EVONIK INDUSTRIES

TEGO Nanoresins – Perfect Protection for Immaculate Beauties

tego

Evonik. Power to create.

Masthead

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About us

TEGO – one of Evonik's leading brands.

As the leading supplier of specialty chemicals worldwide, Evonik offers its customers in the coatings and printing inks industry a unique range of products under the TEGO brand name. Our portfolio is the result of experience gained over the 30 years in which we have researched and developed optimal solutions together with, and for, our customers. With over 200 products, the range currently includes not only the most diverse additives but also co-binders, specialty resins and nanoresins.

We get rid of air from paints, conjure gloss onto surfaces and make lacquers scratch-resistant. Environmental concerns are of key importance to us when developing new products.

Besides our extensive expertise, our numerous contacts in more than 40 countries are an additional advantage. This underlines our philosophy of developing intelligent products for new areas of application not only for, but together with customers. We look forward to your challenge and are confident that we can find an advantageous solution for you.

TEGO – Adding Advantages.

Nanoresins

Innovative technologies for optimizing coatings

The nanoresin portfolio offers various products for targeted modification and customization of coatings systems to suit individual applications.

Silica nanocomposites – NANOCRYL®, NANOPOX® and NANOPOL®

The liquid silica nanocomposites are colloidal dispersions of up to 50 % w/w amorphous silica in unsaturated (meth-) acrylates, epoxy resins, or solvents. The spherical SiO_2 particles are monodisperse with a very narrow particle size distribution. The resulting silica nanocomposites are particularly easy to process because of their low viscosity. The effect is a previously unobtainable, targeted improvement in mechanical properties. The surface hardness and scratch/abrasion resistance of coatings can thus be significantly increased without impairing transparency or gloss.

Reactive resin modifiers – ALBIDUR® and ALBIFLEX®

ALBIDUR® products enable the unique properties of silicone elastomer particles to be introduced into a coatings system. Higher impact strength over a wide range of temperatures results in considerably improved low temperature performance, while the glass transition temperature and chemical resistance of the base resin are unaffected.

ALBIFLEX® products are flexible epoxy-silicone co-polymers which combine the advantageous properties of both epoxy resins and silicones. The high elasticity, even at very low temperatures, stems from the inherent properties of silicone. The epoxy resin contributes excellent adhesion to various substrates, high mechanical strength, and good chemical resistance.

Customized products are offered for different coatings systems. The following pages provide an overview.

Silica nanocomposites

Improved properties

Evonik's silica nanocomposites are colloidal silica sols in various binders and solvents. These are low viscosity products that are highly transparent and do not exhibit any sedimentation. This means that processability is largely unchanged compared to that of the base resin. The result is an almost perfect combination of the advantageous properties of organic and inorganic materials.

The use of silica nanocomposites results in:

- strongly improved scratch and abrasion resistance
- no impairment of transparency or gloss
- barrier effect against gases, water vapor, and solvents
- increased weathering resistance and slower thermal aging
- reduced curing shrinkage and heat of reaction
- lower thermal expansion and internal stresses
- improved adhesion on numerous inorganic substrates (e.g. glass and aluminum)

Silica nanocomposites are used wherever these improvements in properties are desirable or necessary without compromising processability as a result of, for example, disproportionate increases in viscosity which can occur with conventional fillers and pigments. The fact that this can be achieved without impairing optical clarity makes silica nanocomposites particularly suitable for use in transparent formulations. Good examples include highly scratch-resistant, steel wool-resistant clear coats for plastics (e.g. PC, PMMA, PET) and wood.

Mode of action

Silica nanocomposites are colloidal dispersions of up to 50 % w/w amorphous silica in a wide range of conventional binders and solvents. The dispersed phase consists of surface-modified spherical SiO_2 nanoparticles with diameters of 20 nm and an extremely narrow particle size distribution (Fig. 1). The SiO_2 particles are distributed homogeneously and are free of agglomerates in the organic matrix (Fig. 2). This results in dispersion with very low viscosity despite SiO_2 content of up to 50 % w/w.

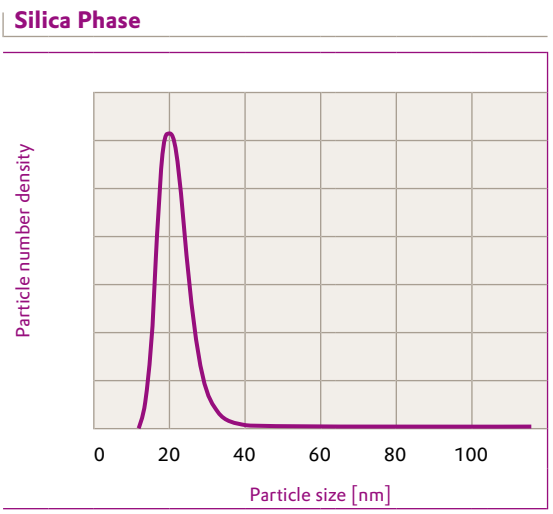


Fig. 1: Particle size distribution (determined by SANS)

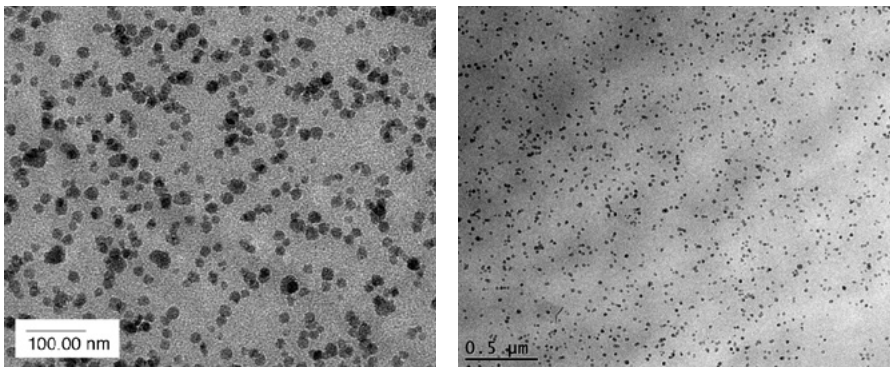


Fig. 2: TEM image of a cured NANOPOX® sample with 5% SiO_2 nanoparticles

User tips

The silica nanocomposites are manufactured from silica sol using a liquid chemical process. This gentle process eliminates the need for high speed stirrers and high shear to mix in fillers in powder form.

The silica nanocomposites can be used independently in formulations or as a co-binder and cured as usual. The total nanosilica content required depends on the desired product properties. In general, the listed effects increase proportionally to the solids content. To begin, 5 - 10 % w/w nanosilica based on the solids in the formulation is recommended. The optimum level should be ascertained by systematic testing.

If necessary, conventional fillers, such as Al_2O_3 or glass microbeads, can be used in addition. This enables the formulator to increase the total filler content and thus optimize material properties without negatively affecting viscosity.

To ensure optimum compatibility, premixing of the silica nanocomposite with the main binder is recommended. After that the other sonstituents of the formulation are added under stirring.

A list of suitable commercial additives can be obtained upon request.

NANOCRYL® and NANOPOX®– silica nanocomposites for the modification of radiation-curing coatings

Product overview/Technical data

Product	Monomer	Characterization	SiO_2-content [%w/w]	Dynamic viscosity, 25 °C [mPa·s]
NANOCRYL® C 130	CTFA	trimethylol propane formal acrylate	50	275
NANOCRYL® C 140	HDDA	hexanediol diacrylate	50	175
NANOCRYL® C 150	TMPTA	trimethylol propane triacrylate	50	3,300
NANOCRYL® C 153	TMPEOTA	ethoxylated trimethylol propane triacrylate	50	1,000
NANOCRYL® C 155	GPTA	propoxylated glycerine triacrylate	50	1,750
NANOCRYL® C 165	PPTTA	alkoxylated pentaerythritol tetraacrylate	50	2,500
NANOPOX® C 620	EEC	cycloaliphatic epoxy resin for cationic curing	40	4,000
NANOPOX® C 680	TMPO	trimethyl propyl oxirane	50	200

Tip:
Other NANOCRYL® and NANOPOX® products and mixtures for special applications are available upon request. Please contact our Application Technology Service.

NANOPOX® – silica nanocomposites for the modification of heat-cured epoxy resin coatings

Product overview/Technical data

Product	SiO_2-content [w/w%]	Base Resin	EEW [g/equiv.]	Dynamic viscosity, 25 °C [mPa·s]	Characteristic
NANOPOX® C 620	40	EEC	220	4,000	Cycloaliphatic
NANOPOX® C 680	50	TMPO	232	200	Reactive diluent for cycloaliphatic systems

NANOPOL® – silica nanocomposites for the modification of 1- and 2-pack coatings

Product overview/Technical data

Product	Characterization	SiO_2-content [w/w%]	Dynamic viscosity, 25 °C [mPa·s]
NANOPOL® C 764	methoxy propyl acetate	50	20
NANOPOL® C 784	n-butylacetate	50	20

Note:
Both NANOPOL® C products are resin- and additive-free. Further products and mixtures for special applications are available upon request. Please contact our Application Technology Service.

ALBIDUR® – silicone elastomer particles for the modification of coatings

Improved properties

Use of ALBIDUR® products results in:

- greatly improved impact resistance
- excellent electrical insulation
- extended usage over a wide temperature range
- glass transition temperature of formulation remains unaffected
- simple incorporation by homogenization of the low-viscosity products
- increased thermal resistance of the cured formulation (by ca. 10 - 20°C)
- improved surface properties such as resistance to suntan lotions and acids

ALBIDUR® products can be used to modify the fracture toughness of a formulation without affecting the modulus or glass transition temperature and without markedly increasing the viscosity of the mixture. Optimal performance is obtained with the addition of 8 - 10 % delivery form in the total formulation (without fillers). This leads to a noticeable improvement of the fracture toughness with scarcely any effect on the modulus.

Mode of action

ALBIDUR® products consist of a reactive resin in which silicone elastomer particles of a defined size (0.1 - 3 µm) are finely distributed. The silicone elastomer products have a physically bonded organic sheath which contains reactive groups (Fig. 3).

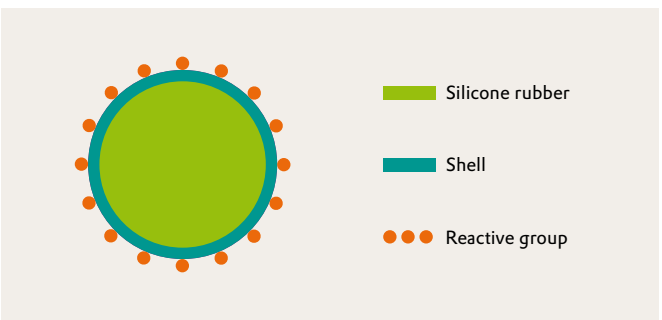


Fig. 3: Schematic representation of an ALBIDUR® particle

These particles can attach to the resin matrix. A force applied to the cured resin system will be dissipated isotropically when it strikes a rubber region. If a crack has already developed, further cracking will be prevented. The elastomer particles deform perpendicular to the direction of the crack and are not stripped from the matrix because they are chemically bound. Fig. 4 shows the finely divided silicone elastomer particles in the epoxide matrix.

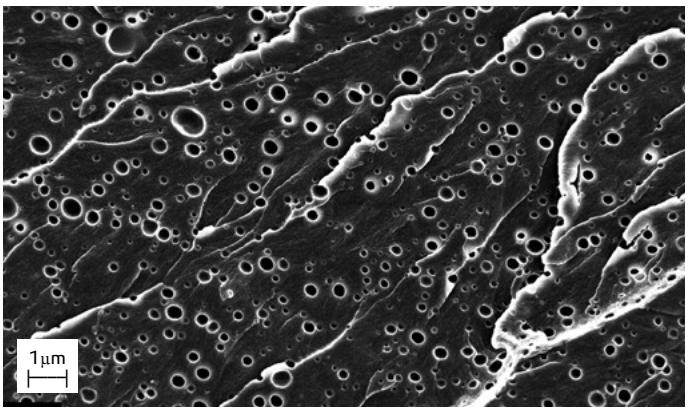


Fig. 4: Scanning electron microscope image of an epoxy resin modified with ALBIDUR®

Product overview/Technical data

Product	Silicone content [w/w%]	Base Resin	Dynamic viscosity, 25 °C [mPa·s]	Comments
ALBIDUR® EP 2240 A	40	DGEBA	35,000	EEW: 300 g/equiv.
ALBIDUR® PU 5640	40	PPG-triol	2,500	Hydroxyl value: 230

ALBIFLEX® – epoxy-silicone copolymers for the modification of coatings

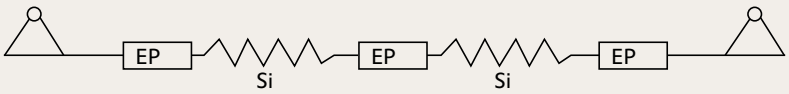
Improved properties

ALBIFLEX® combines normally incompatible epoxy-resin and silicone with a homogeneous copolymer which exhibits the benefits of both its constituent polymers:

- the epoxy component provides excellent adhesion to numerous substrates, high mechanical strength and good chemical resistance
- the silicone component provides high elasticity, even at very low temperatures, good thermal and ageing resistance and excellent dielectric properties

Mode of action

All ALBIFLEX® products have a common basic chemical structure which can be represented as follows:



Essentially this is a linear block copolymer comprised of alternating blocks or segments of hard polyepoxides and soft polysiloxanes with reactive epoxide blocks at both ends of the chain.

The morphology resulting from phase segregation between polysiloxane and polyepoxide segments means that the property profile is not simply an average of the epoxide and silicone portions. In general, the epoxide character predominates in the property profile.

Product overview/Technical data

Product	Silicone content [w/w%]	Base Resin	EEW [g/equiv.]	Dynamic viscosity, 25 °C [mPa·s]
ALBIFLEX® 348	60	DGEBA	1,150	30,000

ALBIFLEX® 296 is the standard product with silicone content of 40 % which is increased to 60 % in ALBIFLEX® 348 for an exceptionally flexible formulation. These water-white products are particularly suitable for transparent coatings. The high silicone content of the copolymers means that they have only limited miscibility with epoxy resins which should be tested in the final formulation.

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