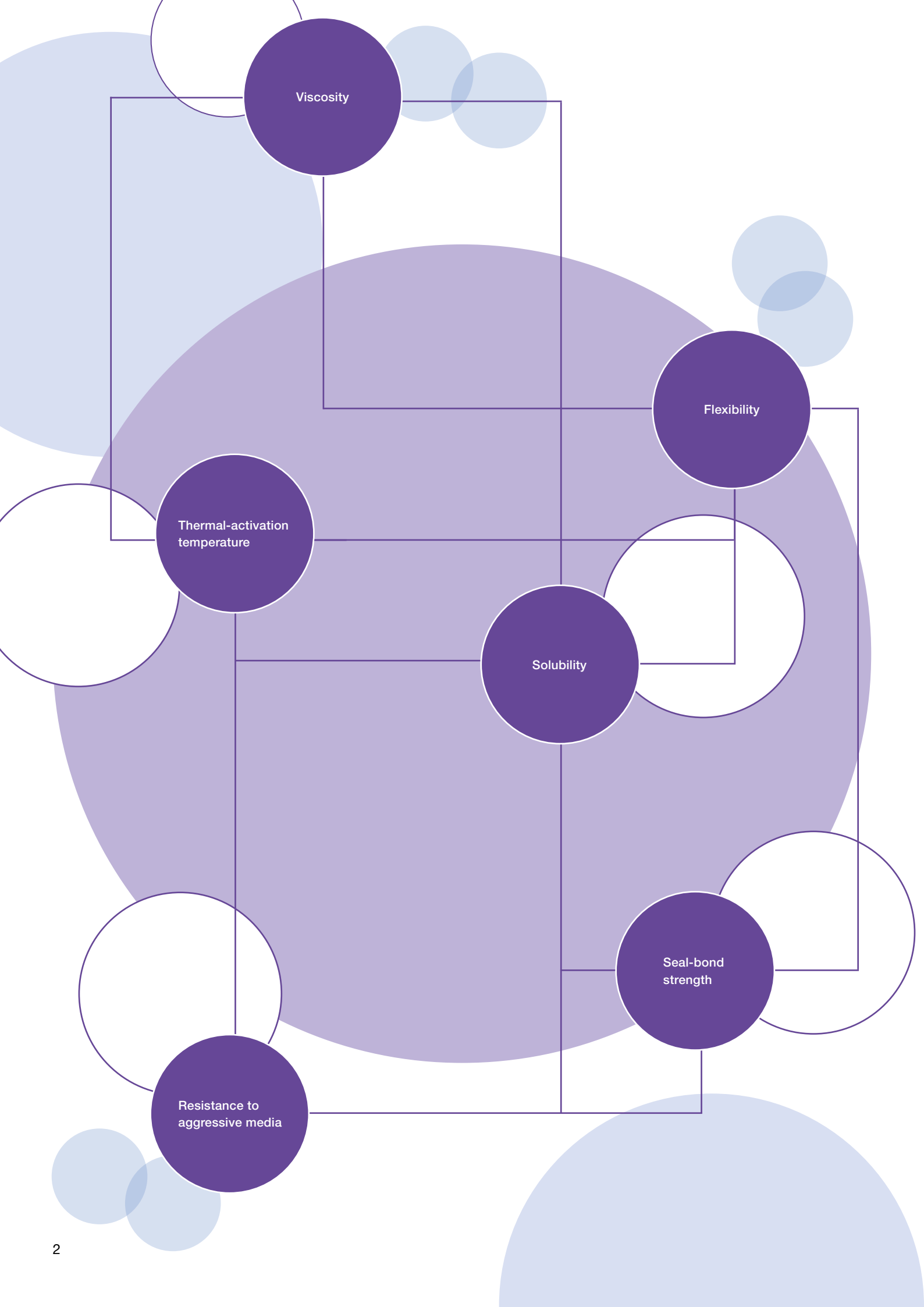
WACKER

CREATING TOMORROW'S SOLUTIONS

VINNOL®

HEAT-SEALABLE COATINGS I PRINTING INKS I INDUSTRIAL COATINGS

VINNOL® RESINS PRODUCT OVERVIEW


Viscosity
Flexibility
Thermal-activation temperature
Solubility
Seal-bond strength
Resistance to aggressive media

CUSTOMIZE YOUR PRODUCTS

VINNOL® is the brand name for a system of vinyl chloride co- and terpolymer resins that are used as binders in various solvent-based coating applications, such as:

- Heat-sealable and heat-seal-resistant coatings for aluminum foil
- Printing inks and pigment preparations
- Industrial coatings
- Adhesives

Discover a Unique Portfolio

To meet customers' needs, WACKER offers a sophisticated portfolio of VINNOL® resins. With a range of different polymer resins that are fully compatible with each other, it is possible to tailor the relevant properties of heat-sealing lacquers, inks and coatings.

By choosing the right combination of VINNOL® grades, our customers are able to adjust e.g., the viscosity of a coating or ink, the pigment-wetting characteristics or the resin-dispersion time, the sealing temperature, seal-bond strength or the adhesion to a specific substrate, the chemical resistance or other relevant properties according to the individual application requirements.

Adhesion to Substrates

Depending on the VINNOL® resin grade, it is possible to achieve good adhesion to different substrates such as:

- Plastics and polymeric films of polar character (for example PVC, PMMA, SAN, ABS, PC, PU, PA, PET)
- Ferrous and nonferrous metal substrates
- Porous and absorbent substrates (such as paper and wood)

In addition to its comprehensive portfolio, WACKER offers you an extensive range of services, from product recommendations and formulation guidelines to assistance in producing and applying coatings with VINNOL® resins. Just contact us!
We will be glad to support you.

Key Advantages of VINNOL®

- Full mutual compatibility of all VINNOL® grades
- High toughness and permanent flexibility
- Superior abrasion resistance
- Outstanding water and chemical resistance
- High corrosion resistance of coatings
- Inherent flame retardance
- Excellent solubility and ease of processing
- Adhesion to many different substrates
- Wide compatibility and formulation range
- Excellent interaction with pigments and fillers
- Odorless and tasteless
- Many grades comply with food contact regulations*

* Contact your WACKER representative regarding specific clearances.



DISCOVER A UNIQUE PORTFOLIO

VINNOL® resins are available in three major product categories:

VINNOL® Resins without Functional Groups

VINNOL® resins without functional groups are copolymers of vinyl chloride and vinyl acetate. They are available in different molar compositions and a broad molecular weight range. They adhere to a wide variety of substrates, especially to plastics and films with polar character. They adhere outstandingly to porous and absorbent substrates such as paper and wood, but only bond well to metal substrates if modified with VINNOL® resins containing carboxyl groups (VINNOL® M grades). When used as cobinders with other resins, VINNOL® resins often help to improve chemical resistance (e.g. against acidic and alkaline aqueous systems, against fat and oil, or against alcoholic media).

In addition, all of the non-functional VINNOL® grades comply with various food contact regulations such as FDA 175.300. Contact your WACKER representatives regarding applications that require specific FDA, EU, BfR and GB clearances.

VINNOL® Resins with Carboxyl Groups

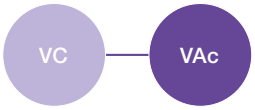
VINNOL® surface coating resins with carboxyl groups are terpolymers of vinyl chloride, vinyl acetate and dicarboxylic acids. These grades are identified by an 'M' in the product name. They provide excellent adhesion, particularly to metal substrates. Adhesion to mineral substrates and glass is also enhanced.

VINNOL® Resins with Hydroxyl Groups

VINNOL® resins with hydroxyl groups are copolymers of vinyl chloride, hydroxy acrylate and, in the case of VINNOL® E 22/48 A, additionally dicarboxylic acid ester.

The hydroxyl groups provide strong adhesion to various plastic substrates as well as to metal and wood. Hydroxy-modified VINNOL® resins are particularly compatible with other coating resin classes such as alkyd, epoxy, urea, ketone, melamine, phenolic, acrylic and isocyanate resins. The hydroxy functionality permits cross-linking reactions for coating systems with outstanding chemical and thermomechanical resistance as well as improved surface hardness and abrasion resistance.

VINNOL® Non-Functional Grades

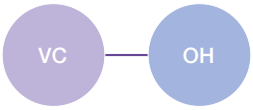


Vinyl chloride Vinyl acetate

VINNOL® Functional Grades: M Types

Dicarboxylic acid

VINNOL® Functional Grades: A Types



Hydroxy acrylate



WACKER uses two different types of polymerization processes for VINNOL® resins.

Suspension Polymerization

VINNOL® H resins are produced by a suspension process and they offer very high water and chemical resistance.

Emulsion Polymerization

VINNOL® E resins are produced by an emulsion process and are unique to the market. They exhibit excellent pigment-wetting properties, which renders them ideal for pigmented systems.

VINNOL® grades are available in different molar compositions and molecular weights, which affects the solubility and the physico-chemical properties of the coatings.

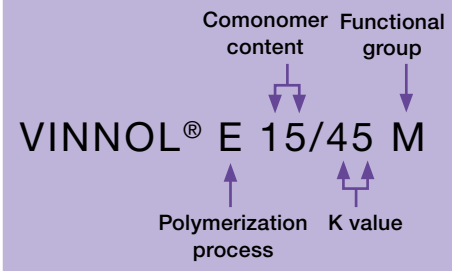
Influence of the Molecular Weight

With increasing molecular weight (K value, degree of polymerization), the solution viscosity is also raised. Consequently the mechanical strength and softening range of the coating are higher.

Influence of Vinyl Acetate Content

The polymer's vinyl acetate content increases the flexibility and lowers the softening temperature of VINNOL® based coatings. Increasing the vinyl acetate content leads to higher solubility in various solvents and lower solution viscosities. Vinyl chloride-vinyl acetate copolymers, with a very high vinyl acetate content, such as the unique VINNOL® H 40 series, and H 30/48 M, are frequently used to facilitate the use of mild solvents such as esters, glycol esters and some glycol ethers. They also exhibit solubility in certain acrylic monomers and styrene. For heat sealing applications, VINNOL® H 40 resins enable customers to significantly lower the sealing temperature.

How to Read the Product Names



Comonomer Content:
A higher content of comonomer besides vinyl chloride reduces solution viscosity and the coating softening range while increasing coating flexibility.

Polymerization Process:
H = suspension polymerization
E = emulsion polymerization

Functional Group:
No letter = no functional group
M = carboxyl group
A = hydroxyl group

K Value:
Molecular weight / viscosity. A higher K value increases solution viscosity, mechanical strength and the coating softening range.

VINNOL® RESINS – PRODUCT OVERVIEW

Without Functional Groups

	Polymer Composition												
Grades	**Vinyl chloride % by wt[1]**	**Vinyl acetate % by wt[1]**	**Other monomers % by wt[1]**	**Acid value mg KOH/g polymer[1]**	**Hydroxyl content % by wt[1]**	**K value[2]**	**Molecular weight average M_w (SEC)[3,4]**	**Viscosity[5] DIN 53015 [mPa·s]**	**Efflux time ISO 2431 4 mm cup[5, 4]**	**Particle size mm[1]**	**Glass transition temperature T_g (DSC) °C[4]**	**Compliance with Food Contact Regulation FDA 175.300**	**Grades**
VINNOL® E 15/45	85.0 ± 1.0	15.0 ± 1.0	-	-	-	45 ± 1	45–55 x 10^3	37 ± 5	ca. 36	< 2.5	ca. 75	Yes	**VINNOL® E 15/45**
VINNOL® E 18/38	82.0 ± 1.0	18.0 ± 1.0	-	-	-	38 ± 1	33–43 x 10^3	15 ± 4	ca. 21	< 2.5	ca. 70	Yes	**VINNOL® E 18/38**
VINNOL® H 14/36	85.6 ± 1.0	14.4 ± 1.0	-	-	-	35 ± 1	30–40 x 10^3	13 ± 3	ca. 20	< 1	ca. 69	Yes	**VINNOL® H 14/36**
VINNOL® H 15/42	86.0 ± 1.0	14.0 ± 1.0	-	-	-	42 ± 1	35–50 x 10^3	28 ± 5	ca. 26	< 1	ca. 70	Yes	**VINNOL® H 15/42**
VINNOL® H 15/50	85.0 ± 1.0	15.0 ± 1.0	-	-	-	50 ± 1	60–80 x 10^3	70 ± 10	ca. 66	< 1	ca. 74	Yes	**VINNOL® H 15/50**
VINNOL® H 11/59	89.0 ± 1.0	11.0 ± 1.0	-	-	-	59 ± 1	80–120 x 10^3	450 ± 100	-	< 1	ca. 75	Yes	**VINNOL® H 11/59**
VINNOL® H 40/43	65.7 ± 1.0	34.3 ± 1.0	-	-	-	42 ± 1	40–50 x 10^3	25 ± 5	ca. 26	< 1	ca. 58	Yes	**VINNOL® H 40/43**
VINNOL® H 40/50	63.0 ± 1.0	37.0 ± 1.0	-	-	-	50 ± 1	60–80 x 10^3	55 ± 10	ca. 45	< 1	ca. 60	Yes	**VINNOL® H 40/50**
VINNOL® H 40/55	62.0 ± 1.0	38.0 ± 1.0	-	-	-	55 ± 1	80–120 x 10^3	100 ± 20	ca. 80	< 1	ca. 60	Yes	**VINNOL® H 40/55**
VINNOL® H 40/60	61.0 ± 1.0	39.0 ± 1.0	-	-	-	60 ± 1	100–140 x 10^3	180 ± 30	ca. 145	< 1	ca. 62	Yes	**VINNOL® H 40/60**

With Carboxyl Groups

	Polymer Composition												
Grades	**Vinyl chloride % by wt[1]**	**Vinyl acetate % by wt[1]**	**Other monomers % by wt[1]**	**Acid value mg KOH/g polymer[1]**	**Hydroxyl content % by wt[1]**	**K value[2]**	**Molecular weight average M_w (SEC)[3,4]**	**Viscosity[5] DIN 53015 [mPa·s]**	**Efflux time ISO 2431 4 mm cup[5, 4]**	**Particle size mm[1]**	**Glass transition temperature Tg (DSC) °C[4]**	**Compliance with Food Contact Regulation FDA 175.300**	**Grades**
VINNOL® E 15/45 M	84.0 ± 1.0	15.0 ± 1.0	ca. 1.0	7.0 ± 1.0	-	45 ± 1	50–60 x 10^3	40 ± 5	ca. 34	< 2.5	ca. 73	Yes	**VINNOL® E 15/45 M**
VINNOL® H 15/45 M	84.0 ± 1.0	15.0 ± 1.0	ca. 1.0	6.5 ± 1.0	-	48 ± 1	60–80 x 10^3	60 ± 10	ca. 50	< 1	ca. 74	Yes	**VINNOL® H 15/45 M**
VINNOL® H 15/45 M special	84.0 ± 1.0	15.5 ± 1.0	ca. 0.5	4.5 ± 1.5	-	48 ± 1	60–80 x 10^3	60 ± 10	ca. 50	< 1	ca. 74	Yes	**VINNOL® H 15/45 M special**
VINNOL® H 30/48 M	70.0 ± 1.0	29.0 ± 1.0	ca. 1.0	7.0 ± 1.5	-	48 ± 1	60–80 x 10^3	45 ± 10	ca. 45	< 1	ca. 65	Yes	**VINNOL® H 30/48 M**

With Hydroxyl Groups

	Polymer Composition												
Grades	**Vinyl chloride % by wt[1]**	**Vinyl acetate % by wt[1]**	**Other monomers % by wt[1]**	**Acid value mg KOH/g polymer[1]**	**Hydroxyl content % by wt[1]**	**K value[2]**	**Molecular weight average M_w (SEC)[3,4]**	**Viscosity[5] DIN 53015 [mPa·s]**	**Efflux time ISO 2431 4 mm cup[5, 4]**	**Particle size mm[1]**	**Glass transition temperature T_g (DSC) °C[4]**	**Compliance with Food Contact Regulation FDA 175.300**	**Grades**
VINNOL® E 15/40 A	84.0 ± 1.0	-	ca. 16.0[6]	-	1.8 ± 0.2	39 ± 1	40–50 x 10^3	20 ± 5	ca. 22	< 2.5	ca. 69	No	**VINNOL® E 15/40 A**
VINNOL® E 15/48 A	83.5 ± 1.0	-	ca. 16.5[6]	-	1.8 ± 0.2	48 ± 1	60–80 x 10^3	60 ± 10	ca. 69	< 2.5	ca. 69	No	**VINNOL® E 15/48 A**
VINNOL® E 22/48 A	75.0 ± 1.0	-	ca. 25.0[6/7]	-	1.8 ± 0.2	48 ± 1	60–80 x 10^3	45 ± 7	ca. 46	< 2.5	ca. 61	No	**VINNOL® E 22/48 A**

[1] WACKER method
[2] EN ISO 1628-2
[3] Method: SEC (size exclusion chromatography)
Solvent: THF
Standard: Polystyrene

[4] These figures are only intended as a guide and should not be used in preparing specifications.
[5] 20% solution in methyl ethyl ketone, dissolved at 50 °C
[6] Hydroxy acrylate
[7] Dicarboxylic ester

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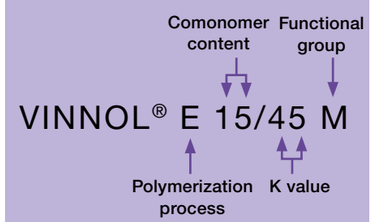

Comonomer Content:
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Polymerization Process:
H = Suspension polymerization
E = Emulsion polymerization

Functional Group:
No letter = no functional group
M = carboxyl group
A = hydroxyl group

K Value:
Molecular weight / viscosity. A higher K value increases solution viscosity, mechanical strength and the coating softening range.

VINNOL® RESINS – APPLICATION
OVERVIEW NON-FUNCTIONAL GRADES

Application	Product										Application
	VINNOL® E 15/45	VINNOL® E 18/38	VINNOL® H 14/36	VINNOL® H 15/42	VINNOL® H 15/50	VINNOL® H 11/59	VINNOL® H 40/43	VINNOL® H 40/50	VINNOL® H 40/55	VINNOL® H 40/60	
Heat-Seal Coatings											**Heat-Seal Coatings**
Heat-sealable coatings			○	○	●		●	●	●	●	Heat-sealable coatings
Heat-seal-resistant coatings											Heat-seal-resistant coatings
Printing Inks											**Printing Inks**
Gravure printing	●	●	●	●	○		○	○			Gravure printing
Ink-jet printing	●	●	●	●			○				Ink-jet printing
Screen or pad printing	●	○			●	●		○	●	●	Screen or pad printing
Transfer printing	●	●	○	○	○	○	●	●	●	●	Transfer printing
Overprint varnishes	●	○	○	○	○	○	○	○	○	○	Overprint varnishes
Pigment Preparations											**Pigment Preparations**
Chips / liquid / paste	●	●		●	●						Chips / liquid / paste
Industrial Coatings											**Industrial Coatings**
Wood coatings / varnishes	○	○	○	○	○		●	●	●	○	Wood coatings / varnishes
Artificial leather coatings	●	●	○	○	●	●	○	●	●	●	Artificial leather coatings
Plastic coatings	○	○	○	○	○	○	○	○	○	○	Plastic coatings
Corrosion-protection coatings							○	○	○	○	Corrosion-protection coatings
Marine paints	○	○		○			○	○	○		Marine paints
Metal coatings	○	○	○	○	○		○	○	○	○	Metal coatings
Baking / wire enamels											Baking / wire enamels
Strippable coatings	●	○	○	○	●	●	○	●	●	●	Strippable coatings
Stamping foils	○	○	○	○	○	○	○	○	○	○	Stamping foils
Nitrocellulose coatings							●	●	●	●	Nitrocellulose coatings
Coil coatings							○	○	○	○	Coil coatings
Magnetic stripes							○	○	○		Magnetic stripes
Reactive Coatings											**Reactive Coatings**
Additive (shrink-control, adhesion, flexibility)		○					●	●	○		Additive (shrink-control, adhesion, flexibility)
Adhesives											**Adhesives**
Adhesive for PVC-plasticized	○	○	○	○	●	●	○	●	●	●	Adhesive for PVC-plasticized
Adhesive for PVC-unplasticized					○	●					Adhesive for PVC-unplasticized
Masonry Paints											**Masonry Paints**
Concrete paints	●	●	●	●	●	○	●	●	●	○	Concrete paints
Floor paints	●	●	●	●	●	○	●	●	●	○	Floor paints
Road-marking paints			●	●			●	●	●	○	Road-marking paints
Roof paints							●	●	●	○	Roof paints
Other Coatings											**Other Coatings**
Barrier coatings	●	○	●	●	●	●	●	●	●	●	Barrier coatings
Primers for metallization			○	○			○	○	○	○	Primers for metallization
Protective coatings for metallized film							○	○	○	○	Protective coatings for metallized film

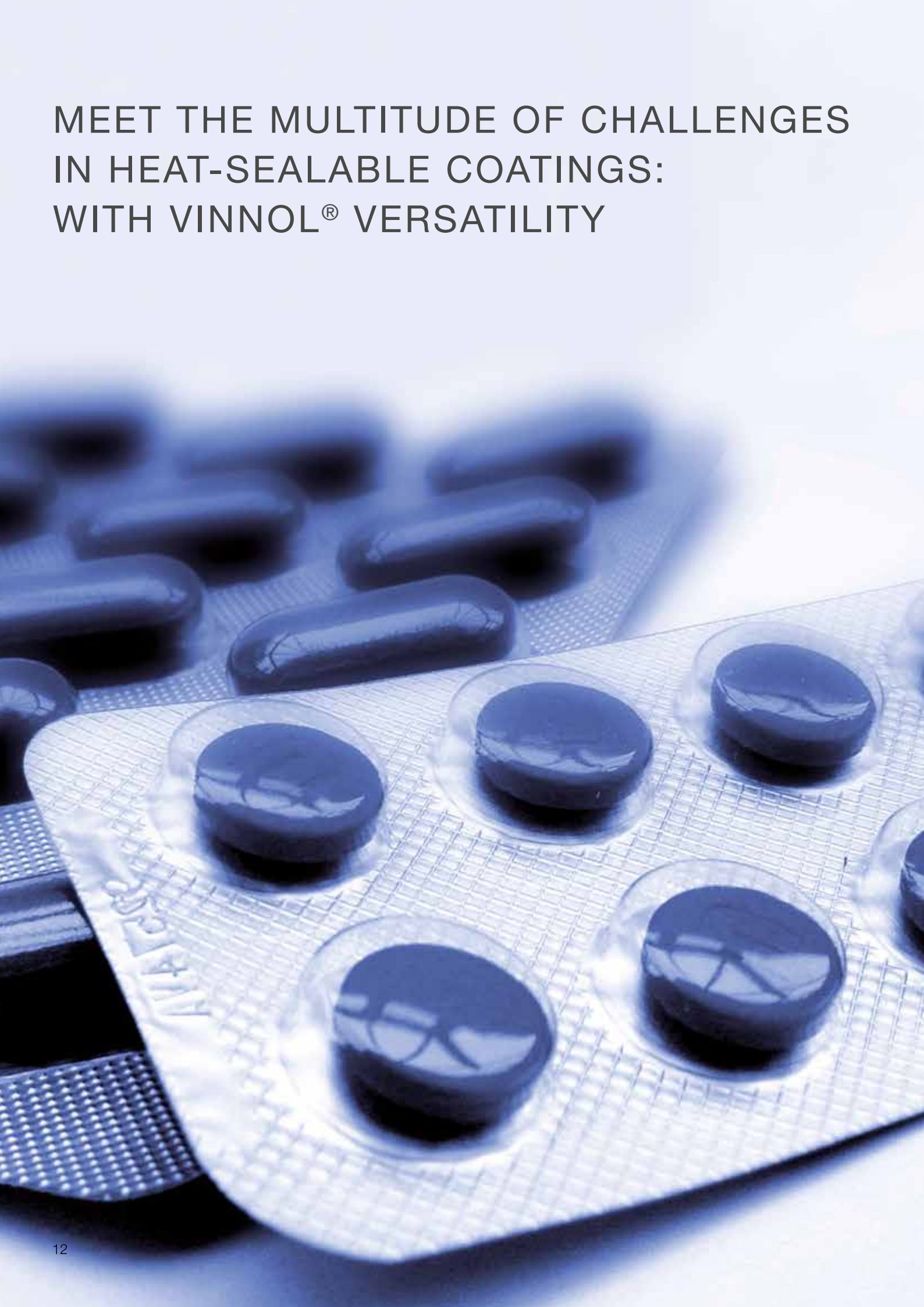
● = Recommended
○ = Suitable

VINNOL® RESINS – APPLICATION OVERVIEW FUNCTIONAL GRADES

Application	Product							Application
	With Carboxyl Groups				With Hydroxyl Groups			
	VINNOL® E 15/45 M	VINNOL® H 15/45 M	VINNOL® H 15/45 M special	VINNOL® H 30/48 M	VINNOL® E 15/40 A	VINNOL® E 15/48 A	VINNOL® E 22/48 A	
Heat-Seal Coatings								**Heat-Seal Coatings**
Heat-sealable coatings	○	●	●	●				Heat-sealable coatings
Heat-seal-resistant coatings					●	●	●	Heat-seal-resistant coatings
Printing Inks								**Printing Inks**
Gravure printing	●	○	○	○	●	●	●	Gravure printing
Ink-jet printing	○				●		○	Ink-jet printing
Screen or pad printing	●	●	●	●		●	○	Screen or pad printing
Transfer printing	●	●	●	●	○	○	○	Transfer printing
Overprint varnishes	○	○	○	○	○	○	○	Overprint varnishes
Pigment Preparations								**Pigment Preparations**
Chips / liquid / paste					●	○	●	Chips / liquid / paste
Industrial Coatings								**Industrial Coatings**
Wood coatings/varnishes					●	●	●	Wood coatings/varnishes
Artifical leather coatings					●	●	●	Artifical leather coatings
Shoe-sole coatings					●	●	●	Shoe-sole coatings
Plastic coatings	●	●	●	●	●	●	●	Plastic coatings
Corrosion-protection coatings	●	●	●	●	●	●	●	Corrosion-protection coatings
Marine paints		●	●	●	●	●	●	Marine paints
Metal coatings	●	●	●	●	●	●	●	Metal coatings
Baking / wire enamels	●	●	●	●	●	●	●	Baking / wire enamels
Strippable coatings								Strippable coatings
Stamping foils	●	●	●	●	●	●	●	Stamping foils
Nitrocellulose coatings								Nitrocellulose coatings
Coil coatings	●	●	●	●	●	●	●	Coil coatings
Magnetic stripes					●	●	●	Magnetic stripes
Reactive Coatings								**Reactive Coatings**
Additive (shrink-control, adhesion, flexibility)				●			●	Additive (shrink-control, adhesion, flexibility)
Adhesives								**Adhesives**
Adhesive for metal	○	●	●	●				Adhesive for metal
Two-pack adhesive					●	●	●	Two-pack adhesive
Staple cement	○	○	●	●		○	○	Staple cement
Masonry Paints								**Masonry Paints**
Concrete paints	●	●	●	●	○	●	○	Concrete paints
Floor paints	●	●	●	●	○		○	Floor paints
Road-marking paints	●	●	●	●		●		Road-marking paints
Roof paints	●	●	●	●				Roof paints
Other Coatings								**Other Coatings**
Barrier coatings	○	○	○	○	○	●	○	Barrier coatings
Primers for metallization	●	●	●	●	○	○	○	Primers for metallization

● = Recommended
○ = Suitable

MEET THE MULTITUDE OF CHALLENGES IN HEAT-SEALABLE COATINGS: WITH VINNOL® VERSATILITY



Heat-sealed closure systems are often the best choice for packaging food or pharmaceuticals. Depending on the specific sealing system, heat-sealable coatings must fulfill various application needs. The VINNOL® resin portfolio enables you to control these product and process requirements.

Typical Product Requirements for Heat-Sealable Coatings

- Adhesion to aluminum substrates
- Transparency
- Thermal stability
- Chemical resistance
- Flexibility
- Seal bond strength
- Corrosion resistance
- Food-contact approval

Typical Process Benefits for Heat-Sealable Coatings

- Adjustable viscosity
- Solubility in a wide range of solvents
- Low levels of solvents required
- Reduction/elimination of plasticizers
- Low thermal activation temperature (e.g. 140 °C)
- Excellent compatibility with cobinders and additives
- High storage stability of coated foils/ easy unrolling of coated foils
- Minimal corrosion of process equipment

VINNOL® can help to fulfil these requirements through a sophisticated product concept.

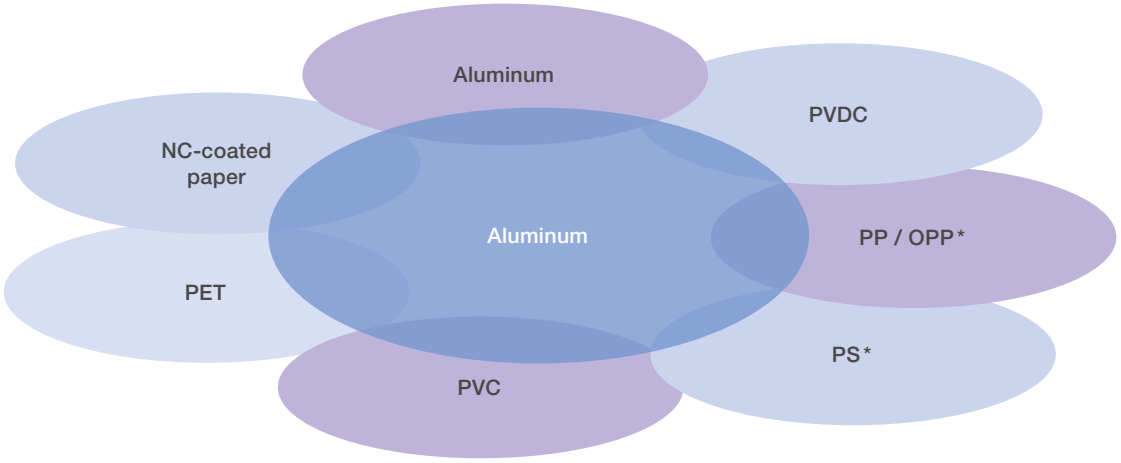
Key Advantages of VINNOL®

- Outstanding water and chemical resistance
- Low odor and taste-free
- Excellent solubility and ease of processing
- Wide formulation range
- High corrosion resistance of coatings
- High toughness and permanent flexibility
- Superior abrasion resistance

Suitable for Food and Pharmaceutical Packaging

Many VINNOL® resin grades comply with food contact regulations. Contact your WACKER representatives regarding applications which require specific clearances.

Substrates Heat Sealable to Aluminum Foils Coated with VINNOL®



* Combined with e.g. acrylic resins or acrylic-olefin dispersions

RESINS TAILOR-MADE FOR VARIOUS REQUIREMENTS

Packaging binders are governed by a number of critical parameters: seal bond strength, viscosity and sealing temperature. With our broad range of tailor-made VINNOL® grades you can optimize your process to meet your specific requirements.

The Basis of Heat-Sealable Coatings

VINNOL® surface coating resins with carboxyl groups are terpolymers of vinyl-chloride, vinyl acetate and dicarboxylic acids. These grades are identified with an "M" in the product name. They provide excellent adhesion, particularly to metal substrates. Adhesion to glass is also enhanced.

Modifiers

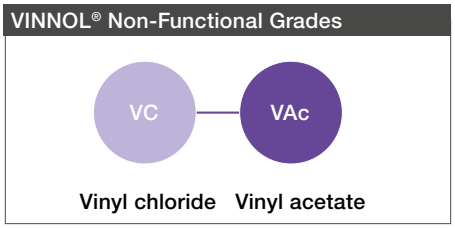
VINNOL® resins without functional groups are copolymers of vinyl chloride and vinyl acetate. They are available in different molar compositions and a broad molecular weight range. These VINNOL® copolymers are used as modifiers to achieve a specific property profile. Solution viscosity and seal bond strength can be adjusted to individual demands.

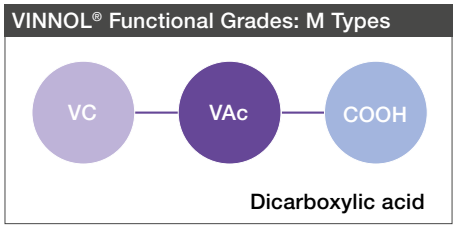
VINNOL® H Grades

VINNOL® H grades are manufactured by suspension polymerization. They allow for highly transparent coatings with low water absorption – which is important for heat-sealable coatings.

In heat-sealing applications, mainly VINNOL® H grades are used.

However, emulsion-polymerized E grades, which are mainly used for applications other than heat sealing, are also available.





VINNOL® H 15/45 M – the Reference Grade with Manifold Advantages

VINNOL® H 15/45 M is the market reference grade and fulfills all possible needs in most heat-sealing applications. VINNOL® H 15/45 M is a carboxy-containing copolymer of vinyl chloride and vinyl acetate, mainly used as a binder for heat-sealable coatings. It shows excellent adhesion to metal surfaces as well as to polar substrates, e.g. PVC and PET. It is approved for food-contact applications and is in compliance with FDA 21 CFR 175.300. It is an excellent, well-established choice for many types of foodstuffs and pharmaceutical packaging.

Major Benefits Provided by VINNOL® H 15/45 M:

- Excellent chemical resistance
- Low water uptake
- High abrasion resistance
- High toughness
- Permanent flexibility
- Low gas-permeability
- High solubility in ketones

VINNOL® H 30/48 M

VINNOL® H 30/48 M is a coating resin containing a higher proportion of vinyl acetate polymer units compared to VINNOL® H 15/45 M.

Excellent Solubility in Pure Ester

VINNOL® H 30/48 M has the additional advantage of excellent solubility in lower-cost esters, enabling the formulation of clear, colorless solutions without any use of ketones whatsoever.

Low Viscosity

Even with an increased solids content, the resin solution is still of low viscosity. Less solvent is required as a result, reducing costs and allowing a higher resin load.

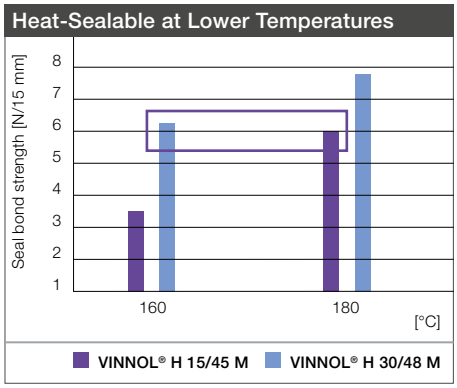
Low Viscosity

	Viscosity in ethyl acetate [mPa•s]	
Solid content	VINNOL® H 15/45 M	VINNOL® H 30/48 M
15%	43	35
20%	146	89
25%	601	254
30%	Gel-like	716

The lower viscosity facilitates processing and cuts solvent consumption.
Reference of the test method: measured by Brookfield viscometry at 25 °C

Heat-Sealable at Lower Temperatures

Coatings based on VINNOL® H 30/48 M can be heat-sealed even at lower temperatures due to the higher vinyl-acetate content in the polymer backbone. This lowers energy and processing costs and opens up new applications, as it enables the packaging of heat-sensitive foods such as cheese.



A lower sealing temperature saves energy and enables the packaging of heat-sensitive food.

VINNOL® H 40 Grades: The Perfect Modifiers

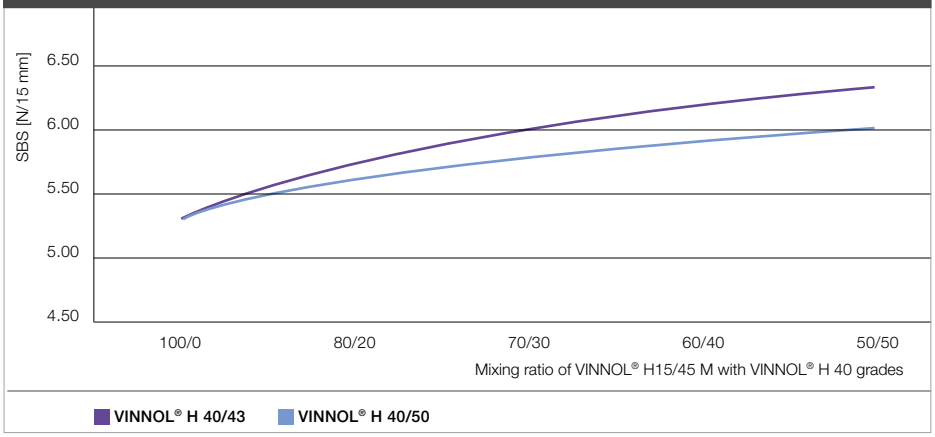
The VINNOL® H 40 series can be used to modify various process parameters:

- Blending VINNOL® H 40 grades with carboxy-modified grades such as VINNOL® H 15/45 M leads to a higher seal bond strength (see graph). Various VINNOL® H 40 grades have the capability to enhance the seal bond strength of VINNOL® H 15/45 M to a certain extent. On the other hand, with this combination, the sealing temperature can be significantly reduced while retaining the original bond strength.
- Due to their higher vinyl acetate content in the polymer, VINNOL® H 40 grades lead to a better solubility, lower viscosities and thus to higher dispersion and processing speeds. For example, combining VINNOL® H 15/45 M with VINNOL® H 40/43 will significantly reduce the viscosity, increase the solubility and allow for higher processing speeds.

Seal Bond Strength

Under given sealing conditions the seal bond strength can be raised by blending VINNOL® H 15/45 M with VINNOL® H 40/43 or VINNOL® H 40/50. Alternatively the sealing temperature may be significantly reduced, while retaining the original bond strength.

Influence on Seal Bond Strength: Mixing Ratio of VINNOL® H 15/45 M with VINNOL® H 40 Grades



By influencing these variables, you can seal even thermally sensitive composite systems. Therefore, a broader range of products can easily and safely be packaged.

VINNOL® H 15/45 M Special

VINNOL® H 15/45 M special is a more advanced version of VINNOL® H 15/45 M. An optimized manufacturing process, as well as slight modifications in the polymer backbone, allow significant improvements in the following properties as compared to VINNOL® H 15/45 M.

Thermal Stability

The product can resist higher temperatures for longer timeframes, which has a positive impact on storage stability. This characteristic makes it especially suitable for countries with hot climates.

Water Resistance

The seal bond strength remains very high, even under very humid or wet conditions. VINNOL® H 15/45 M special is highly recommended for packaging refrigerated foodstuffs.

UNLIMITED POSSIBILITIES ON VARIOUS SUBSTRATES

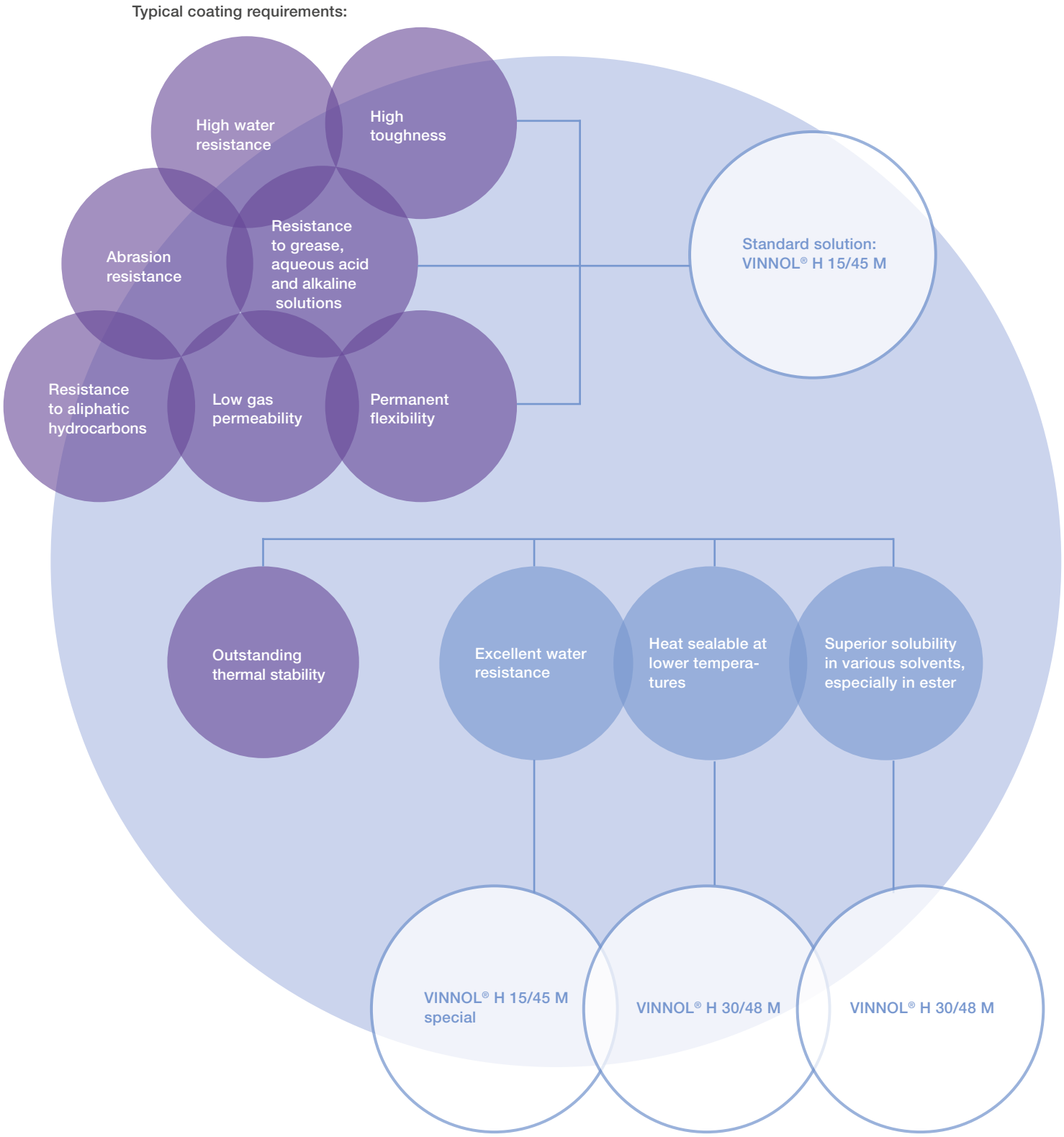
Key Applications Areas for Aluminum Foils Coated with VINNOL®				
Sealing System	**One-Coat System**		**Two-Coat System**	
		Blending ratio	**Primer**	**Sealing coat**
Alu – Alu	VINNOL® H 15/45 M or VINNOL® H 30/48 M		VINNOL® H 15/45 M	VINNOL® H 40/43 VINNOL® H 40/50
Alu – NC-coated paper	VINNOL®H 30/48 M		VINNOL® H 15/45 M	VINNOL® H 40/43 VINNOL® H 40/50
Alu – PET	VINNOL® H 15/45 M		–	–
Alu – PP and OPP	VINNOL® H 15/45 M + Acrylic-olefin dispersion		VINNOL® H 15/45 M	Acrylic-olefin dispersion
Alu – PS	VINNOL® H 15/45 M + acrylic resin	1/1 – 1/4	VINNOL® H 15/45 M or VINNOL® H 30/48 M	Blend of VINNOL® resins/ acrylic resin in a ratio of 1/9 or pure acrylic resin
Alu – PVC	VINNOL® H 15/45 M or VINNOL® H 30/48 M		VINNOL® H 15/45 M or VINNOL®H 30/48 M	VINNOL® H 40/43 VINNOL® H 40/50 VINNOL® H 15/50
	VINNOL® H 15/45 M + VINNOL® H 40/43	1/1		
	VINNOL® H 15/45 M + VINNOL® H 15/50	1/1		
Alu – PVDC	VINNOL® H 15/45 M + acrylic resin	1/1	–	–

Product Overview: Heat-Sealable Coatings							
	Polymer Composition						
Grades	**Vinyl chloride % by wt[1]**	**Vinyl acetate % by wt[1]**	**Other monomers % by wt[1]**	**K value[2]**	**Glass transition temperature T_g (DSC) °C**	**Viscosity[3] DIN 53015 [mPa•s]**	**FDA regulation 175.300**
With Carboxyl Groups							
VINNOL® H 15/45 M	84.0 ± 1.0	15.0 ± 1.0	ca. 1.0[4]	48 ± 1	ca. 73	60 ± 10	Yes
VINNOL® H 15/45 M special	84.0 ± 1.0	15.5 ± 1.0	ca. 0.5[4]	48 ± 1	ca. 74	60 ± 10	Yes
VINNOL® H 30/48 M	70.0 ± 1.0	29.0 ± 1.0	ca. 1.0[4]	48 ± 1	ca. 65	45 ± 10	Yes
Without Functional Groups							
VINNOL® H 14/36	85.6 ± 1.0	14.4 ± 1.0	-	35 ± 1	ca. 69	13 ± 3	Yes
VINNOL® H 15/42	86.0 ± 1.0	14.0 ± 1.0	-	42 ± 1	ca. 70	28 ± 5	Yes
VINNOL® H 15/50	85.0 ± 1.0	15.0 ± 1.0	-	50 ± 1	ca. 74	70 ± 10	Yes
VINNOL® H 40/43	65.7 ± 1.0	34.3 ± 1.0	-	42 ± 1	ca. 58	25 ± 5	Yes
VINNOL® H 40/50	63.0 ± 1.0	37.0 ± 1.0	-	50 ± 1	ca. 60	55 ± 10	Yes

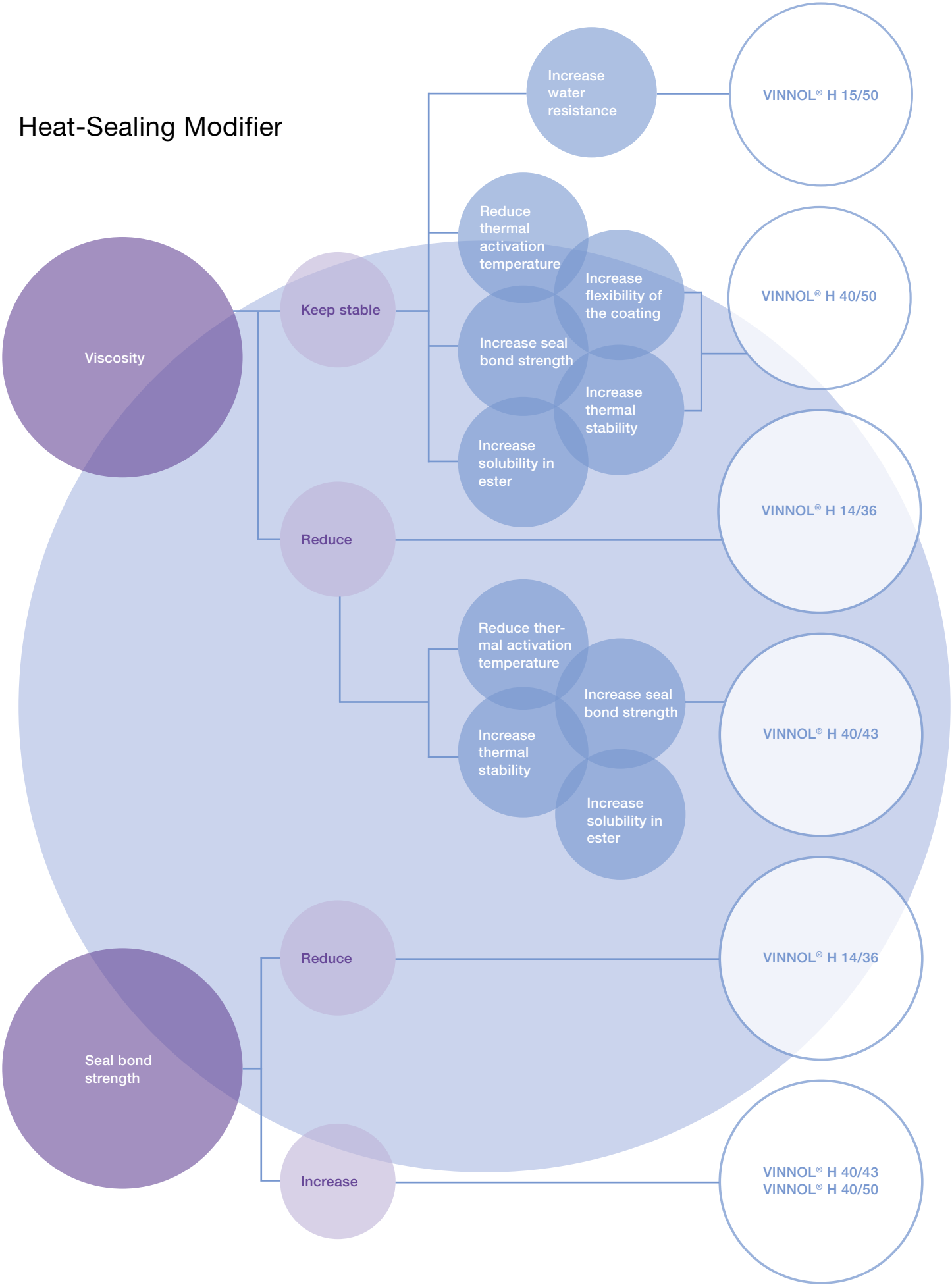
[1] WACKER method
[2] EN ISO 1628-2
[3] 20% solution in methyl ethyl ketone, dissolved at 50 °C
[4] Dicarboxylic acid

BENEFIT FROM AN INTELLIGENT SYSTEM

Heat-Sealing Grade



Heat-Sealing Modifier



ADD GLOSS TO EFFICIENCY: WITH VINNOL® FOR PRINTING INKS

Depending on the specific application and processing technology, printing inks must fulfill various requirements. Among the most important characteristics are viscosity, gloss and – of course – cost effectiveness. The VINNOL® resin portfolio enables you to adjust application and process requirements extraordinarily well. Due to their excellent pigment-wetting and short dispersion times, VINNOL® E grades are particularly suitable for printing inks

Range of Applications

VINNOL® binders are suitable for a variety of applications, e.g.:

- Gravure inks
- Inkjet inks
- Screen-printing inks
- Transfer printing inks
- Overprint varnishes

Typical Product Requirements for Printing Inks:

- High gloss
- Superior color development
- Resistance to typical packaging contents
- Adhesion to various substrates
- Low VOC content
- Light fastness
- Strong hiding power
- Raw-material quality consistency

Typical Process Requirements for Printing Inks:

- Short dispersion times
- High resin solubility
- Wide range of compatibility with pigments and other raw materials

A Unique Combination of Gloss and Efficiency for Pigmented Systems

WACKER offers unique emulsion polymerized vinyl chloride co- and terpolymers to the printing ink industry. These VINNOL® E grades provide the following advantages for high-quality and cost-efficient printing inks:

- Exceptional gloss and color development
- Low gel-forming tendency
- Very good overprintability
- Excellent compatibility with other formulation components
- Short pigment dispersion times
- Reduced usage of dispersion additives and pigments

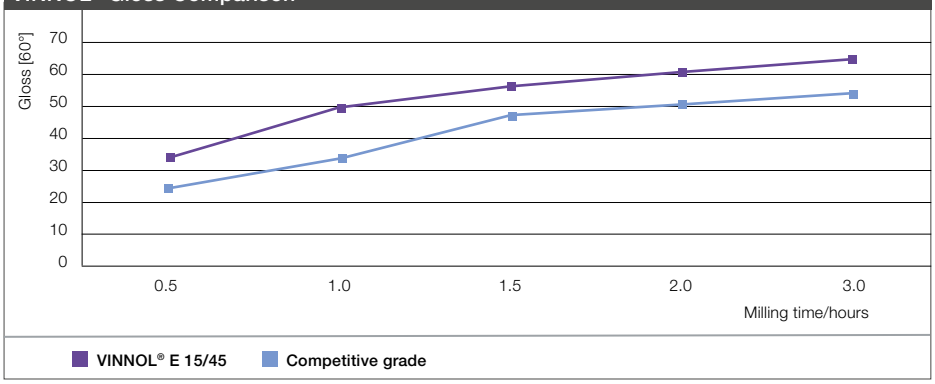
Suitable for Food Packaging

Many VINNOL® resin grades can be used for applications compliant with FDA 21 CFR 175.300 as well as European Food Contact Regulations. Contact your WACKER representative for applications requiring specific clearances.

Available in High and Low Molecular Weight

For the formulation of gravure printing inks, inkjet printing inks and overprint varnishes, VINNOL® grades with low molecular weight are available. For higher-viscosity screen-printing inks, we offer VINNOL® grades of higher molecular weights.

VINNOL® Gloss Comparison



Balancing Gloss and Viscosity by Combining VINNOL® E and VINNOL® H Grades					
Test	**Milling medium (mill base)**	**Diluting medium (varnish)**	**Gloss**	**Gloss evaluation**	**Impact on viscosity after dilution**
1	VINNOL® H 15/50	VINNOL® H 15/50	7	---	0
2	VINNOL® E 15/45	VINNOL® E 15/45	53	+++	0
3	VINNOL® E 15/45	VINNOL® H 15/50	52	+++	++
4	VINNOL® E 15/45	VINNOL® H 14/36	53	+++	--
5	VINNOL® E 15/45	VINNOL® H 15/42	41	++	-
6	VINNOL® E 15/45	VINNOL® H 40/50	48	++	+

Find The Perfect Mix

The combination of VINNOL® E and VINNOL® H grades is especially attractive due to their high compatibility. VINNOL® E grades boost pigment performance and provide higher gloss. VINNOL® H grades of various K values may be used to fine-tune printing ink viscosity.

Product Overview: Printing Inks*

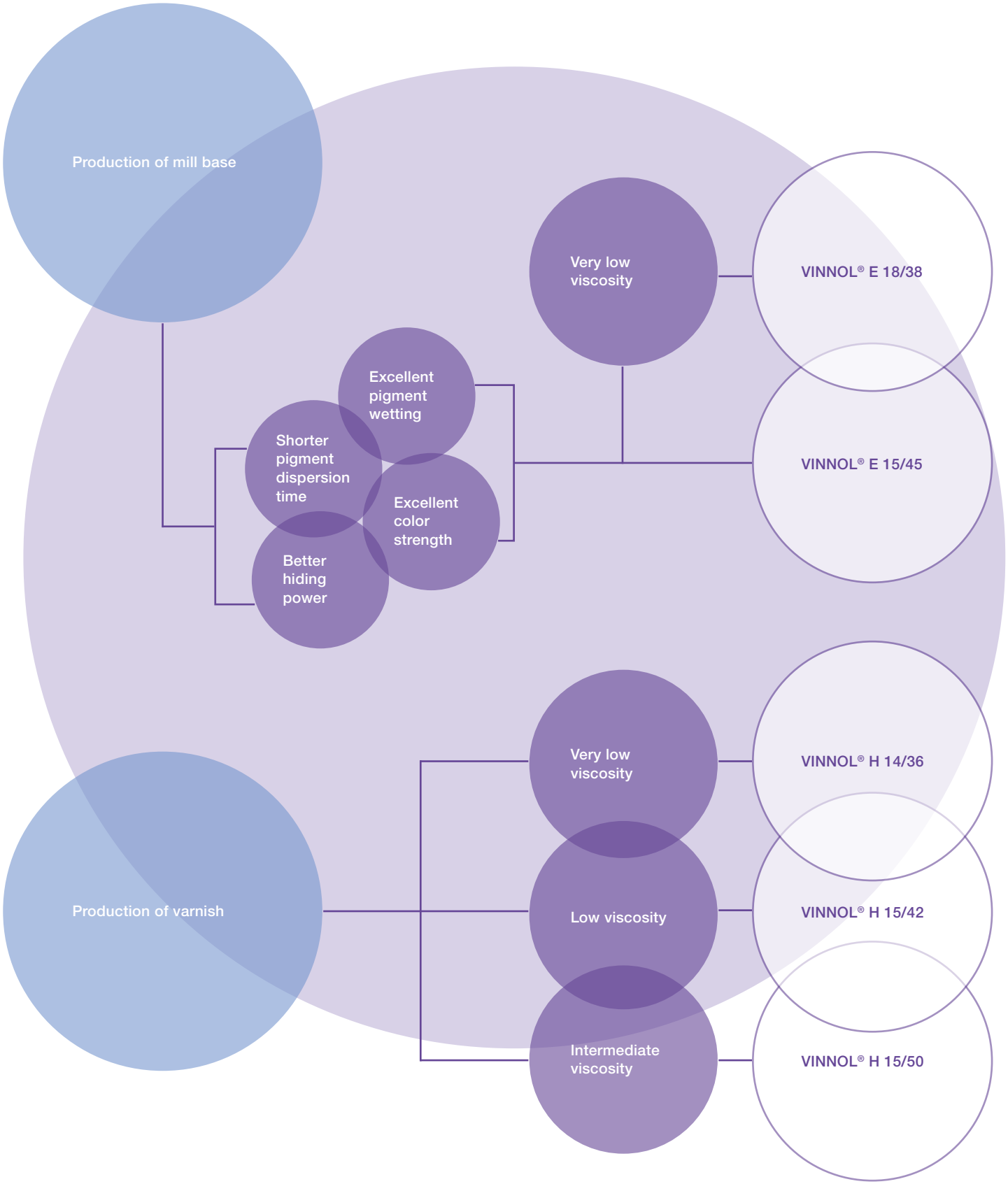
	Polymer Composition						
Grades	**Vinyl chloride % by wt[1]**	**Vinyl acetate % by wt[1]**	**Other monomers % by wt[1]**	**K value[2]**	**Glass transition temperature T_g (DSC) °C**	**Viscosity[3] DIN 53015 [mPa·s]**	**FDA Regulation 175.300**
With Carboxyl Groups							
VINNOL® E 15/45 M	84.0 ± 1.0	15.0 ± 1.0	ca. 1.0	45 ± 1	ca. 73	40 ± 5	Yes
VINNOL® H 15/45 M	84.0 ± 1.0	15.0 ± 1.0	ca. 1.0	48 ± 1	ca. 74	60 ± 10	Yes
VINNOL® H 15/45 M special	84.0 ± 1.0	15.5 ± 1.0	ca. 0.5	48 ± 1	ca. 74	60 ± 10	Yes
VINNOL® H 30/48 M	70.0 ± 1.0	29.0 ± 1.0	ca. 1.0	48 ± 1	ca. 65	45 ± 10	Yes
With Hydroxyl Groups							
VINNOL® E 15/40 A	84.0 ± 1.0	-	ca. 16.0[4]	39 ± 1	ca. 69	20 ± 5	No
VINNOL® E 15/48 A	83.5 ± 1.0	-	ca. 16.5[4]	48 ± 1	ca. 69	60 ± 10	No
VINNOL® E 22/48 A	75.0 ± 1.0	-	ca. 25.0[4/5]	48 ± 1	ca. 61	45 ± 7	No
Without Functional Groups							
VINNOL® E 15/45	85.0 ± 1.0	15.0 ± 1.0	-	45 ± 1	ca. 75	37 ± 5	Yes
VINNOL® E 18/38	82.0 ± 1.0	18.0 ± 1.0	-	38 ± 1	ca. 70	15 ± 4	Yes
VINNOL® H 14/36	85.6 ± 1.0	14.4 ± 1.0	-	35 ± 1	ca. 69	13 ± 3	Yes
VINNOL® H 15/42	86.0 ± 1.0	14.0 ± 1.0	-	42 ± 1	ca. 70	28 ± 5	Yes
VINNOL® H 15/50	85.0 ± 1.0	15.0 ± 1.0	-	50 ± 1	ca. 74	70 ± 10	Yes
VINNOL® H 40/43	65.7 ± 1.0	34.3 ± 1.0	-	42 ± 1	ca. 58	25 ± 5	Yes
VINNOL® H 40/50	63.0 ± 1.0	37.0 ± 1.0	-	50 ± 1	ca. 60	55 ± 10	Yes

[1] WACKER method
[2] EN ISO 1628-2
[3] 20% solution in methyl ethyl ketone, dissolved at 50 °C
[4] Hydroxy acrylate
[5] Dicarboxylic ester

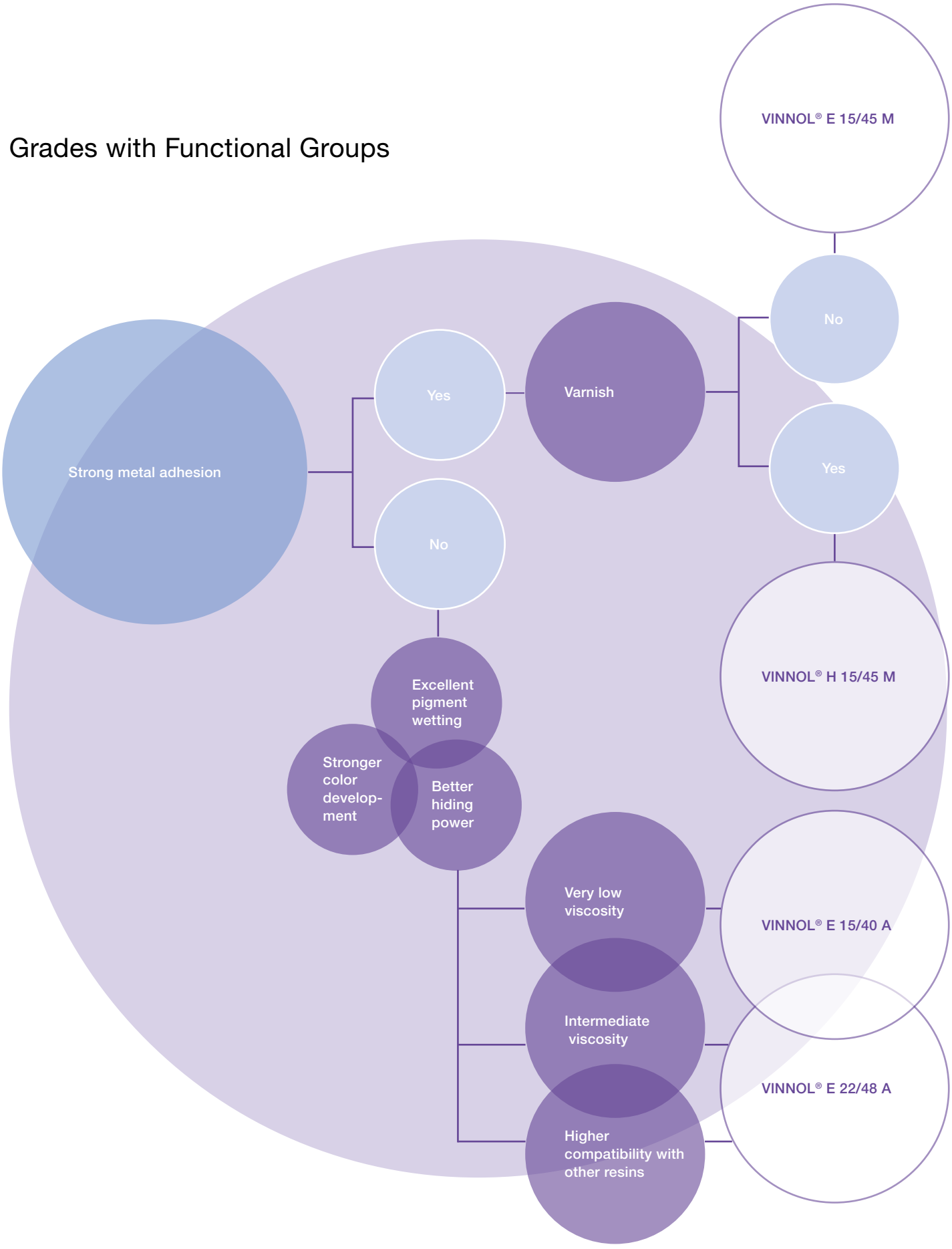
*See pages 8-11 for more information in uses of VINNOL® in particular printing technologies

DISCOVER AN INTELLIGENT SYSTEM

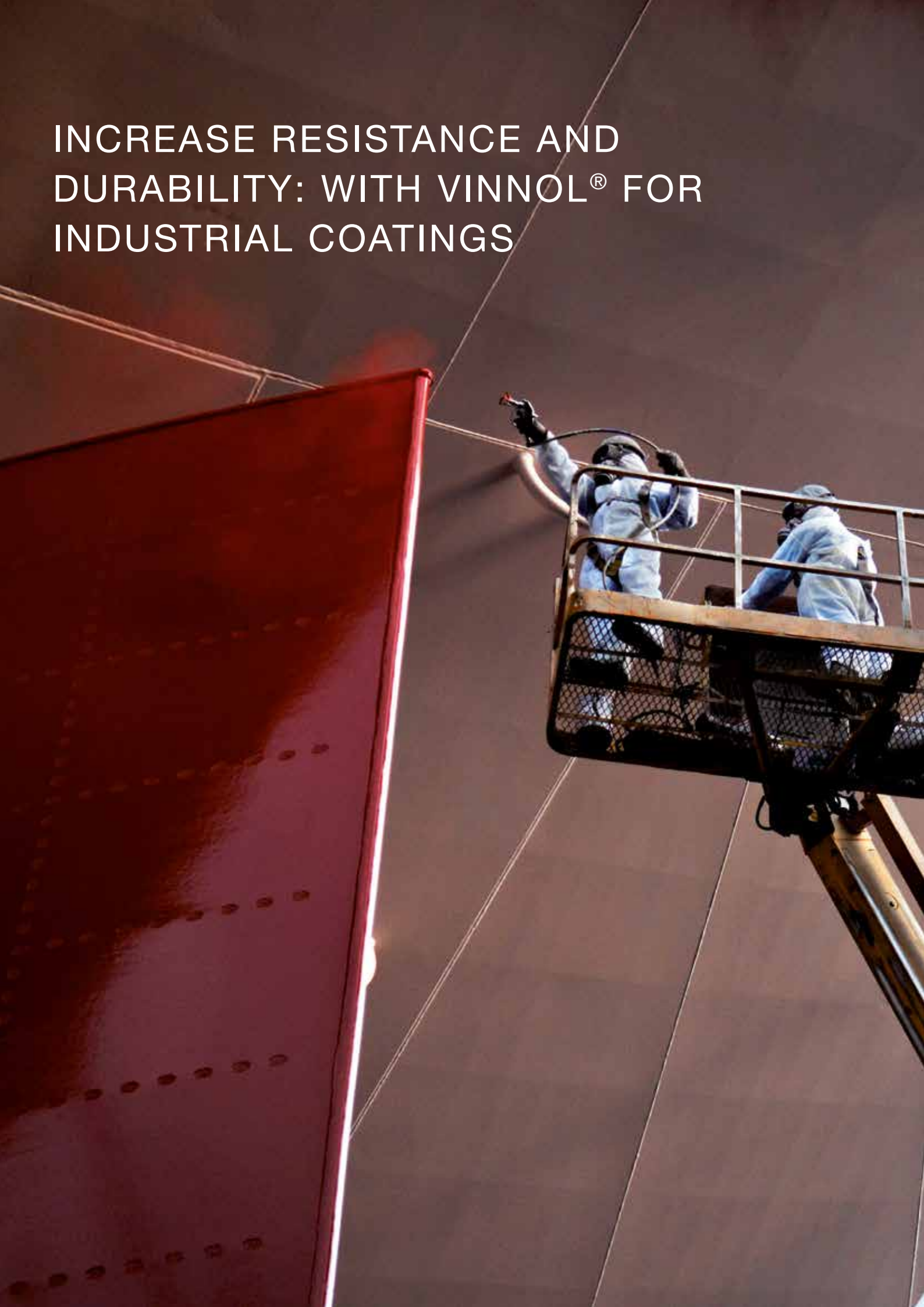
Grades without Functional Groups



Grades with Functional Groups



INCREASE RESISTANCE AND DURABILITY: WITH VINNOL® FOR INDUSTRIAL COATINGS



APPLICATION EXAMPLES

VINNOL® surface coating resins are specialty binders for the formulation of solvent-based industrial coatings. Industrial coatings is a collective term that embraces the following areas of application, among others:

- **Wood coatings**
- **Artificial leather coatings**
- **Shoe-sole coatings**
- **Plastic coatings**
- **Corrosion protection and marine paints**
- **Metal coatings**
- **Baking / wire enamels**
- **Strippable coatings**
- **Stamping foils**
- **Coil coatings**

Wood Coatings/Varnishes

It pays to incorporate VINNOL® into wood coatings – it improves their chemical stability, flexibility and impact resistance. Color fastness is also optimized – especially when the products are used for topcoats in conjunction with nitrocellulose, shellac or other resins. Adding VINNOL® helps to reduce bleeding from the wood and to preserve the wood grain.

Applications include: clear wood varnishes, furniture for interior (e.g., chairs, kitchen, etc.), wood toys, among others.

VINNOL® grades used for wood coatings are mainly hydroxy-functional grades. VINNOL® H 40 resins are suitable for blending with ester-soluble NC coatings to increase their elasticity as well as chemical and yellowing resistance.

Effects of VINNOL® A Grades (VINNOL® E 22/48 A, E 15/48 A and E 15/40 A) Used as Co-binders in PU Coatings:

- Easy pigment wetting
- Improved leveling characteristics
- Improved solvent release
- Optimized balance between elasticity and hardness
- Enhanced chemical resistance
- Reduced yellowing

Artificial Leather Coatings

In artificial-leather applications, VINNOL® provides protective properties and gloss to the surface, helping to prevent brittleness. VINNOL® resin-based coatings on flexible PVC reduce the undesirable migration of plasticizers to the surface, thus preventing the material from becoming tacky.

For PVC artificial leather, combinations of nonfunctional VINNOL® with methylmethacrylate copolymers are frequently used. For PU artificial leather, hydroxy-functional VINNOL® grades are usually the right choice.

Shoe-Sole Coatings

In shoe-sole coatings VINNOL® can contribute the necessary flexibility and also promote adhesion, chemical and water resistance and gloss. For polar sole materials such as PU or PVC, OH-functional grades are typically used.

Plastic Coatings

Plastics are often coated in order to decorate or protect their surfaces. VINNOL® resins adhere to many plastic substrates such as PVC, PET, PU, PC, ABS, PMMA and other polar materials. VINNOL® resins offer an effective means to impart resistance to abrasion, chemicals or light, pigmentability, good compatibility with other systems or flexibility. They can therefore be used for formulating plastic coatings and primers.

VINNOL® resins are used in some cases in conjunction with other resins for formulating plastic coatings on both flexible and rigid plastics.

VINNOL® grades used for polar coatings are mainly carboxy- and hydroxy functional grades. For non-polar plastic surfaces, a chemical or physical pre-treatment (e.g., corona or flame) is usually needed in order to obtain sufficient adhesion.

The main applications for coating flexible plastics are on plastic tarpaulin and as vinyl wallpaper top coats. VINNOL® H 40 resins can be used in vinyl wallpaper top coats to produce permanently elastic coatings for flexible substrates subject to high stress.
Examples of coatings on rigid plastics are communication tools (smartphones, GPS navigation devices, etc), computers and computer equipment, audio equipment, edge-banding (edge ribbons, e.g. for furniture), in-mold decoration and many other plastic coating applications.

Furthermore, a variety of attractive designs are possible as a result of outstanding interaction with numerous pigments. When a metallic pigmentation is desired for plastics, for example for navigation systems or other electronic devices, carboxy-functional VINNOL® grades are used on account of their excellent adhesion to metal surfaces.

Possible Advantages of VINNOL® Grades in Plastic Coatings

- Better alcohol and detergent resistance
- Optimum interlayer adhesion between primer and top coat
- Improvement of levelling characteristics
- High gloss
- H 30/48 M for coating of recycled polar plastics using mild solvents

Strippable Coatings

VINNOL® surface coating resins without functional groups are mainly used in conjunction with monomeric or polymeric plasticizers for formulating permanently-elastic strippable (also often called “peelable”) coatings that can withstand high loads. The extent of adhesion to the substrate may be adjusted by adding functional VINNOL® M grades or VINNOL® A grades.

Applications include the automotive sector (e.g Plasti Dip coatings), temporary protective coatings and the like.

Stamping Foils

Hot stamping foils are used to enhance the look of many everyday products. Product finishing with hot stamping technology is often used to improve the product appearance – for example in intricately designed packaging, high-quality book covers, smartphone housings, through to products for the automotive industry. In other cases, the enhancement may serve a technical function, for example when security elements are applied to credit cards, ID cards or banknotes, or else trademarks / brand protection are incorporated into high-end holographic foil.

All functional VINNOL® resins are highly suitable for this application. Different VINNOL® grades are used depending on the technical properties needed for the application method and substrates.

The binders used in the coatings have a crucial impact on the manufacturing process and on how well the decorative foils work. In particular, the binder selection affects the stamping temperature and the cycle time for machine application. The lacquer system can be tailored by choosing VINNOL® resins with the appropriate functionality – with crosslinkers and cobinders if necessary.

In particular, hydroxy- and carboxy-VINNOL® grades are used in the partially crosslinked decorative layers, which ensure the flawless transfer of the intended design from the foil to the substrate under the influence of heat and pressure. VINNOL® resins are also used in the so-called adhesive layer, which bonds the decorative layers to the respective carrier under the influence of temperature and pressure.

Hot stamping foils are available in a wide range of pigmented and metallized colors and holographic designs. In general, VINNOL® surface coating resins are known for their broad versatility, even in sensitive applications, and their excellent interaction with organic and metallic pigments, resulting in brilliant colors.

Coil Coatings

VINNOL® resins containing carboxyl groups are suitable for this application area on account of their good metal adhesion, but less widespread than PVC organosols and plastisols. VINNOL® resins containing hydroxyl groups are also used for this application.

Corrosion-Protection Coatings and Marine Paints

VINNOL® surface coating resins containing carboxyl groups are ideal for formulating primers, corrosion-protection paints, as well as highly filled marine paints, thanks to their excellent metal adhesion combined with high resistance to acids, alkalis and salt solutions, their good pigment wetting and their low water absorption. The hydroxy-functional grades are suitable for formulating crosslinkable coatings.

The good pigment wetting of the VINNOL® hydroxy functional grades allows the formulation of highly-filled coatings with especially good adhesion to primers based on polyvinyl butyrals, which serve above all as the intermediate coating in multilayer coatings. One application area imited not only to shipbuilding is the manufacturing of primers for hot-dip-galvanized substrates and for underwater paints.

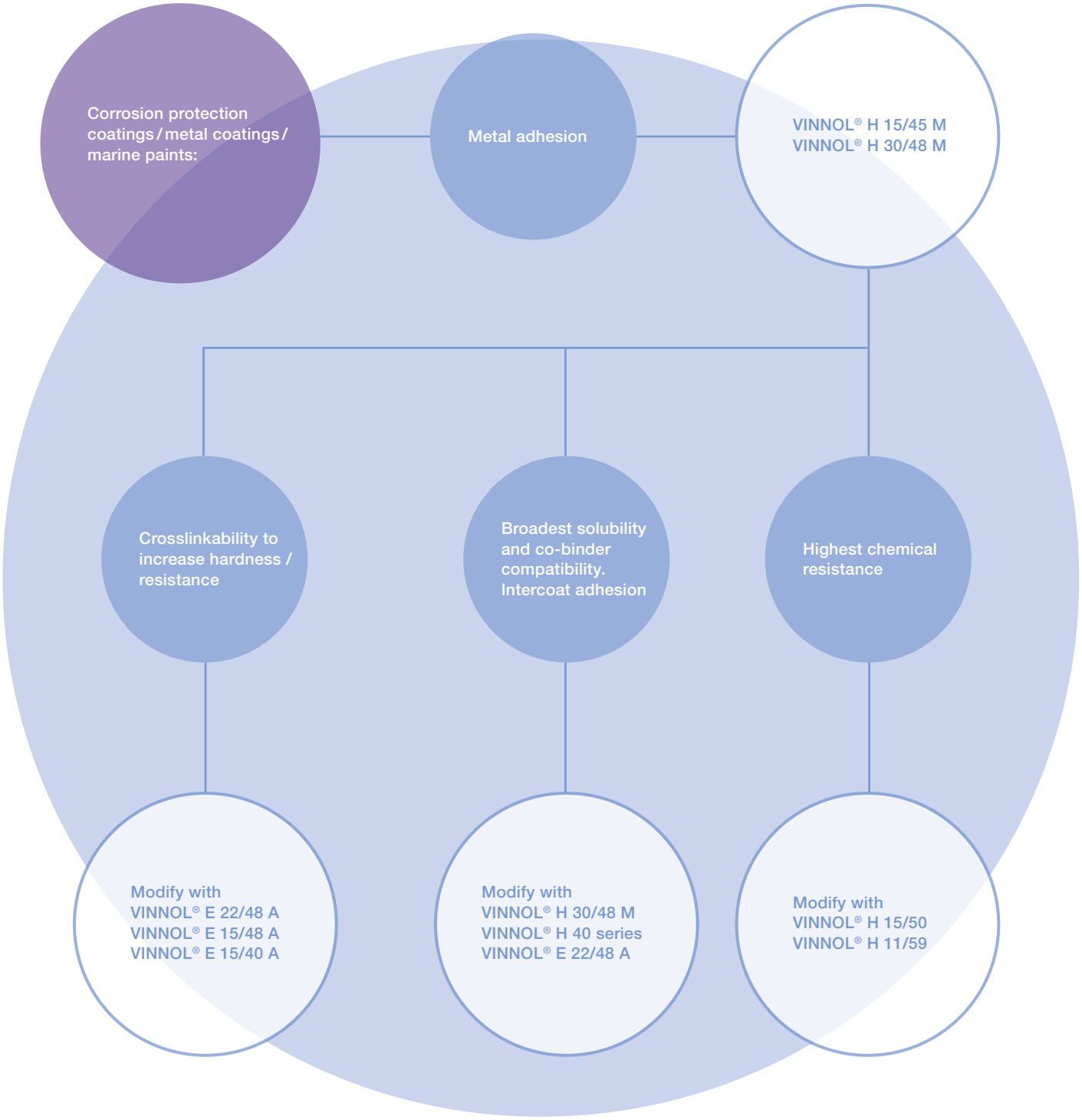
Metal Coatings

VINNOL® combines the advantages of very good adhesion and abrasion resistance with a high degree of flexibility. Due to their good compatibility, they are very often combined with other organic binders. They are especially good at improving color constancy and color gradient.
Main VINNOL® grades used in this application are carboxy- and hydroxy-functional grades. VINNOL® H 15/45 M and H 30/48 M are used for the production of sterilization-resistant interior coatings of cans and closures for food and beverage packaging applications.

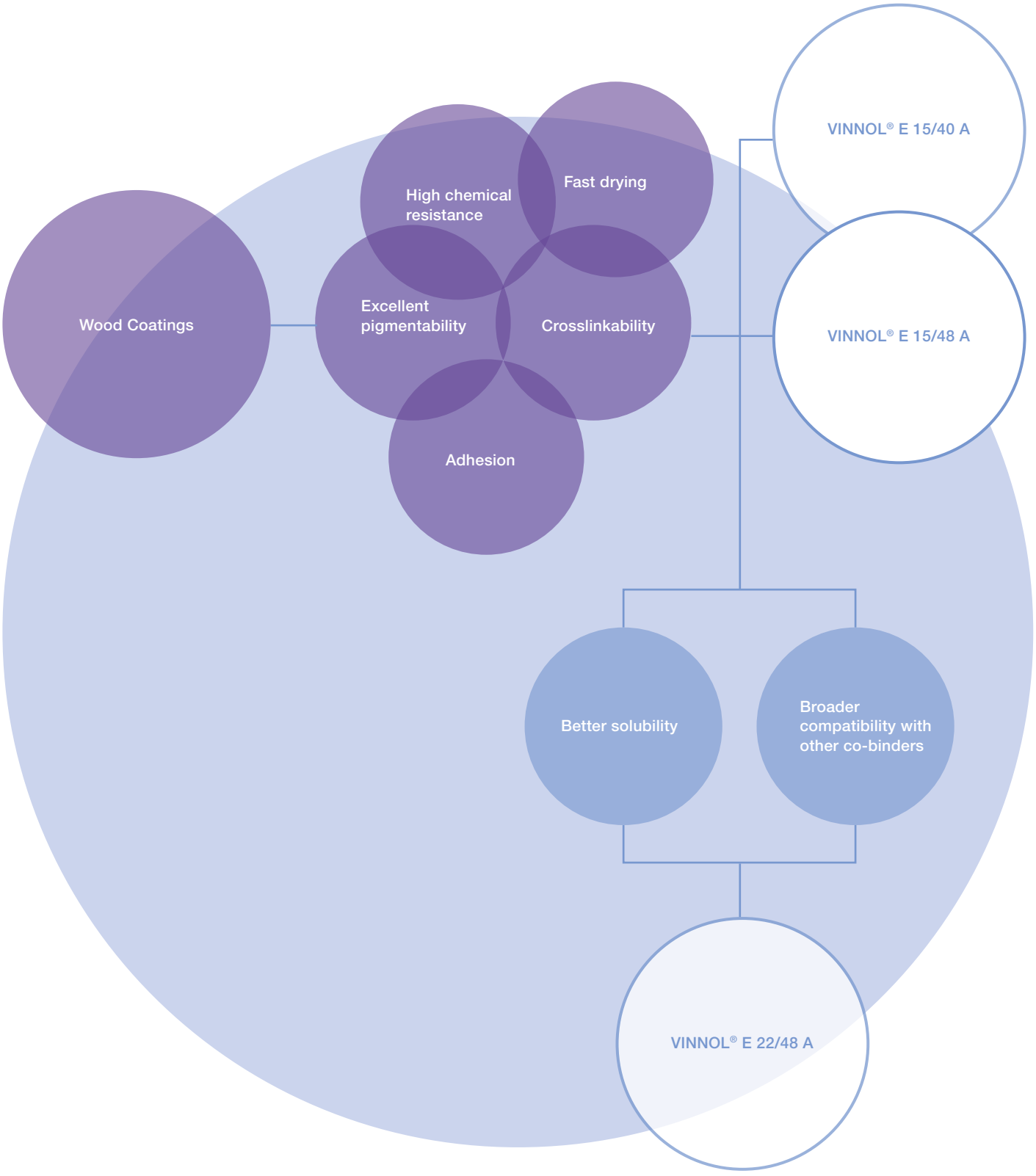
Baking Enamels / Wire Enamels

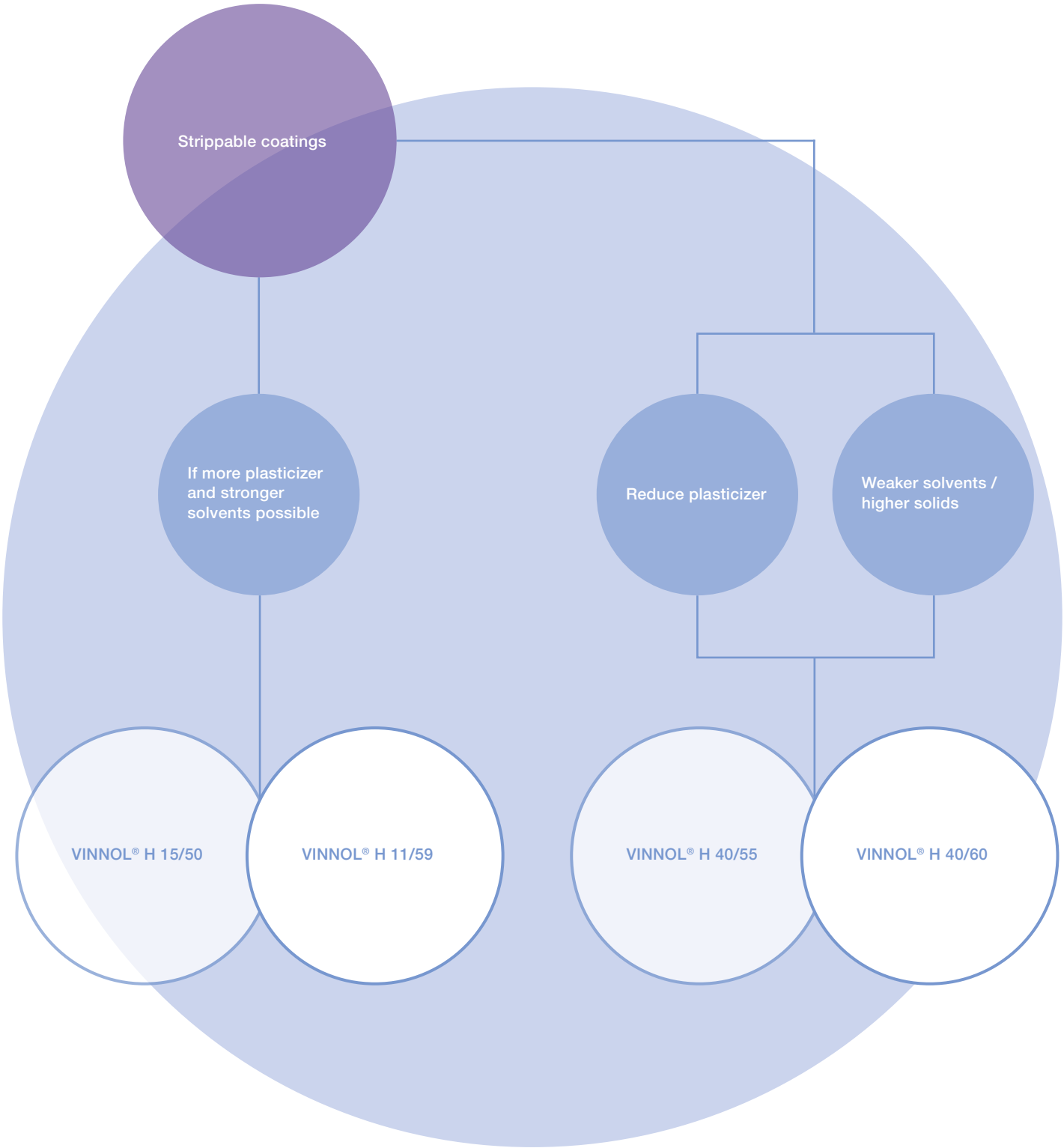
The hydroxyl groups of the VINNOL® grades and their high polymer compatibility facilitate blending with alkyd, epoxy, urea, ketone, melamine, phenolic, polyacrylic and polyisocyanate resins as well as crosslinking reactions in order to enhance chemical and mechanical resistance. The widest polymer compatibility of all VINNOL® grades with other blending resins is shown by VINNOL® E 22/48 A.

INDUSTRIAL COATINGS



INDUSTRIAL COATINGS




Strippable coatings
If more plasticizer and stronger solvents possible
Reduce plasticizer
Weaker solvents / higher solids
VINNOL® H 15/50
VINNOL® H 11/59
VINNOL® H 40/55
VINNOL® H 40/60

COMPATIBILITY OF VINNOL® WITH OTHER BINDERS AND PLASTICIZERS

Binders	Chemical Characterization*	Product																	
		VINNOL® E 15/45	VINNOL® E 18/38	VINNOL® E 15/40 A	VINNOL® E 15/48 A	VINNOL® E 22/48 A	VINNOL® E 15/45 M	VINNOL® H 11/59	VINNOL® H 14/36	VINNOL® H 15/42	VINNOL® H 15/50	VINNOL® H 15/45 M	VINNOL® H 15/45 M special	VINNOL® H 30/48 M	VINNOL® H 40/43	VINNOL® H 40/50	VINNOL® H 40/55	VINNOL® H 40/60
Polyester Resin																		
TEGO AddBond LTH	Styrene-free unsaturated polyester resin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
TEGO AddBond LTW	Styrene-free unsaturated polyester resin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Epoxy Resins																		
EPON® 828	Medium-viscosity liquid bisphenol A/epichlorohydrin epoxy resin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
EPON® 834	High-viscosity liquid bisphenol A/epichlorohydrin epoxy resin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
EPON® 1001	Solid bisphenol A/epichlorohydrin epoxy resin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Acrylic Resins																		
DEGALAN® P 24	Polyacrylate resin based on n-butylmethacrylate and methylmethacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DEGALAN® PM 555	Organic dispersion of copolymers based on methacrylic acid ester and olefines	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DEGALAN® LP AL 23	Polyacrylate resin based on n-butylmethacrylate and methylmethacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DEGALAN® MB 319	Polyacrylate resin based on methylmethacrylate and ethylacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DEGALAN® M 345	Polyacrylate resin based on methylmethacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PARALOID® A 11	Polyacrylate resin based on methylmethacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PARALOID® B 82	Polyacrylate resin based on methylmethacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
NeoCryl® B 805	Polyacrylate resin based on methylmethacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
NeoCryl® B 842	Polyacrylate resin based on butylmethacrylate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Macrynal® SM 510	Hydroxy-functional polyacrylate resin	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Amino-Formaldehyde Resins																		
Maprenal® MF 590/55IBX	Melamine-formaldehyde resin, isobutylated	○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○
Maprenal® MF 800/72IB	Hexamethoxymethylmelamine resin, solvent-free	○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○
CYMEL® 300	Melamine-formaldehyde resin, alkylated	○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○
Urea Resin																		
Plastopal® ATB	Urea-formaldehyde resin, butylated	○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○
Maleic Resin																		
ALRESAT® KM 140	Maleic acid-modified colophony resin	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
ERKAMAR 2100	Maleic acid-modified colophony resin	○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○
Polyisocyanate																		
Desmodur® N	Aliphatic polyisocyanate	○	○	●	●	●	○	○	○	○	○	○	○	○	◐	◐	◐	◐
Desmodur® L	Aromatic polyisocyanate	○	○	●	●	●	○	○	○	○	○	○	○	○	◐	◐	◐	◐
Cellulose Derivates																		
Walsroder Nitrocellulose E 510	Ester soluble grade (app. 12% nitrogen)	○	○	○	○	◐	○	○	○	○	○	○	○	○	●	●	●	●
CAB 551-02	Cellulose acetate butyrate	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Phenolic Resin																		
Phenodur® PR 285	Unplasticized phenolic resin	◐	◐	●	●	●	◐	◐	◐	◐	◐	◐	◐	◐	○	○	○	○
Alkyd Resin																		
Short oil alkyd resin, based on synthetic fatty acid		○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○
Middle oil alkyd resin, based on linseed oil		○	○	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○

VINNOL® Grades are Compatible with a Large Number of Plasticizers, Such As:

- Phthalates
- Adipates
- Sebacates
- Citrates
- Phosphates
- Epoxides
- Chlorinated paraffins

● Compatible
◐ Partially compatible
○ Incompatible

* according to manufacturer/supplier

The information contained in this leaflet is for guideline purposes only. The information does not necessarily apply to situations where additional components other than VINNOL® and the plasticizer/binder referenced in the table of this leaflet are used. The recipient of this leaflet should test and verify the fitness for his or her specific requirements. Although this leaflet has been created with utmost care, WACKER does not, neither directly nor indirectly, warrant the accuracy of the data or statements made therein.

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Maprenal® is a product of INEOS.

TEGO AddBond LTH and LTW are products of Evonik/Degussa.
Plastopal® is a product of BASF.
ALRESAT® is a product of Allnex.
ERKAMAR is a product of KRAEMER.
Desmodur® is a product of Covestro.
Walsroder Nitrocellulose is a product of DOW Chemical.
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Phenodur® is a product of Allnex.
EPON® is a product of Hexion.
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NeoCryl® is a product of DSM.

VINNOL® is a registered trademark of Wacker Chemie AG.

SOLUBILITY OF VINNOL®
IN VARIOUS SOLVENTS – TABLE 1

Solvent	CAS Number	Product																
		VINNOL® E 15/45	VINNOL® E 18/38	VINNOL® E 15/40 A	VINNOL® E 15/48 A	VINNOL® E 22/48 A	VINNOL® E 15/45 M	VINNOL® H 11/59	VINNOL® H 14/36	VINNOL® H 15/42	VINNOL® H 15/50	VINNOL® H 15/45 M	VINNOL® H 15/45 M special	VINNOL® H 30/48 M	VINNOL® H 40/43	VINNOL® H 40/50	VINNOL® H 40/55	VINNOL® H 40/60
Alcohols																		
Ethanol	64-17-5	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Diacetone alcohol	123-42-2	●	●	●	●	●	●	◐	◐	◐	◐	◐	◐	●	●	●	●	●
Ketones																		
Acetone	67-64-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Methyl ethyl ketone	78-93-3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Methyl isobutyl ketone	108-10-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Diisobutyl ketone	108-83-8	●	●	●	●	●	◐	◐	●	●	◐	◐	◐	●	●	●	●	●
Cyclohexanone	108-94-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Isophorone	78-59-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ethers																		
Dioxane	123-91-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
1,3-Dioxolane	646-06-0	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Tetrahydrofuran	109-99-9	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Glycol Ethers																		
2-Methoxyethanol	109-86-4	●	●	●	●	●	●	○	◐	◐	◐	◐	◐	●	●	●	●	●
2-Ethoxyethanol	110-80-5	◐	◐	●	●	●	◐	○	○	○	◐	○	○	●	●	●	●	●
2-Butoxyethanol	111-76-2	○	○	◐	○	○	○	○	○	○	○	○	○	○	○	○	○	○
1-Methoxy-2-propanol	107-98-2	○	○	●	◐	●	○	○	○	○	○	○	○	◐	◐	◐	◐	◐
Diethylene glycol diethylether	112-36-7	◐	◐	◐	○	●	○	○	○	○	○	○	○	◐	●	●	◐	◐
Diethylene glycol methylethylether	1002-67-1	●	●	●	●	●	●	◐	●	●	◐	◐	◐	●	●	●	●	●
Dipropylene glycol methylether	34590-94-8	○	○	○	○	◐	○	○	○	○	○	○	○	◐	◐	◐	○	○
Aromatic Hydrocarbons																		
Toluene	108-88-3	○	○	○	○	○	○	○	○	○	○	○	○	◐	●	◐	○	○
Xylene	1330-20-7	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

● Soluble ◐ Partially soluble ○ Insoluble
20% solids; H 11/59: 10% solids

Insoluble Solvents

Acetic acid, cyclohexane, decalin, diethyl ether, diethylene glycol, ethanol, ethylene glycol, glycerol, i-butanol, i-propanol, methanol, 3-methoxy-butanol-1, 1-methoxy-propanol-2, n-hexane, n-octanol, n-propanol, petroleum spirit 100/140, solvent naphtha, tetrachloromethane, tetrachloroethylene, white spirit 180/210

SOLUBILITY OF VINNOL®
IN VARIOUS SOLVENTS – TABLE 2

Solvent	CAS Number	Product																
		VINNOL® E 15/45	VINNOL® E 18/38	VINNOL® E 15/40 A	VINNOL® E 15/48 A	VINNOL® E 22/48 A	VINNOL® E 15/45 M	VINNOL® H 11/59	VINNOL® H 14/36	VINNOL® H 15/42	VINNOL® H 15/50	VINNOL® H 15/45 M	VINNOL® H 15/45 M special	VINNOL® H 30/48 M	VINNOL® H 40/43	VINNOL® H 40/50	VINNOL® H 40/55	VINNOL® H 40/60
Esters																		
Methyl acetate	79-20-9	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ethyl acetate	141-78-6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
n-Propyl acetate	109-60-4	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Isopropyl acetate	108-21-4	●	●	●	●	●	●	◐	●	●	●	●	●	●	●	●	●	●
n-Butyl acetate	123-86-4	●	●	●	●	●	●	●	●	●	●	◐	◐	●	●	●	●	●
Isobutyl acetate	110-19-0	●	●	●	●	●	●	◐	●	●	●	◐	◐	●	●	●	●	●
tert-Butyl acetate	540-88-5	●	●	●	◐	●	○	○	○	○	○	○	○	●	●	●	●	●
γ-Butyrolactone	96-48-0	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Glycol Esters																		
2-Methoxyethyl acetate	110-49-6	●	●	●	●	●	●	◐	●	●	●	●	●	●	●	●	●	●
Methoxypropyl acetate	108-65-6	●	●	●	●	●	●	◐	●	●	◐	◐	◐	●	●	●	●	●
3-Methoxybutyl acetate	4435-53-4	●	●	●	●	●	●	◐	●	●	●	●	●	●	●	●	●	●
Glycolic acid n-butyl ester	7397-62-8	●	●	●	●	●	●	◐	●	●	◐	◐	◐	●	●	●	●	●
Butylglycol acetate	112-07-2	●	●	●	●	●	●	○	◐	◐	◐	◐	◐	●	●	●	●	●
Propyleneglycol methylether acetate	108-65-6	●	●	●	●	●	●	◐	●	●	◐	◐	◐	●	●	●	●	●
Dipropyleneglycol methylether acetate	88917-22-0	◐	◐	●	●	●	◐	○	◐	◐	◐	◐	◐	●	●	●	●	●
Chlorinated Hydrocarbons																		
Methylene chloride	75-09-2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ethylene chloride	107-06-2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Propylene dichloride	78-87-5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Chloroform	67-66-3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Others																		
Dimethyl acetamide	127-19-5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Dimethyl formamide	68-12-2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
N-methyl-2-pyrrolidone	872-50-4	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Dimethyl sulfoxide	67-68-5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Propylene oxide	75-56-9	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pyridin	110-86-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Propylene carbonate	108-32-7	●	●	●	●	●	◐	◐	◐	◐	◐	◐	◐	●	●	●	●	●
Aliphatic hydrocarbons		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

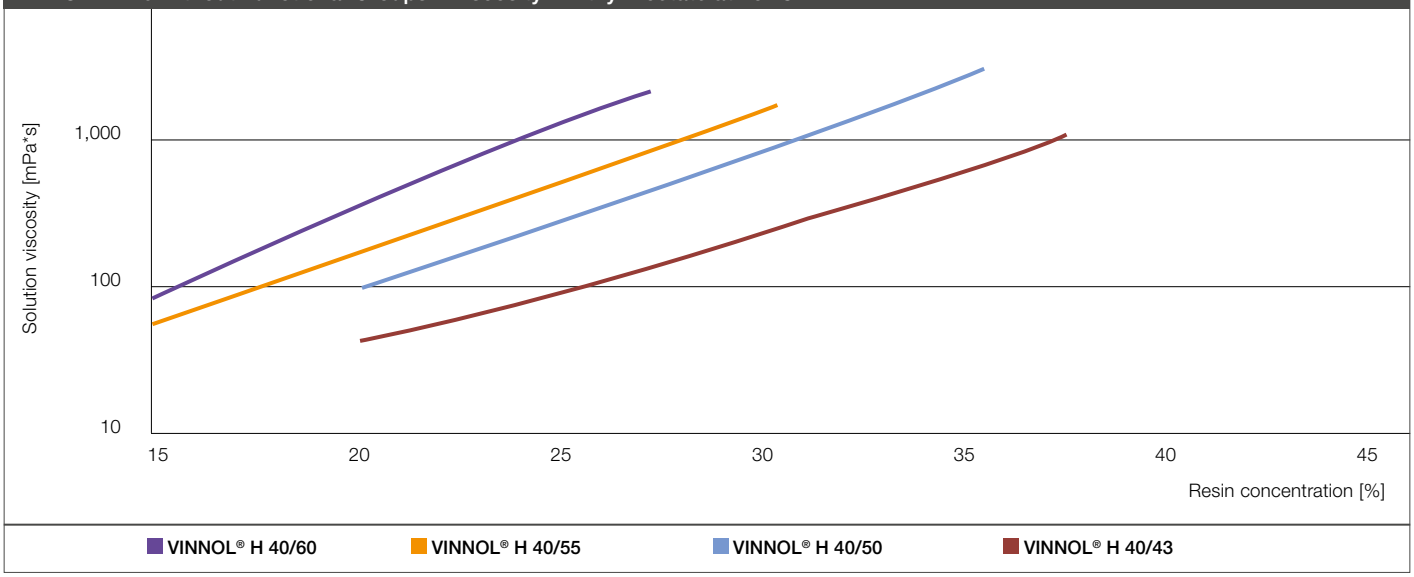
● Soluble ◐ Partially soluble ○ Insoluble
20% solids; H 11/59: 10% solids

Insoluble Solvents

Acetic acid, cyclohexane, decalin, diethyl ether, diethylene glycol, ethanol, ethylene glycol, glycerol, i-butanol, i-propanol, methanol, 3-methoxy-butanol-1, 1-methoxy-propanol-2, n-hexane, n-octanol, n-propanol, petroleum spirit 100/140, solvent naphtha, tetrachloromethane, tetrachloroethylene, white spirit 180/210

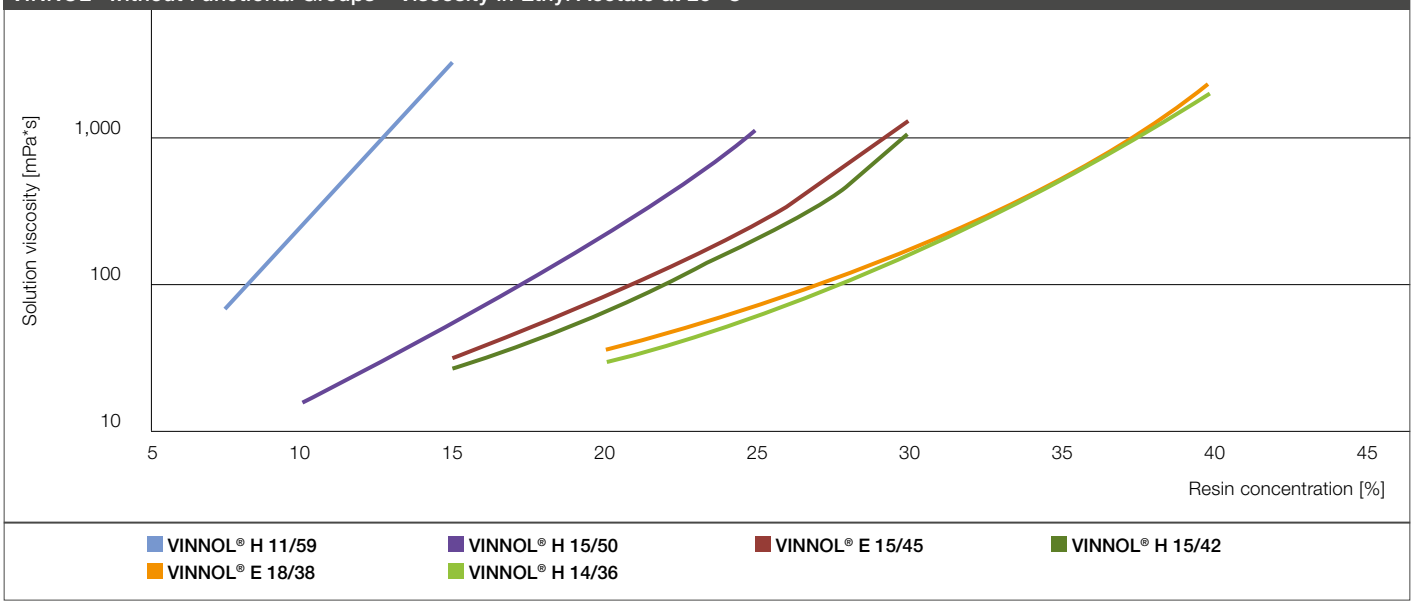
VISCOSITY OF VINNOL®
IN ETHYL ACETATE

VINNOL® H 40 without Functional Groups – Viscosity in Ethyl Acetate at 25 °C



Test method: Brookfield viscometry

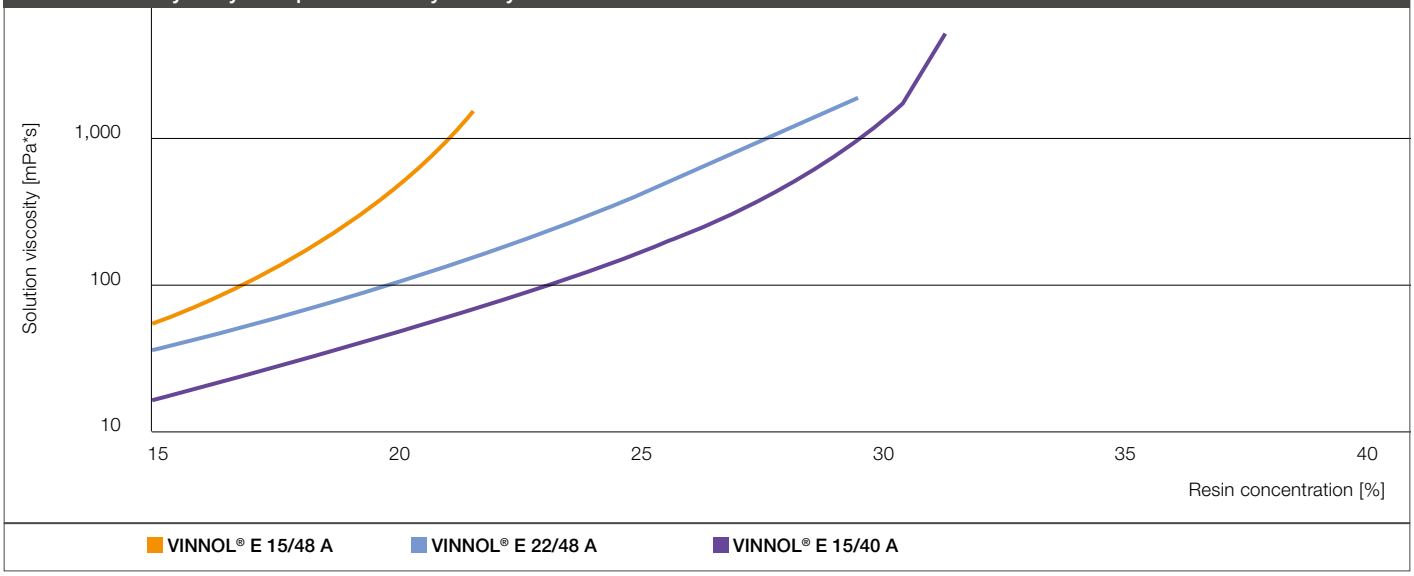
VINNOL® without Functional Groups – Viscosity in Ethyl Acetate at 25 °C



Test method: Brookfield viscometry

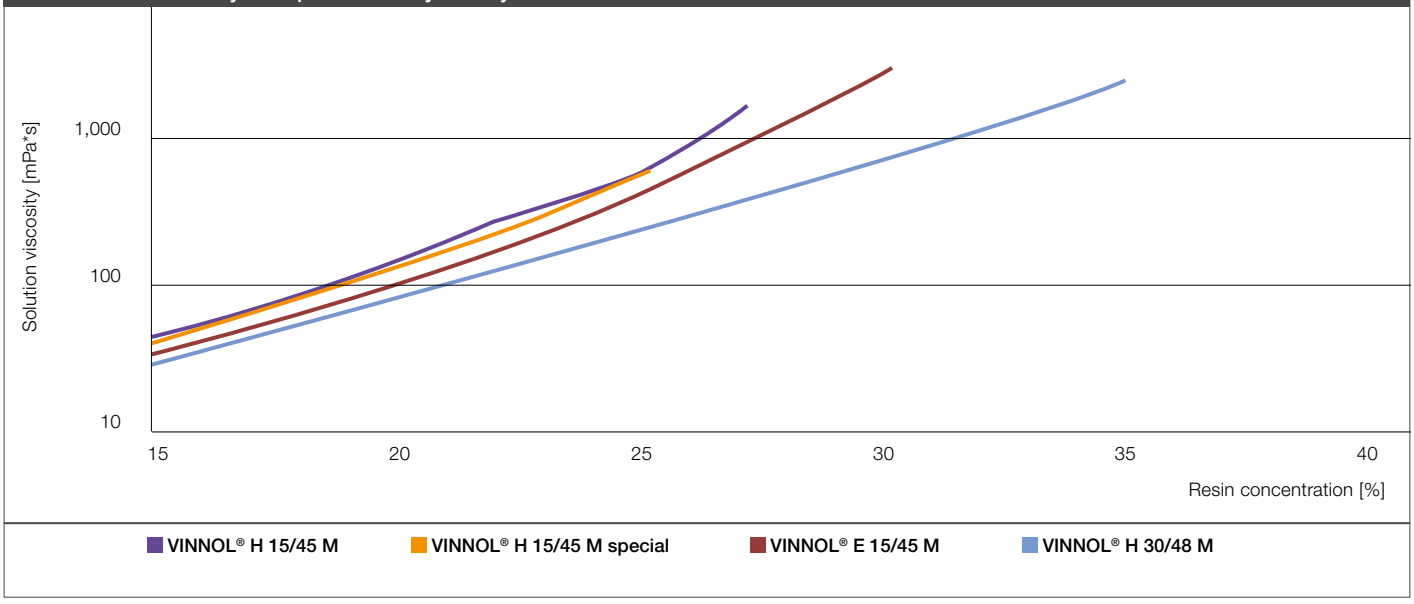
VISCOSITY OF VINNOL®
IN ETHYL ACETATE

VINNOL® with Hydroxy Groups – Viscosity in Ethyl Acetate at 25 °C



Test method: Brookfield viscometry

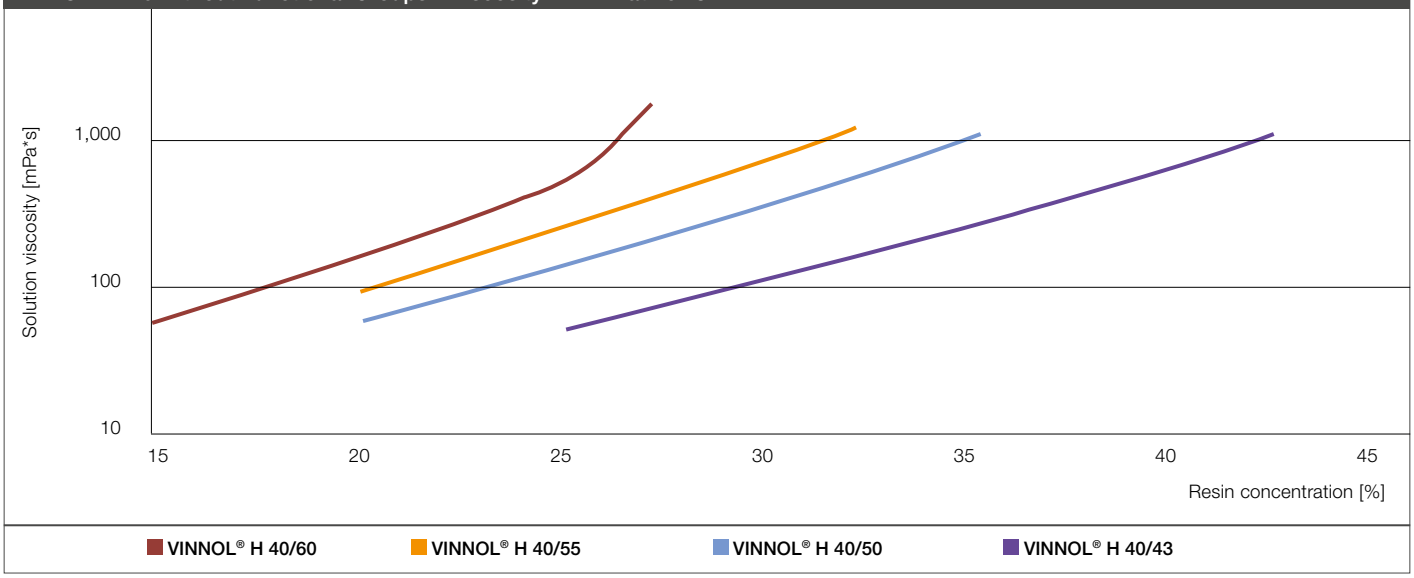
VINNOL® with Carboxy Groups – Viscosity in Ethyl Acetate at 25 °C



Test method: Brookfield viscometry

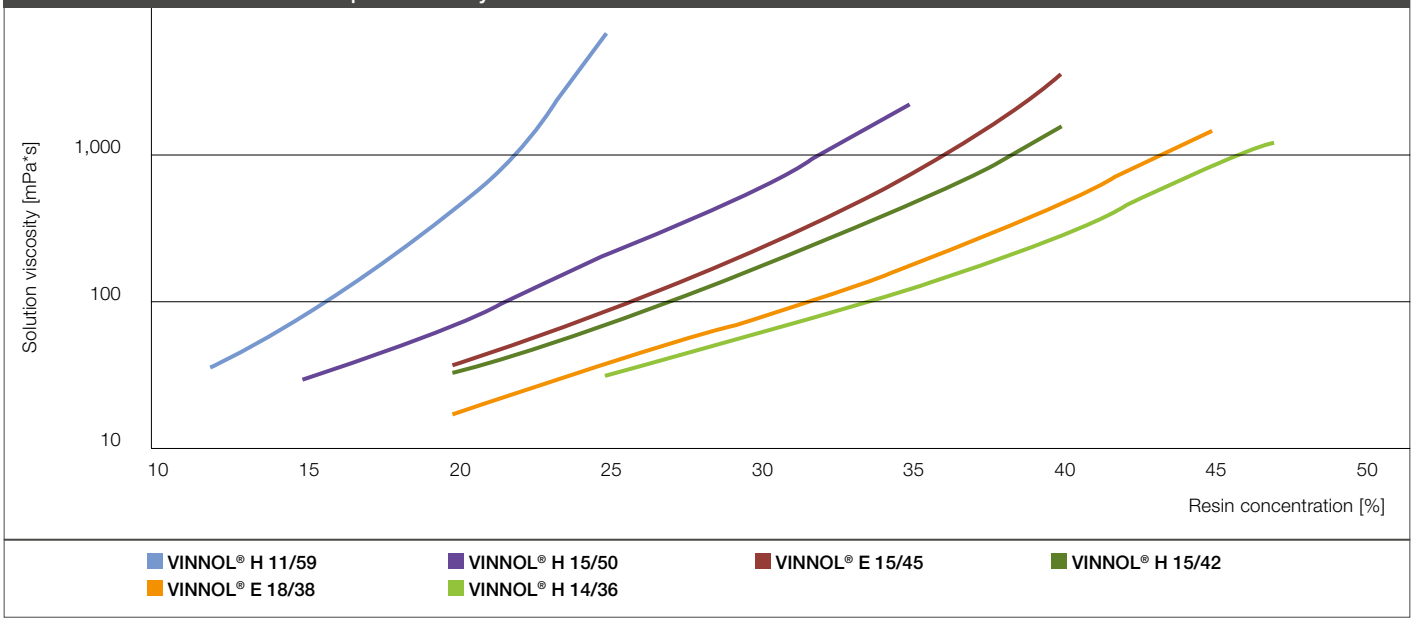
VISCOSITY OF VINNOL®
IN MEK

VINNOL® H 40 without Functional Groups – Viscosity in MEK at 25 °C



Test method: Brookfield viscometry

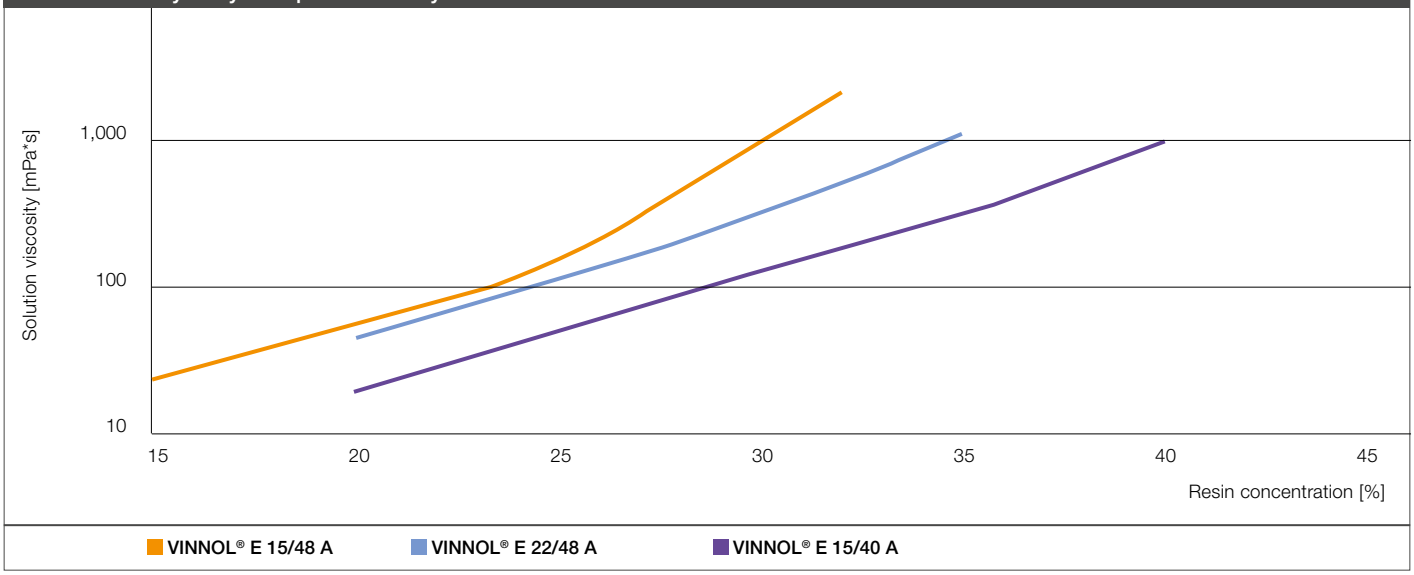
VINNOL® without Functional Groups – Viscosity in MEK at 25 °C



Test method: Brookfield viscometry

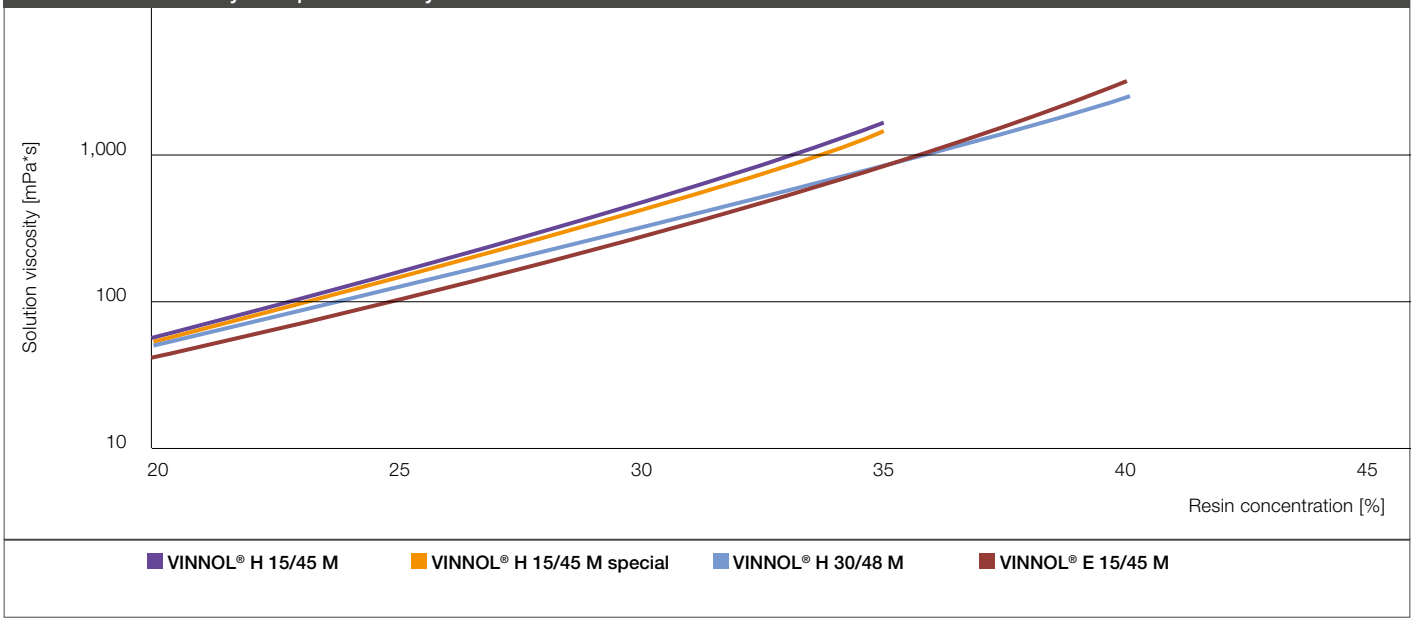
VISCOSITY OF VINNOL®
IN MEK

VINNOL® with Hydroxy Groups – Viscosity in MEK at 25 °C



Test method: Brookfield viscometry

VINNOL® with Carboxy Groups – Viscosity in MEK at 25 °C



Test method: Brookfield viscometry

EXPERTISE AND SERVICE NETWORK ON FIVE CONTINENTS

• Sales offices and production sites, plus 18 technical centers, ensure you a local presence worldwide.

WACKER is one of the world's leading and most research-intensive chemical companies, with total sales of €4.6 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bioengineered pharmaceutical actives and hyperpure silicon for semiconductor and solar applications. As a technology leader focusing on sustainability, WACKER promotes products and ideas that offer a high value-added potential to ensure that current and future generations enjoy a better quality of life based on energy efficiency and protection of the climate and environment.

Spanning the globe with 4 business divisions, we offer our customers highly-specialized products and comprehensive service via 23 production sites, 18 technical competence centers, 13 WACKER ACADEMY training centers and 48 sales offices in Europe, North and South America, and Asia – including a presence in China. With a workforce of some 13,450, we see ourselves as a reliable innovation partner that develops trailblazing solutions for,

and in collaboration with, our customers. We also help them boost their own success. Our technical centers employ local specialists who assist customers worldwide in the development of products tailored to regional demands, supporting them during every stage of their complex production processes, if required.
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All figures are based on fiscal 2016.

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