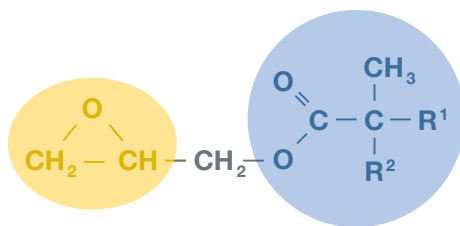
Cardura E10P Glycidyl Ester

Bulky group

- Sterically protected ester group
- Bulky structure
- Reduce inter molecular interaction between polymer chains
- Aliphatic structure
- Hydrophobicity

Reactive group

- Reactive epoxy group
- Highly reactive towards amines, acids and alcohols
- Ring opening generates a hydroxyl group for cure



R¹ + R² = 7 carbon atoms

Performance Characteristics

- Excellent compatibility with a wide range of solvents and polyesters
- Lower resin VOC
- Improved pigment utilization
- Lower solution viscosity
- Improved gloss
- Excellent acid resistance
- Excellent outdoor durability
- High boiling point
- Stable esters

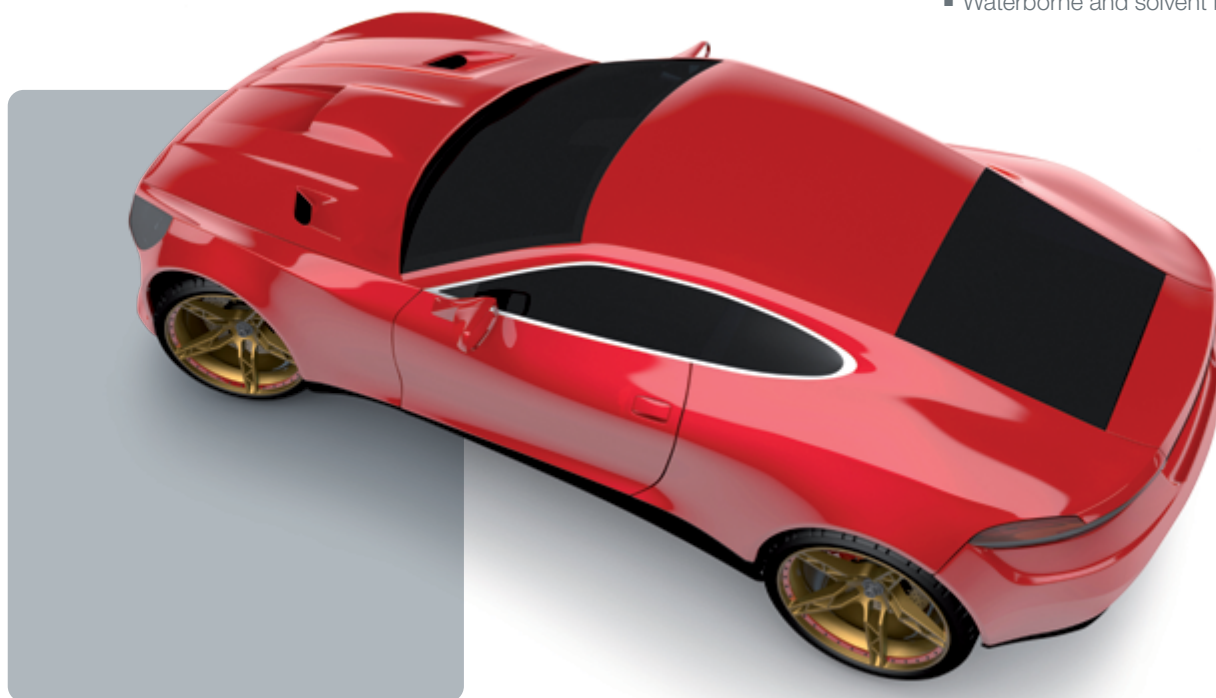
Typical Applications

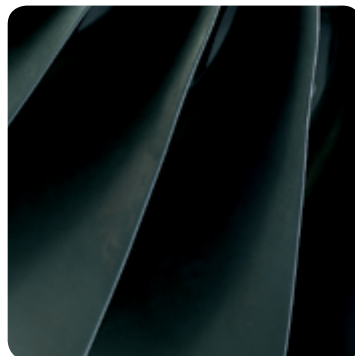
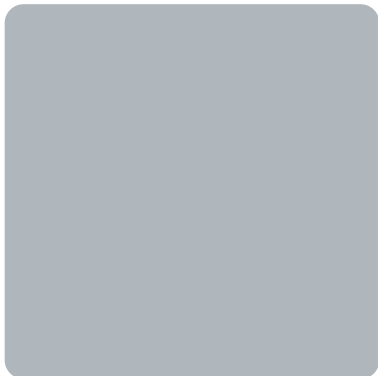
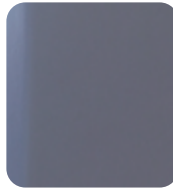
Cardura E10P glycidyl ester bridges the gap between environmentally friendly and high performing coatings. Its features and performance characteristics make it a unique molecule for numerous applications.

- Automotive (OEM/Refinish) and transportation coatings
- Protective (industrial and marine) coatings
- Coil coatings
- Civil engineering (flooring)

Cardura E10P glycidyl ester is usually dosed at the end of the production cycle of a polyester to quickly and efficiently bring the acid value to the desired specification. The temperatures for the reaction of Cardura glycidyl ester with carboxylic acids ranges from 140 °C to 240 °C. Its main applications include:

- Base oils for lubricants
- Saturated and unsaturated polyesters
- Waterborne and solvent borne alkyds





Wherever you look a part of us is there.

We are pioneers of a higher chemistry. A chemistry designed to address the most pressing issues of our time. Forged from generations of invention and collaboration. Committed to safe manufacturing and community involvement. This powerful chemistry understands no boundaries, making it capable and responsible for shaping the future. This is the responsible path forward. This is what we call Responsible Chemistry.

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