

Co-Binders

TEGO® AddBond – TEGO® VariPlus



TEGO® AddBond Polyester resins as co-binders

Adhesion is a key topic in coatings systems. The demands made on adhesion-promoting products are highly sophisticated. Besides excellent compatibility with other formulation components, such resins must be able to optimize adhesion on all types of substrates. TEGO® AddBond products provide formulators with a

range of polyester resins which improve adhesion of solventborne, waterborne and radiation-curing coatings and printing inks regardless of the way they dry or cure. The resins can be used in physically drying, oxidatively drying, heat-curing and radiation-curing systems.

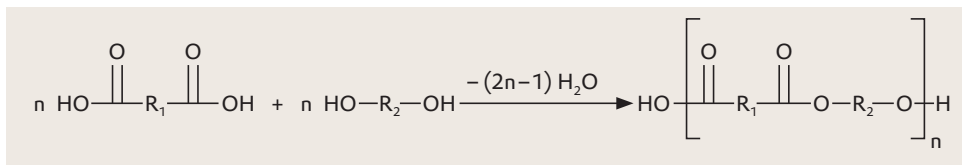


Figure 1: General reaction (schematic) for the manufacture of TEGO® AddBond resins

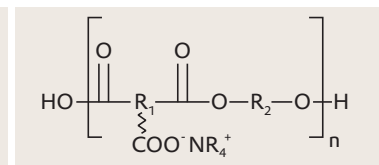


Figure 2: Structure of an aqueous dispersion of a TEGO® AddBond resin

How are polyester resins manufactured?

TEGO® AddBond resins are polyester resins with a special structure. They are manufactured by the polycondensation of special-purpose carboxylic acids and polyols (fig. 1). Aqueous secondary dispersions are obtained by neutralizing car-

boxyl groups with amines (fig. 2). Such solvent-free dispersions have a good storage life. The TEGO® AddBond resins are resistant to hydrolysis. They always contain free carboxyl and hydroxyl groups. Their hydrophilic and hydrophobic characteristics are designed to make a maximum contribution to improving adhesion and enhancing corrosion protection.

Some properties of TEGO® AddBond products

Product	Supply form	Viscosity (23°C, mPa.s)	Softening temperature (°C)	Acid value (mg KOH/g)	Hydroxyl value (mg KOH/g)
TEGO® AddBond LTH	solid	600 – 1500 ¹	90 – 102	12 – 20	~ 25 ²
TEGO® AddBond LTW	60 % in xylene	350 – 650	soft resin	20 – 30	~ 30 ²
TEGO® AddBond LTW-B	60 % in n-butyl acetate	350 – 650	soft resin	20 – 30	~ 30 ²
TEGO® AddBond 2220 ND	60 % in SOLVESSO 150	1500 – 2700	soft resin	18 – 22	~ 30 ²
TEGO® AddBond 2325	60 % in n-butyl acetate	300 – 700	~ 60	~ 18	~ 16 ²
TEGO® VariPlus 3350 UV	50 % in TPGDA	~ 8000	~ 60	~ 18	~ 16 ²
TEGO® AddBond 1270	70 % in sec-butanol	4000 – 9000	soft resin	56 – 65	~ 25 ²
TEGO® AddBond DS 1300	45 % in water	~ 150	~ 55	–	~ 60 ²
TEGO® AddBond HS	75 % in n-butyl acetate	1500 - 2500	soft resin	20 - 30	~ 100 ²

¹ 60% in xylene ² solid resin

Table 1

What do polyester resins achieve?

With the exception of TEGO® AddBond LTH, which is a solid resin, all other products in the TEGO® AddBond range are supplied as solutions (table 1). Since TEGO® VariPlus 3350 UV is also a polyester resin, it is listed here. This resin is dissolved in tripropyleneglycol diacrylate, a UV-reactive solvent. TEGO® AddBond DS 1300 is an aqueous secondary disper-

sion which does not contain any organic solvents. All other products are dissolved in an organic solvent.

TEGO® AddBond resins contribute to improved adhesion on numerous substrates. They are effective on metals, minerals and various plastics and are thus often used in primers or one-coat finishes. They also improve intercoat adhesion so they are highly recommended

for use in multicoat finishes. In effect-finishes, they improve cohesion within the film. The adhesion promoting properties of TEGO® AddBond products, complemented by excellent resistance to hydrolysis, significantly improve the anti-corrosion performance of coatings. TEGO® AddBond resins help to enhance gloss, flexibility and hardness.



Figure 3: Use of TEGO® AddBond LTW in coil coatings

Areas of application of TEGO® AddBond resins

	HS	LTH	LTW/ LTW-B	2220 ND	2325	1270	DS 1300	VariPlus 3350 UV
Can Coating	+	-	+	+	o	-	-	-
Coil Coating	+	-	+	+	o	-	-	-
Automotive OEM finishes	+	o	+	-	-	-	+	-
Container lacquers	+	o	+	o	+	o	-	-
Floor coatings	-	+	-	-	-	-	-	-
Metal finishes	+	+	+	+	+	+	+	-
Can coating lacquers	+	+	+	+	-	o	+	-
Finishes for plastics	+	+	+	+	+	+	+	+ (UV)
Anti-corrosion paints	+	+	+	-	+	+	+	-
Primers (air-drying)	-	+	-	-	o	-	+	-
Primers (baking systems)	+	o	+	+	o	o	+	-
Printing inks	-	+	-	-	-	-	-	+ (UV)
Road marking paints	+	+	+	+	+	-	-	-
Waterborne coatings	-	-	-	-	-	+	+	-
Adhesives	+	+	+	-	o	o	+	o (UV)
Hot embossing foils	-	+	-	-	-	-	+	-
UV coatings	-	+	-	-	-	-	-	+

+ recommended use o possible use - limited use

TEGO® AddBond resins are used as co-binders in numerous paints and lacquers such as can coatings and coil coatings, automotive OEM or refinish coatings, industrial coatings, anti-corrosion paints, road marking paints, printing inks, adhesives, hot embossing foils and UV coatings.

Figs. 3 to 7 show typical examples of applications. TEGO® AddBond LTW and LTW-B improve adhesion of can coatings and coil coatings (fig. 3). These resins exhibit a flexibilizing effect and enhance the coating's processing properties.

An additional important area of application is automotive OEM or refinish coatings. TEGO® AddBond LTW and LTW-B are widely used in solventborne finishes. TEGO® AddBond 1270 is used in brake disc lacquers. TEGO® AddBond DS 1300 is used, for example, to improve the adhesion of waterborne paints on plastic fenders (fig. 4).

TEGO® AddBond products are also used in anti-corrosion paints, TEGO® AddBond LTH and LTW in solventborne coatings, and TEGO® AddBond DS 1300 in waterborne coatings (fig. 5).

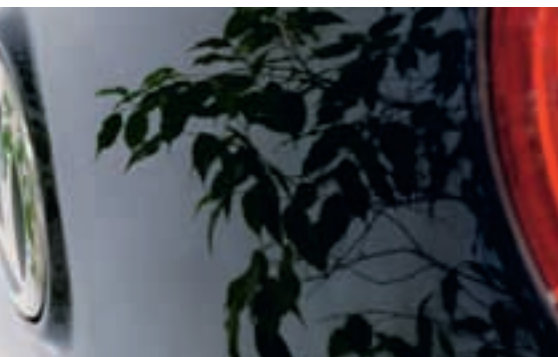


Figure 4: Use of TEGO® AddBond DS 1300 in automotive finishes



Figure 5: Use of TEGO® AddBond LTH in anti-corrosion paints

TEGO® AddBond products improve adhesion in numerous paints and lacquers for plastics substrates such as polyamide, polyvinylchloride, polycarbonate, ABS, ABS/polycarbonate, Noryl or HIPS. The TEGO® AddBond products LTH, LTW, LTW-B, 2325 and 1270 are recommended for solventborne finishes, DS

1300 and 1270 for waterborne finishes and TEGO® AddBond LTH and TEGO® VariPlus 3350 UV for radiation-curing coatings. The flexible TEGO® AddBond LTW ensures good substrate wetting, improved adhesion and excellent cohesion of effect pigment finishes (fig. 6). Because of its high compatibility with

acrylic resins and reactive thinners, TEGO® VariPlus 3350 UV is recommended for use in radiation-curing coatings, printing inks and adhesives (fig. 7). TEGO® AddBond LTH is also used in some UV formulations. Both resins enhance not only adhesion but also reduce volume shrinkage during curing.



Figure 6: Use of TEGO® AddBond LTW in plastic coatings



Figure 7: Use of TEGO® VariPlus 3350 UV in UV printing inks

TEGO® VariPlus Ketone-aldehyde resins and special resins derived from them

Numerous coatings and printing inks are available commercially. Physically-drying coatings, air-drying paints, stoving enamels and radiation-curing systems are used in diverse fields and applied to very different substrates. TEGO® VariPlus resins are frequently used to enhance the property profile of such systems. These non-saponifiable, neutral, hard resins have a low molecular weight, low inherent color and exhibit good light and heat resistance. Their outstanding compatibility with the most important main binders and their

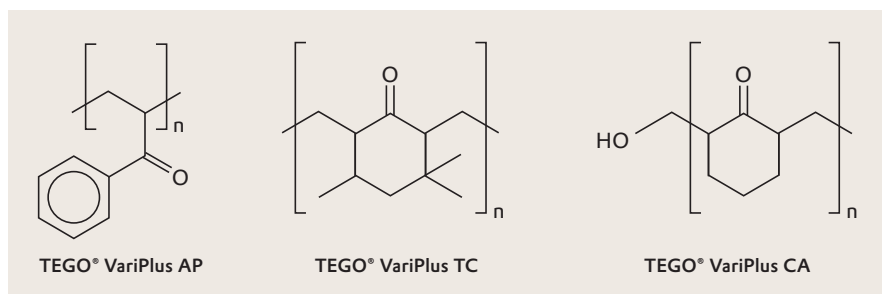
good solubility in the solvents commonly used in these systems make them highly versatile.

How are ketone-aldehyde resins and the special resins derived from them manufactured?

Ketone-aldehyde resins are manufactured by an aldol condensation of a ketone with an aldehyde. The resulting chemical structures and their properties depend sub-

stantially on the ketone used. If acetophenone or trimethylcyclohexanone are used, resins with exclusively keto groups are obtained (fig. 1). It is possible to manufacture ketone resins containing hydroxyl groups by using suitable reaction conditions and cyclohexanone.

Figure 1: Typical structures of TEGO® VariPlus resins based on ketone-aldehyde chemistry



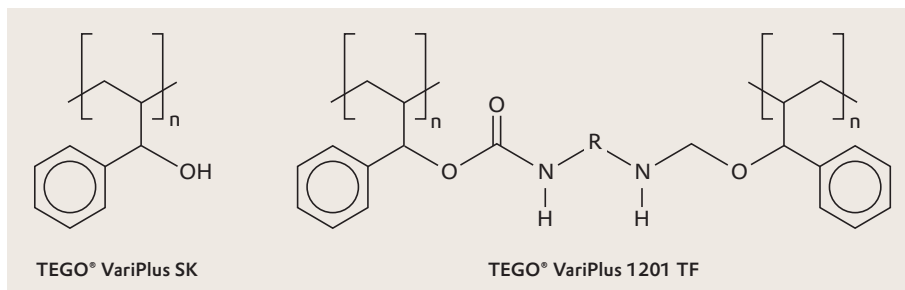


Figure 2: Typical structures of TEGO® VariPlus resins based on modified ketone-aldehyde resins

Another possibility for obtaining alcohol groups is by hydrogenating the keto group. In this way, the ketone-aldehyde resin TEGO® VariPlus AP is made into the polyol resin TEGO® VariPlus SK (fig. 2). The polyurethane-polyol resin TEGO® VariPlus 1201 TF is manufactured by reacting the hydroxyl groups of TEGO® VariPlus SK with a special light-resistant polyisocyanate using an organotin-free catalyst.

Resins for waterborne applications can be manufactured by various means. Water-insoluble resins, for example, are rendered water-dispersible by neutralization of the carboxyl groups. These polyurethane-polyol dispersions are resistant to hydrolysis (fig. 3).

Another method ensures water-compatibility by incorporating polyether chains. This enables TEGO® VariPlus UC to be used to manufacture a water-soluble polyetherketone resin which is also soluble in organic solvents.

How do ketone-aldehyde resins and special resins derived from them perform?

As a result of their chemical structure and the production process, the ketone-aldehyde resins are very light in color and transparent compared with natural resins. The inherent color and resistance to light and heat of the special resins obtained by chemical modification of the ketone-alde-

hyde resins are also substantially improved. The solubility of TEGO® VariPlus resins in organic solvents is very good. The polarity determines the solubility in very polar (alcohols) or very non-polar (aromatic-free white spirit) solvents. With one exception, all TEGO® VariPlus resins are hard solids. The glass transition temperature ranges from -47°C to +130°C. While most resins are supplied as solids, TEGO® VariPlus 1201 TF is supplied in an organic solvent. As an aqueous secondary dispersion with excellent stability, TEGO® VariPlus DS 50 is free from organic solvents. TEGO® VariPlus UC is the only solvent-free, liquid resin with a low glass transition temperature of -47°C.

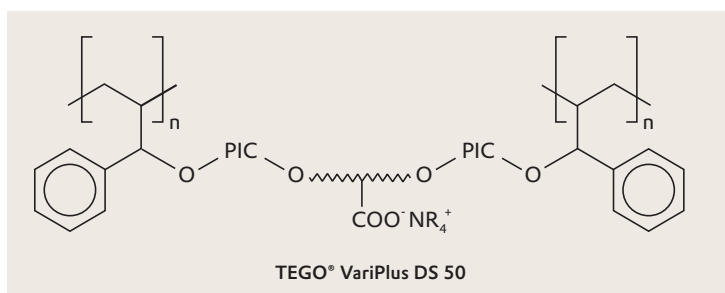


Figure 3: Structure of the water-dispersible TEGO® VariPlus DS 50

Physical properties of TEGO® VariPlus resins

Product	Supply form	Color value Gardner	Softening temp./ Melting temp. (°C)	Tg (°C)	OH-value (mg KOH/g)
TEGO® VariPlus AP	solid	≤ 3	~ 75	~ 50	~ 5
TEGO® VariPlus TC	solid	≤ 3	~ 65	~ 40	~ 10
TEGO® VariPlus CA	solid	≤ 2	~ 102	~ 75	~ 200
TEGO® VariPlus SK	solid	≤ 1	~ 115	~ 90	~ 325
TEGO® VariPlus 1201 TF	49% in EA	≤ 2	~ 163 ¹	~ 130 ¹	~ 200 ¹
TEGO® VariPlus DS 50	33% in water	–	~ 150 ¹	~ 120	~ 190
TEGO® VariPlus UC	liquid	< 7	–	~ – 47	~ 40
TEGO® VariPlus UC W 40	40% in water	–	–	~ – 47	~ 40

¹solid resin

As a result of the optimized process, the formaldehyde content of products based on acetophenone is below the limits of detectability.

Because of their low molecular weights and high softening or melting temperatures, resins in the TEGO® VariPlus range are not film-forming. They are thus combined with other binders to improve the properties of coatings.

TEGO® VariPlus resins influence in all sorts of ways the properties of solvent-borne, waterborne and radiation-curing coatings, printing and other inks as well as of adhesives:

- faster drying and set times
- lower VOC content
- higher hardness
- higher gloss
- improved adhesion
- improves ability to be used in primers
- better heat resistance
- better chemical resistance
- better mechanical resistance
- better corrosion protection
- better block resistance
- higher pigment loading and higher color intensities through improved pigment wetting
- lower pigment paste viscosities

Figure 4: Use of TEGO® VariPlus 1201 TF in printing inks



Areas of application of TEGO® VariPlus resins

	AP	SK	1201 TF	CA	TC	DS 50	UC/UC W 40
Wood finishes	+	+	-	+	o	+	-
Coatings for plastics	o	+	+	+	+	+	-
Anti-corrosion coatings	+	+	-	+	o	o	-
Concrete coatings	+	-	-	+	o	-	-
Road marking paints	+	+	-	+	o	-	-
Industrial finishes	+	+	-	+	o	+	o
Paper coatings	-	+	+	+	-	+	-
Writing inks	-	+	-	o	-	+	-
Adhesives	+	o	-	+	+	o	-
Pigment pastes	o	o	+	o	+	+	+
Printing inks	-	+	+	+	-	+	-
Hot embossing foils	-	+	+	+	-	-	-
UV coatings	+	+	-	o	o	o	o

+ recommended use
o possible use
- limited use

Besides their widespread use in printing inks (rotogravure, flexographic, screen printing, uv and specialist printing processes) and hot embossing foils, TEGO® VariPlus resins are proven co-binders in coatings and adhesives. They are used in wood finishes, coatings for plastics, anti-corrosion paints, concrete paints, road

marking paints, industrial finishes, packaging coatings, paper coatings, writing inks, pigment pastes, liquid adhesives and hot melt adhesives.

Figures 4 to 7 show typical applications. TEGO® VariPlus 1201 TF imparts printing inks with very good adhesion, excellent

gloss, and good block resistance during rapid drying. Because of its very good pigment wetting, it is also used in pigment pastes to achieve high color intensity and good transparency.



Figure 5: Use of TEGO® VariPlus SK in ballpoint pen pastes

Ballpoint pen pastes owe their special rheological properties to the unique structure of TEGO® VariPlus SK. This resin prevents drying out and leakage of the ink while ensuring rapid setting after writing.



Figure 6: Use of TEGO® VariPlus DS 50 in coatings for plastics

Used as a resin in the top coat of hot embossing foils, TEGO® VariPlus CA has a positive influence on a range of properties such as gloss, flexibility and fastness. It is also used in the adhesive film of these coated foils because it enhances adhesion.

Because of its high glass transition temperature and special chemical structure, TEGO® VariPlus DS 50 improves the resistance of waterborne coatings for

plastics to water, solvents and chemicals as well as their film hardness and gloss. Substrate adhesion is also optimized.

TEGO® VariPlus TC has proved itself as a grind paste resin in pigment concentrates because of its universal solubility in organic solvents, compatibility with binders and excellent pigment wetting. TEGO® VariPlus UC represents a new generation of pigment paste resins devel-

oped specifically for solventborne, extremely high-solids pigment concentrates with high pigment loadings. TEGO® VariPlus UC W 40 makes this resin accessible for use in waterborne (including universal) pigment preparations.



Figure 7: Use of TEGO® VariPlus TC in pigment pastes for coatings