

**Solutions for
Longer Lasting
Wood Protection**



Wood is a very popular building material not only for exterior applications such as window frames and cladding but also for the creation of outdoor living space such as wooden patios, decks, fences and garden furniture. Without some type of protective surface coating, most wood will deteriorate very rapidly during outdoor exposure.

Besides excellent resistance to weathering and UV, other features such as good adhesion to wood, protection against liquid water ingress and a good balance between hardness and flexibility are key requirements for exterior wood coatings.

While solvent-borne alkyd binders have limited durability, they offer many of these properties and are therefore widely formulated into exterior wood coatings. Nevertheless, with increasing pressure to reduce the level of volatile organic emissions, acrylic-based water-borne systems are rapidly gaining popularity. Moisture protection, however, remains a critical parameter still to be optimized in the field of water-borne acrylic wood coatings.

While various additives exist to increase the short-term hydrophobicity of coatings, the incorporation of highly hydrophobic Veova™ monomers into an acrylic polymer is an ideal and durable solution for enhancing the final wood coatings ability to repel water and resist to weathering influences.

Benefits of Veova™

Veova™ improves performance by increasing **water resistance, UV resistance and adhesion**. A Veova™ containing self-crosslinkable core/shell polymer imparts a **superior exterior durability** to wood coatings. Coatings based on these polymers can be formulated at **very low VOC levels**.

Veova™ Monomer 10

Veova™ 10 is the vinyl ester of Versatic™ acid 10, a highly branched and saturated carboxylic acid containing 10 carbon atoms.

Veova™ 10 is a monomer with a unique hydrophobic bulky structure and is used in the production of a broad range of high quality latex polymers.

Veova™/Acrylic Copolymers (Veocryls)

Veova™ monomers readily copolymerize in emulsion with acrylate and methacrylate monomers to yield latices that are especially suitable for high-performance coatings. Veova™ monomers significantly upgrade key performance properties of acrylic coating systems, such as water resistance, chemical resistance, adhesion and exterior durability.

Typical examples of use include wood stains and wood coatings, gloss paints, exterior masonry paints, roof tile coatings, anti-corrosion coatings and protective concrete coatings.

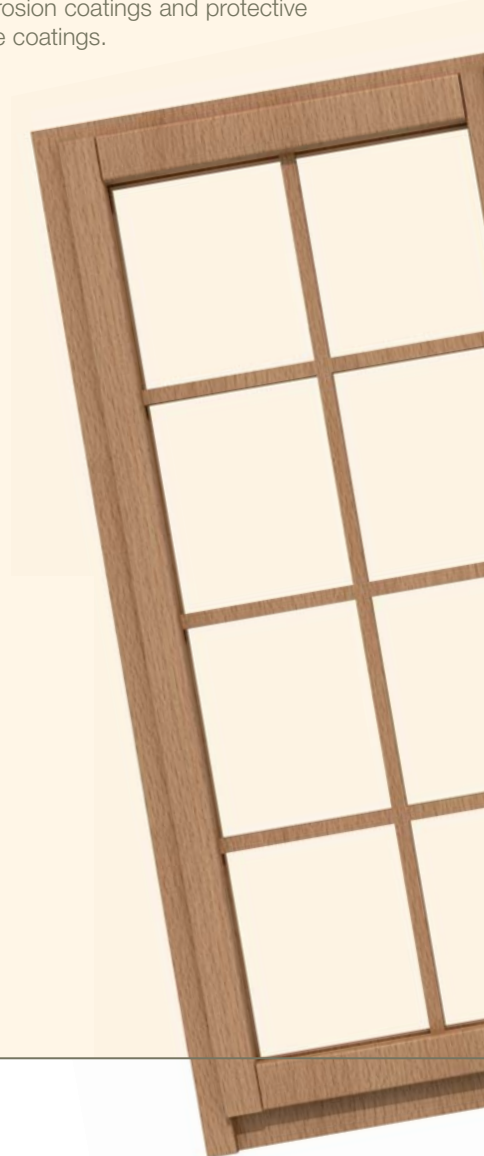
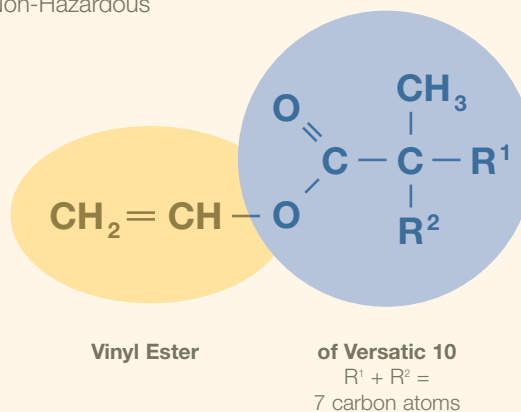
Structure and Properties:

Vinyl Ester

- Easily copolymerisable with vinyl acetate, ethylene, acrylates and methacrylates.

Versatic™ Acid 10

- Hydrophobic
- Low surface tension
- UV Resistant
- Hydrolytically stable
- Non-Hazardous





Core/Shell Technology

Core/Shell Process

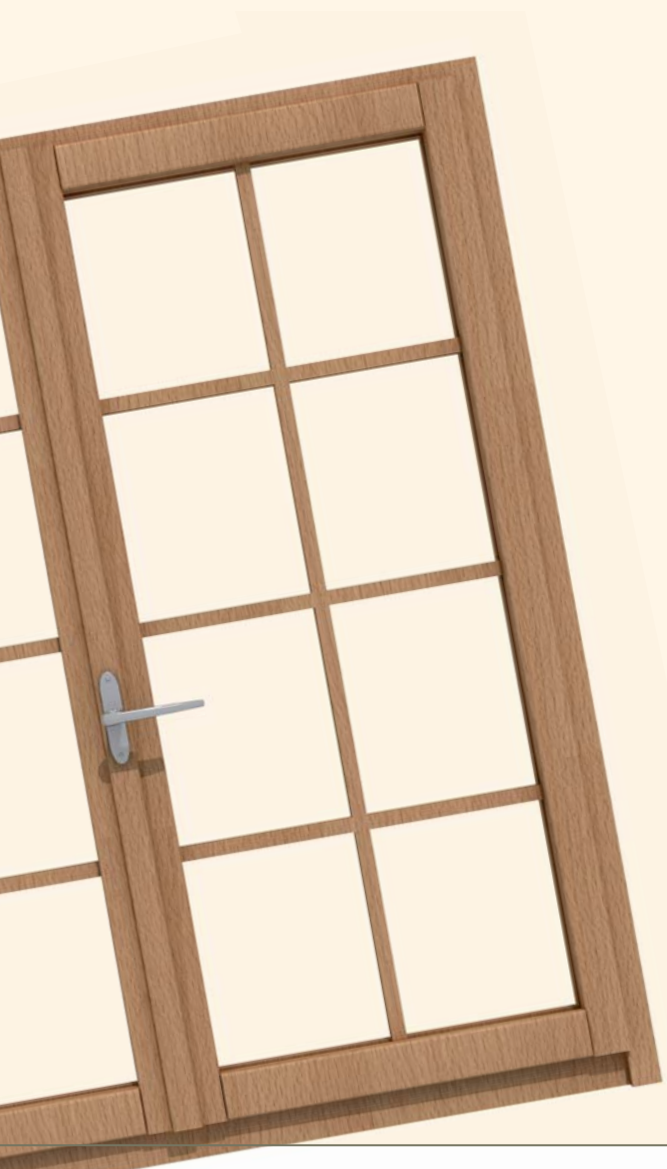
A two-stage process is used whereby first a combination of acrylic monomers are reacted followed by delayed addition of a mixture of acrylate and VeoVa™ 10 monomers. Incorporation of specific functional monomers leads to stable 1-pack self-crosslinkable polymers that will cure at room temperature upon drying of the coating.

Polymer Properties

A self-crosslinkable Veocryl polymer consisting of a hard core (glass transition temperature T_g of 50 °C) and a soft shell (T_g of 0 °C), is a good example of a high performance water-borne binder for wood coatings.

Upon drying a soft flexible Veocryl matrix containing hard acrylic domains will be formed. The hard pure acrylic core imparts a good blocking resistance, and the combination with the soft shell matrix, provides a very good balance between hardness and flexibility.

With the hydrophobic bulky VeoVa™ monomer present in the shell, the polymer and the resulting wood coatings offer a superior water resistance and water repellence, good adhesion and outstanding exterior durability.

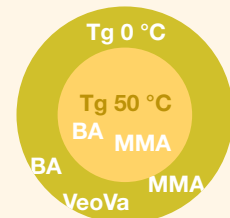
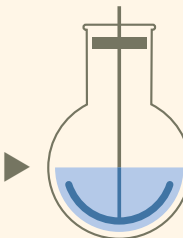


**Stage 1
Core**
30%



+

**Stage 2
Shell**
70%



Core/Shell:

Hard core =
blocking resistance

Soft shell =
flexibility, hydrophobicity

Strong Reduction Of Volatile Organic Emission Levels

Careful selection of the monomers used in the shell enables the preparation of emulsions that form tough polymer films at temperatures as low as 0 °C. Wood coatings based on these polymers can be formulated with very low co-solvent levels and still form high quality coating films at very low application temperatures.

In addition, the VeoVa™/acrylic core/shell polymers are formaldehyde free and also have a low residual monomer content of < 500 ppm.

This enables the development of a new generation of wood coatings with very low volatile organic emission levels.



Veova™ Based Self-Crosslinkable Core/Shell Polymers Impart Long-Lasting and Superior Water Barrier Properties

Veova™ 10 monomer imparts protection against water and therefore also increases the durability of wood coatings. This is clearly demonstrated by comparing the performance of Veocryls versus benchmark acrylic emulsions.

A series of self-crosslinkable core/shell acrylic latices with a fixed core Tg of ~50 °C and a soft flexible shell were prepared. The outer shell of the polymer particles were modified by incorporating either 2-ethylhexyl acrylate (2-EHA) or Veova™ 10 as hydrophobic monomers. In addition, two representative commercial acrylic emulsion binders for wood coatings were evaluated.

Water Repellency

Expensive additives such as special waxes or silicones are commonly formulated into wood coatings to provide them with a water beading effect. Often, the effect of these additives is only temporarily as they will gradually leach out of the coating.

The incorporation of Veova™ 10 into the polymer backbone has a significant and long-lasting impact on the water contact angle and hence water repellence of the polymer. The water repellence behaviour of the Veova™ 10 based systems is very pronounced and is very much superior to that of the 2-EHA based polymer or any of the other acrylic benchmark polymers tested.

Early Water Resistance

Early resistance to weathering is a requirement that exterior wood coatings must meet if they risk to be subjected to moisture or rain shortly after application. This moisture will typically cause blistering, loss of adhesion, or surface staining.

The increased hydrophobicity of the Veova™ containing polymer improves its early water resistance to levels above those of the other pure acrylic polymers.

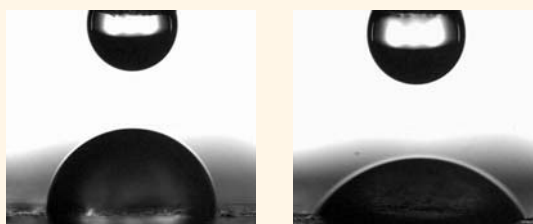
Composition and latex properties of the evaluated systems:

- 30% Veova: Core/shell polymer containing 30% of Veova™ 10
- 30% 2-EHA: Core/shell polymer containing 30% of 2-ethylhexyl acrylate
- Acrylic Benchmark 1 (BM1): A commercial high-end acrylic emulsion polymer tailored towards the decorative wood coatings market
- Acrylic Benchmark 2 (BM2): A commercial high-end acrylic emulsion polymer tailored towards the industrial wood coatings market

Typical Polymer Properties

Property	30% Veova	30% 2-EHA	Acrylic BM1	Acrylic BM2
MFFT initial	< 0 °C	9 °C	15 °C	7 °C
Particle size	110 nm	110 nm	100 nm	75 nm
Water contact angle	79°	67°	54°	74°

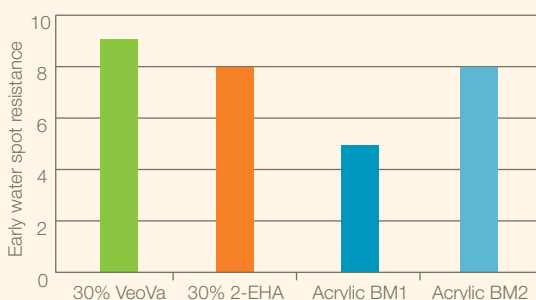
Core/shell Veocryls exhibit a long lasting and superior water repellency



Water contact angle
30% Veova

Water contact angle
30% 2-EHA

Early (1h dry) water spot resistance



10 = film unaffected / 0 = film completely white

Performance Benefit

Veova™ strongly increases the **water barrier properties** and **water repellency** of wood coatings while maintaining a **good water-vapour permeability**.

VOC Compliant Wood Coatings

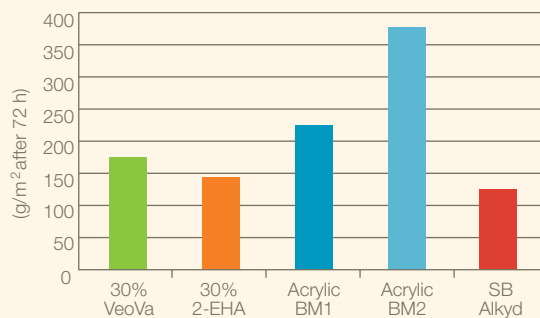
Different acrylic binders were formulated into semi-transparent stains and white pigmented wood coatings. All these systems are compliant with the new European Union 2010 VOC legislation (< 130g VOC/l). A commercial (SB Alkyd) 2010 compliant high-solids solvent-based alkyd stain (< 400g VOC/l) was used as additional benchmark.

Resistance To Liquid Water

Water absorption is a key driving force for expansion and contraction of wood, for mould growth and therefore also for wood degradation. The liquid water uptake into wood was tested for wood stains applied on Epicea wood.

Veova™ based wood stains have superior water barrier properties and significantly decrease the water uptake by the wood. From the water based systems the Veova™ core/shell system has one of the lowest liquid water permeability values and is close in performance to the solvent based alkyd.

Liquid water permeability of wood stains (EN 927-5)



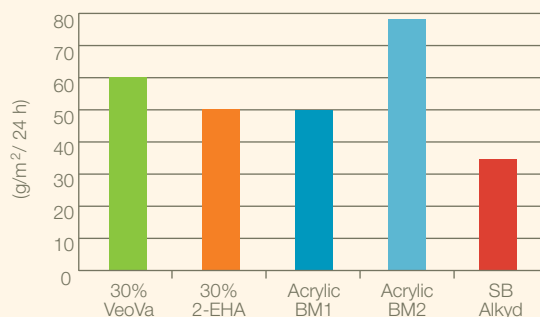
Water Vapour Permeability

Where a coating with a low water permeability clearly reduces the water uptake, it should at the same time be breathable to water vapour, and quickly release the moisture absorbed in the wood.

Veova™ based polymers not only provide an excellent barrier to liquid water, but more importantly do this without negatively affecting the moisture vapour permeability of the wood stain.

Overall the combination of repelling liquid water and releasing water vapour is of great value to create effective protection against water attack.

Water vapour permeability of wood stains (ASTM D 1653-93)



Blocking Resistance

The core/shell polymers have an equal or better blocking resistance than the commercial acrylic and alkyd benchmarks. By adjusting the Tg of the shell the blocking resistance can be further adjusted to meet specific needs.

Typical Coating Properties

Property	Blocking (1 week dry)	Adhesion on aged alkyd
30% VeoVa	Tg shell 0 °C: 8 Tg shell 14°C: 9	No detachment
30% 2-EHA	9	1 – 5% detachment
Acrylic BM1	7	No detachment
Acrylic BM2	9	No detachment
SB Alkyd	5	Total detachment

0 = very poor / 10 = perfect

For Longer Lasting Wood Protection Use Veova™ Based Emulsions

Veova™ enables the development of exterior wood coatings with a **superb exterior durability**.

Veova™ Based Self-Crosslinkable Core/Shell Polymers Enable the Development of Wood Coatings With A Superior Durability And Weathering Resistance.

Wooden articles intended for exterior use are exposed to severe UV-radiation, rain and temperature changes. Coatings for exterior wood therefore need to have a long-term weather stability. The different wood stains were evaluated in accelerated weathering for 2000h according to EN 927-6 by an independent leading testing and certification institute for wood coatings (CATAS).

Accelerated Weathering

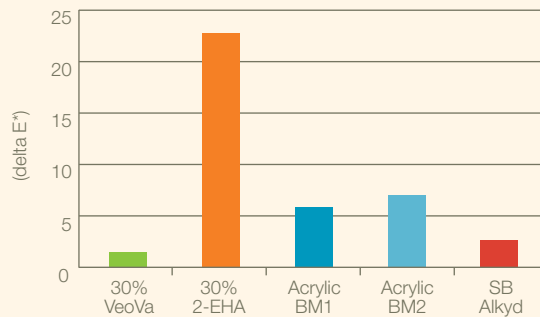
The wood stain based on the Veova™/acrylic core/shell polymer significantly outperformed the stain based on the 2-EHA containing polymer and was superior to any of the other systems tested.

The good retention of the appearance of the Veova™ based coatings after artificial weathering is not only very visible but can also be clearly quantified by minimal colour change and the excellent gloss retention of the formulated stain.

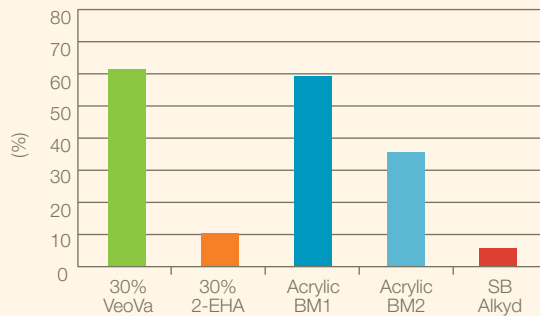
Natural Weathering

The Veova™/acrylic core/shell systems also shows excellent performance during natural weathering, and whereas the tests are still ongoing, they have currently reached 3 years of exposure without any significant performance loss.

Accelerated weathering - Colour changes (2000 h EN927-6)



Accelerated weathering - Gloss retention (2000 h EN927-6)

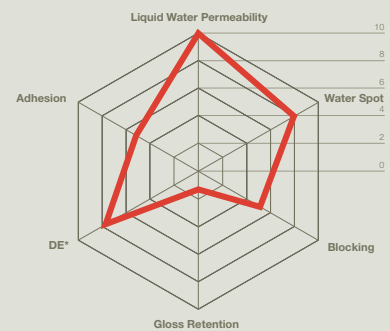
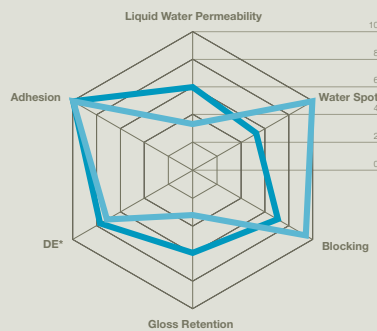
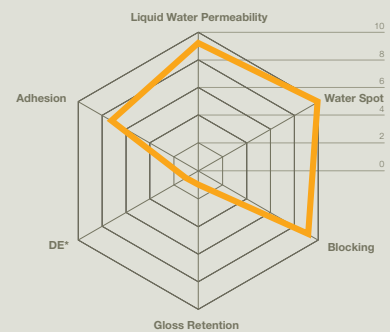
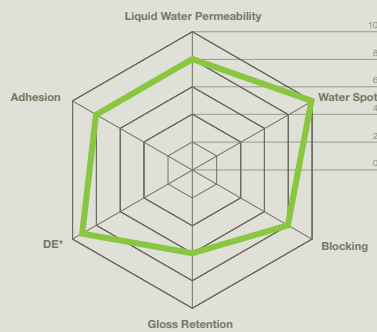


Your Solution for Longer Lasting Wood Protection.



Performance comparison summary of wood stains

- 30% VeoVa
- 30% 2-EHA
- Acrylic BM1
- Acrylic BM2
- SB Alkyd



Veova™ Helps You Developing Sustainable Solutions Characterized by

- A superior and long-lasting water repellent effect
- Low liquid water up-take combined with good water vapour permeability
- High exterior durability through excellent resistance to cracking, peeling and blistering, and good adhesion combined with adequate flexibility
- Environmentally safe systems with low co-solvent demand, low residual monomers levels, and free of formaldehyde and APE-surfactants.

Ideal for Transparent Stains and Pigmented Wood Coatings for:

- Fences
- Siding
- Garden furniture
- Decking
- Industrial joinery (window frames)

Veova™/acrylic polymers are also ideal binders for the formulation of high performance anti-corrosion coatings, protective concrete coatings, exterior masonry paints and roof tile coatings.

The Global Leader in Thermoset Resins

As the world's largest producer of thermoset resins and the leader in adhesive and structural resins and coatings, Hexion Specialty Chemicals meets customers' specific application needs with a total solutions approach of products and services.

Hexion offers the broadest range of thermoset resin technologies and unmatched technical support – and provides them around the globe.

With our extensive research and development capabilities and applications know-how, we are uniquely able to work in partnership with customers to co-develop better products and systems.

Plus, Hexion's worldwide production network facilitates assured supply and prompt delivery wherever our customers do business.

World Headquarters / North America:

Hexion Specialty Chemicals, Inc.

180 East Broad Street
Columbus, OH 43215-3799
+1 614 225 4000

Regional Headquarters:

Asia

Hexion Specialty Chemicals Trading Co., Ltd.

Lippo Plaza # 3701
222 Central Huai Hai Road
Shanghai 200021 China
+86 21 3318 4800

Australia

Hexion Specialty Chemicals Australia Pty.

2-8 James Street
Laverton North Victoria 3026
Australia
+61 39 369 2377

Europe

Hexion Specialty Chemicals B.V.

Seattleweg 17
3195 ZH Rotterdam, Portpark
The Netherlands
+31 10 295 4000

Latin America

Hexion

Química Indústria e Comércio Ltda.

Rua Cyro Correa Pereira, 2525
Area-Sul – CIC
81450-090 Curitiba, Brazil
+55 41 212 1600

Hexion's Versatics Business Unit is a worldwide organization which focuses on selling, marketing, manufacturing and developing technology utilizing Versatic Acid and its derivatives. All derivatives contain a unique highly branched non-polar alkyl group. The structure is then modified with Glycidyl, Vinyl, Acrylate, Hydroxyl and Acid functionality to allow it to be reacted into a wide variety of polymers, chemical compounds and products. The bulky, highly branched, aliphatic Versatic structure has the ability to improve the performance of a wide variety of chemicals and polymers. Versatic derivatives are suitable for use in Aqueous, Solvent, Powder, UV Curable and 100% solids systems.



Hexion Specialty Chemicals B.V. Versatics

Seattleweg 17
3195 ZH Rotterdam, Portpark
The Netherlands
+31 10 295 4000

Hexion Specialty Chemicals Versatics

630 Morrison Road Suite 300
Gahanna, OH 43230
USA
+1 866 443 9466

For more informations visit
versatics.com today.

Hexion Specialty Chemicals Belgium SA Versatics

Avenue Jean Monnet 1
1348 Ottignies Louvain-La-Neuve
Belgium
+32 10 49 7205

Hexion Specialty Chemicals B.V. Trading (Shanghai) Co., Ltd Versatics

Room 338, Bldg A, No 8, Lane 1305, Huajing Road
Science & Technology Park of ECUST
Shanghai 200231, China
+86 21 3318 4871

For worldwide locations visit
hexion.com