Capa™

For spearhead performance

Our Capa™ caprolactones

- Easy to process, shape and apply
- Outstanding flexibility even at low temperatures
- Lasting outdoor performance for polyurethane materials
- Excellent strength and abrasion resistance for polyurethanes
- Strong adhesion on difficult and sensitive substrates
- From a trusted partner offering tailor-made caprolactones

Perstorp
WINNING FORMULAS

Spearheading performance with Capa™

Enhancing performance & adding value

Capa™ is our range of caprolactones, comprising monomer, polyol and thermoplastic caprolactones of varying molecular weight and functionality.

As the leading global producer of Capa™ caprolactones, we offer you the full range of caprolactone grades and technical support to enable the properties of Capa™ products to be exploited fully in the most demanding applications. The synergy of our own product expertise and your specialized application know-how helps to guarantee that Capa™ caprolactones can be targeted with precision to ensure optimum performance.

Whether you are looking at enhancing your coating, adhesive or elastomer, Capa™ can achieve the whole spectrum of different properties such as wear-resistance, UV-resistance, gloss, adhesion or low temperature flexibility to name just a few – properties that add value to your product in a competitive market.

Endless properties – endless possibilities

Capa™ polycaprolactones take your product performance to a higher level and open up new market areas. Capa™ improves the quality of high-end coatings and paints in for example the automotive, transportation, marine and protective coatings industries, as well as the electronics sectors. Capa™ used in adhesives have found applications in shoe sole bonding, laminated packaging and textile bonding, while in elastomers Capa™ is used in diverse applications such as mine screens, printing rollers and advanced sports shoes. The possibilities are almost endless. Maybe you have an application just waiting to be tested?

Capa™ thermoplastics typically come in the form of granules or powders that can be remelted and remoulded, and are used in hot melt adhesives and biodegradable packaging.

The chemistry behind Capa™

The special performance properties of Capa™ polycaprolactones are determined by the ring-opening addition polymerization used in their manufacture. Ring-opening polymerization is carried out under mild conditions resulting in a very controlled polymerization meaning that by-products, such as water, are not produced. The resultant products have a low acid value, highly defined functionality, low polydispersity and very high reproducibility.

Global partner for caprolactone innovation

Your partner for development

Perstorp offers unique caprolactone market knowledge and experience. Based on that, we can offer tailor-made poly-caprolactones for your specific product need if our existing products do not exactly match your requirements. It is our desire to deliver a spearheaded solution regardless of whether your need is related to environmental demands, end-performance or the manufacturing process. We are helping customers to reduce or even eliminate VOC, we have improved mechanical performance and durability in end-products and our low viscosity products make processing easier and more economical. We welcome challenges.

Our sales and technical staff have the competence to discuss all caprolactone issues with you. Sometimes it is about finding the right product from our portfolio, at other times it may involve tailoring a product specifically for your application. Within a matter of months, we can come up with a new product. We have experts in Europe, Asia, North and South America, so you will always have someone locally to turn to with your query.

Meeting high capacity & quality at Warrington

With over 30 years' experience of making caprolactones, our plant in Warrington, UK, has accumulated genuine knowledge all the way to the factory floors. With a dedicated team entirely focused on Capa™ you can feel certain that you are getting the highest quality product possible. We have a controlled process for making the products to the right specification and with good consistency.

Perstorp has made significant investments at our Warrington plant to fulfill our customers' expectations. The factory has been expanded to meet higher market needs. We are constantly developing and testing our technology for new applications. Welcome to our exciting Capa™ world!

The multi-talented polyol

Introducing the Capa™ family

Made via Perstorp's unique process, we offer Capa™ monomer and from this we produce a wide range of Capa™ polyols and Capa™ thermoplastics. Our polyols and thermoplastics are made through ring opening polymerization technology giving a narrow molecular weight distribution, low viscosity and very low levels of bi-products.

Our Capa™ polyols are aliphatic esters that are extremely versatile and can deliver top performance in many different areas. Their low viscosity is particularly advantageous in applications for polyurethane elastomers, thermoplastics, coatings, paints, adhesives and foams. Capa™ polyols combine the performance of polyethers and polyester adipates in one structure.

General properties:

- Consistent crystallization
- High flexibility and low viscosity
- Low impurities
- Non-toxic and biodegradable

Polyurethans properties	Choice of polyol		
	Capa™	Polyether	Polyester adipate
Easy processing	•		
Hydrolytic stability	•	•	
High and low temperature service interval	•		
UV resistance	•		•

Capa™ polyols

Our portfolio of Capa™ polyols range from mono to tetra-functional polyols with molecular weights from 240 to 8000. Currently we employ 10 different initiators giving us the flexibility to tune the end-properties of polyurethane materials. The portfolio includes premium grades where the levels of impurities have been reduced even further and molecular weight distributions have been made even narrower. Premium grades offer additional benefits including an extra level of hydrolytic stability and are even easier to process due to exceptionally low viscosities.

Capa™ in polyurethane casts

Top benefits:

- Easy processing
- Consistent and adjustable reactivity
- Wide interval of service temperatures
- Overall excellent mechanical properties

The liquid poly-functional Capa™ grades are used to provide a highly flexible cross-linking for cast elastomers and give:

- Remarkable cold flex fatigue
- Improved compression sets
- Improved tear strength

Applications for polyurethane cast elastomers include leisure products, mining screens, acoustic submarine tiles, wheels and rollers.

Capa™ in thermoplastic polyurethanes

We supply a wide range of linear polycaprolactone diols with consistent and narrow molecular weight distribution, consistent reactivity and low viscosity to meet the demands of the TPU producer. Applications in automotive and industrial segments include seals and gaskets.

Top benefits:

- Easy processing with short cycle times
- Wide interval of service temperatures
- Overall excellent mechanical properties

Capa™ in polyurethane coatings

Capa™ polyols can be used in environmentally friendly coatings, such as polyurethane dispersions, high solid and UV-cure resins. The lower viscosity of the Capa™ polyol compared to an adipate based polyol means that no or less solvents are needed. Applications include industrial, leather and textile coatings, as well as non-polyurethane coating industries.

Top benefits:

- Low VOC and environmentally friendly coating
- Excellent solvent, chemical and UV resistance

Capa™ in adhesives

Capa™ polyols can be used in waterborne, solvent-based and hot melt polyurethane adhesives. They are particularly useful as they yield low viscosity adhesives which create strong bonds even to difficult substrates under demanding conditions. In the case of reactive adhesives the purity and consistency of Capa™ results in a valuable controlled and consistent open time. Applications can be found in the automotive and footwear industries, as well as a range of other areas.

Top benefits:

- Durable joints even in humid environments
- Excellent adhesion to various substrates including leather
- Fast wetting process

Capa™ in foams

Caprolactone-based micro-cellular foams combine the toughness and excellent physical properties normally associated with polyesters, with enhanced hydrolytic stability. Applications include automotive components and shoe soles.

Top benefits:

- Excellent mechanical properties even at low density
- Improved service life in humidity compared to adipates
- Reduced density compared to adipates

Capa™ thermoplastics

Capa™ in hot melt adhesives (HMAs)

Capa™ thermoplastics are low-melting crystalline polymers that are used as hot melt adhesives. Applications include toe puff and shoe counter components in footwear, scatter coat interlining adhesives, binders for non-wovens and structural and laminating adhesives for the automotive industry.

Top benefits:

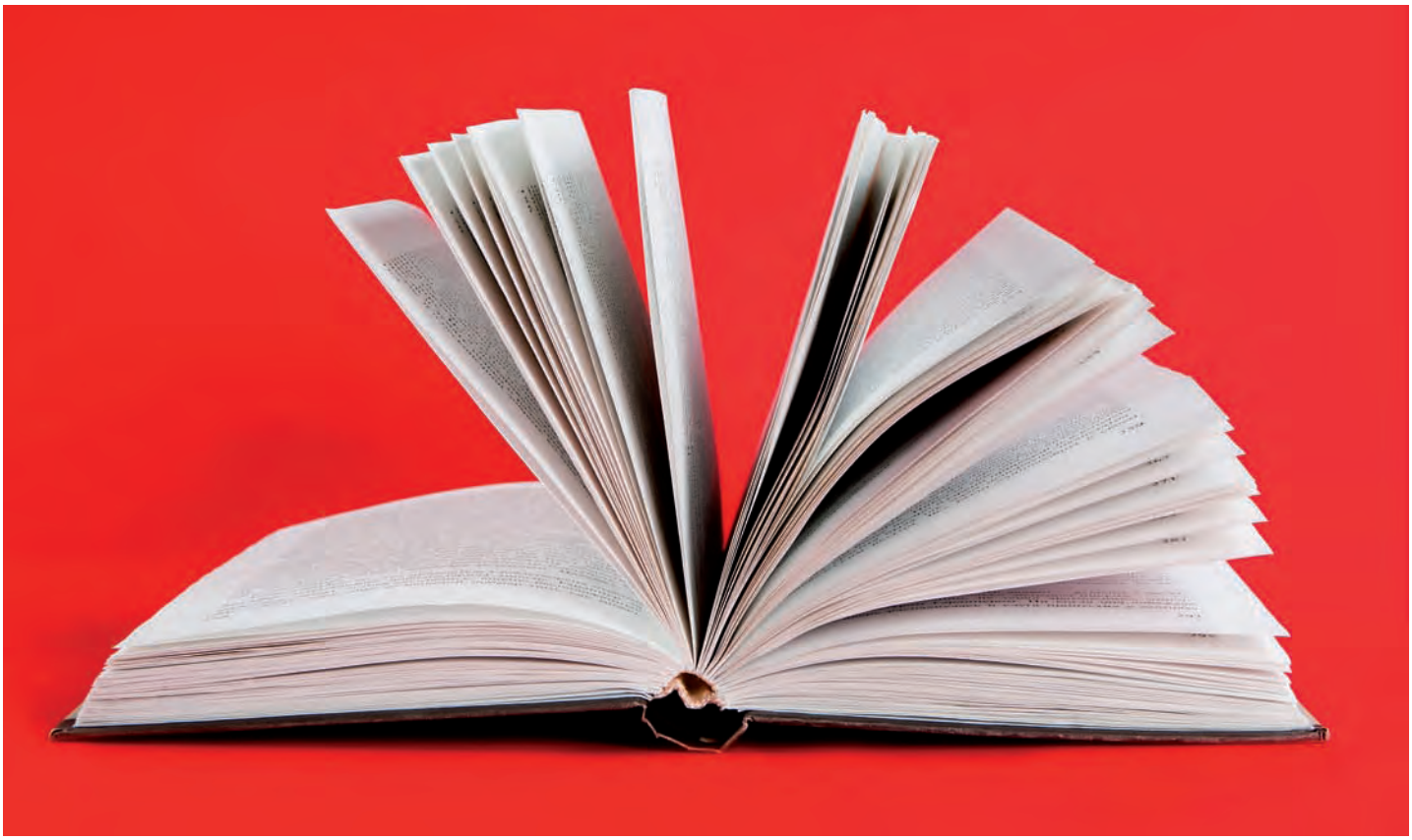
- Easy to apply with fast penetration into substrate
- Excellent adhesion to leather and other greasy substrates
- Low temperature activation, Tm = 60 °C
- Good hydrolytic stability

Capa™ in laminating adhesive film

The higher molecular weight Capa™ grades are ideal for being processed into cast films for use as laminating adhesives. The benefits are the same as for HMAs and applications include binders for non-wovens and paper laminates.

Capa™ in reactive hot melt adhesives

In reactive hot melt adhesives, Capa™ thermoplastic polymers are used for their green strength and their ability to react with isocyanates as they have some OHV. Isocyanates can be added to create additional cross-linking which give added adhesive strength. The low viscosity is useful when mixing together and the low levels of catalysts ensure a controllable reaction. Reactive hot melt adhesives can be used in applications such as structural adhesives, textile bonding, bookbinding and shoes.



Capa™ in polymer applications

Capa™ in external medical applications

Low temperature moldability coupled with rigidity allows Capa™ thermoplastics to be a more versatile alternative to traditional plaster. These Capas™ can be used in orthopedic splints, dental impressions and oncology immobilization systems.

Capa™ in films & laminates

Capa™ thermoplastics include grades to make blown films, laminates and packaging. Films with biodegradable properties are suitable in e.g. foamed packaging or wrapping for both direct and indirect food contact.

Capa™ in other applications

Capa™ has an excellent compatibility with a wide range of polymers. The latter quality coupled with the ability to have high pigment loadings, also enables Capa™ to be used in universal master batches.

Product data summary

Capa™ monomer							
	Assay	Boiling point	Melting point	Viscosity, cps at 20 °C	Specific gravity, 20 °C	Flash point, closed cup	Refractive index nD20
Monomer	> 99.9%	232 °C	-1 °C	6.67	1.079	127 °C	1.4629

Capa™ polyols								
Product group	Grade	Initiator	Typical molecular weight	OH value, mg KOH/g	Acid value, mg KOH/g	Reactivity	Viscosity, mPas[1)]	Melting range, °C
Monols	Capa™1301	CA	3000	18	< 0.25	Slow	640	60
Standard diols	Capa™ 2043	BDO	400	280	< 0.25	Slow	40	0-10
	Capa™ 2054	DEG	550	204	< 0.25	Fast	60	18-23
	Capa™ 2085	DEG	830	135	< 0.25	Slow	100	25-30
	Capa™ 2100	NEO	1,000	112	< 0.25	Fast	150	30-40
	Capa™ 2121	NEO	1,250	90	< 0.25	Slow	180	35-45
	Capa™ 2125	DEG	1,250	90	< 0.25	Slow	180	35-45
	Capa™ 2200	NEO	2,000	56	< 0.25	Fast	480	40-50
	Capa™ 2201	NEO	2,000	56	< 0.25	Slow	480	40-50
	Capa™ 2205	DEG	2,000	56	< 0.25	Slow	435	40-50
	Capa™ 2209	MEG	2,000	56	< 0.25	Slow	380	40-50
	Capa™ 2302	BDO	3,000	37	< 0.25	Fast	1,100	50-60
	Capa™ 2303	BDO	3,000	37	< 0.25	Slow	1,100	50-60
	Capa™ 2304	DEG	3,000	37	< 0.25	Fast	1,050	50-60
	Capa™ 2402	BDO	4,000	28	< 0.25	Fast	1,670	55-60
	Capa™ 2803	BDO	8,000	14	< 0.25	Slow	8,600[2)]	55-60
Premium diols	Capa™ 2077A	HDO	750	150	< 0.05	Slow	85	20-30
	Capa™ 2100A	NEO	1,000	112	< 0.05	Fast	150	30-40
	Capa™ 2101A	NEO	1,000	112	< 0.05	Slow	150	30-40
	Capa™ 2125A	DEG	1,250	90	< 0.05	Slow	175	35-45
	Capa™ 2161A	NEO	1,600	70	< 0.05	Slow	300	35-50
	Capa™ 2200A	NEO	2,000	56	< 0.05	Fast	480	40-50
	Capa™ 2200D	NEO	2,000	56	< 0.25	Fast	480	40-50
	Capa™ 2200P	NEO	2,000	56	< 0.05	Fast	400	40-50
	Capa™ 2201A	NEO	2,000	56	< 0.05	Slow	385	40-50
	Capa™ 2203A	BDO	2,000	56	< 0.05	Slow	460	40-50
	Capa™ 2302A	BDO	3,000	37	< 0.05	Fast	1,100	50-60
	Capa™ 2403D	BDO	4,000	28	< 0.25	Slow	1,670	55-60
Triols	Capa™ 3022	DEG/G	240	540	< 1.0	Fast	40	0-10
	Capa™ 3031	TMP	300	560	< 1.0	Slow	170	0-10
	Capa™ 3031A	TMP	300	560	< 0.05	Slow	170	0-10
	Capa™ 3041	TMP	400	395	< 1.0	Slow	160	0-10
	Capa™ 3050	TMP	540	310	< 1.0	Fast	160	0-10
	Capa™ 3091	TMP	900	183	< 1.0	Slow	165	0-10
	Capa™ 3121J	TMP	1,200	140	< 0.25	Slow	125	15.4
	Capa™ 3201	TMP	2,000	84	< 0.25	Slow	355	40-50
	Capa™ 3301	TMP	3,000	56	< 0.25	Slow	310	45-50
Tetrols	Capa™ 4101	Penta	1,000	218	< 1.0	Slow	260	10-20
	Capa™ 4801	Penta	8,000	28	< 1.0	Slow	4,700	40-50
Co-polymers	Capa™ 7201A	PTMEG	2,000	56	< 0.05	Slow	315	30-35
	Capa™ 7203	PC	2,000	56	< 0.25	Slow	1,100	25-35

Capa™ thermoplastic polyaprolactones							
	Grade	Approximate molecular weight	Appearance	OH value, mg KOH/g	Melt flow index[3]	Viscosity, mPas[4]	Melting range, °C
Thermoplastic polycaprolactones	Capa™ 6100	10,000	Solid	circa 11	N/A	9300	58-60
	Capa™ 6200	20,000	Solid	circa 6	15	N/A	58-60
	Capa™ 6250	25,000	Granules	circa 5	9	N/A	58-60
	Capa™ 6400	37,000	Granules	circa 4	40	N/A	58-60
	Capa™ 6430	43,000	Granules	circa 5	13	N/A	58-60
	Capa™ 6500	50,000	Granules	circa 2	7	N/A	58-60
	Capa™ 6500C	50,000	Granules	circa 2	7	N/A	58-60
	Capa™ 6506	50,000	Powder	circa 2	7	N/A	58-60
	Capa™ 6800	80,000	Granules	circa 1	3[5]	N/A	58-60

[1] Viscosity measurement: typical values, shear rate 0-500s^{-1} at 60 °C

[2] Viscosity measured at 80 °C

[3] Typical values, melt flow index measured with 1" PVC die, 2.16 kg weight, g/10 minutes at indicated temperature; for 6200s at 80 °C, 6500s and 6800s at 160 °C

[4] Viscosity measurement: typical values, shear rate 0-500s^{-1} at 100 °C

[5] Melt flow index = 5 kg, standard die at 190 °C

A = signifies enhanced hydrolytic stability

D = signifies reduced fogging and low viscosity

P = signifies low viscosity and increased reactivity

C = signifies high clarity

BDO = Butane Diol

CA = Cetyl Alcohol

DEG = Diethylene Glycol

DEG/G = Diethylene Glycol and Glycerine

HDO = Hexane Diol

MEG = Monoethylene Glycol

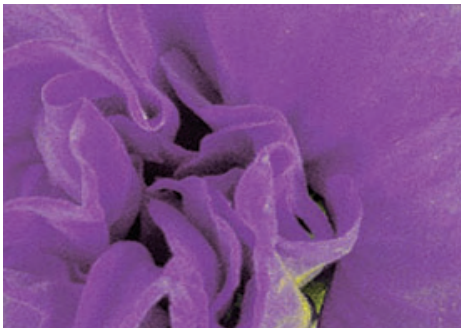
PC = Polycarbonate (aliphatic type)

Penta = Pentaerythritol

PTMEG = Polytetramethylene Ether Glycol

TMP = Trimethylolpropane





Your Winning Formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on 130 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. This is how we enable you to meet market demands for safer, lighter, more durable and environmentally sound end-products – for the aerospace, marine, coatings, chemicals, plastics, engineering, and construction industries, as well as automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Consistent high quality, capacity and delivery security are ensured through strategic production plants in Asia, Europe and North America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of smarter and safer products and sustainable processes that reduce environmental impact and create real value in new chemical applications. This principle of proactive innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

Discover your winning formula at www.perstorp.com

Perstorp
WINNING FORMULAS

Voxtar™ renewable pentaerythritol platform

- Cuts carbon footprint by up to 75% with renewable raw materials and energy
- Differentiates your offer and adds value throughout the value chain
- Meets the growing demand for renewable alternatives
- Ensures the same efficiency, security and performance as our trusted Penta and Di-Penta

Perstorp
WINNING FORMULAS

The pure advantage of higher value & lower impact

The world's first & only renewable pentaerythritol platform

As a leading global supplier of pentaerythritol and its derivatives and in our commitment to developing solutions that combine high performance and low environmental impact, we are proud to present Voxtar™ – our newest product line and the world's first pentaerythritol platform based on renewable raw materials and energy.

Voxtar™ renewability is independently certified and shrinks carbon footprint by up to 75% compared to conventional Penta and Di-Penta, all while providing the same trusted efficiency, security and high performance. With Voxtar™ we have just made it ingeniously simple to cut your environmental impact, differentiate your offer, sharpen your competitive edge, and demonstrate your commitment to your customers' success – both in today's competitive business environment and in helping them meet the challenges of tomorrow.

Further maximizing your value, Voxtar™ products help you capitalize on the growing demand for renewable alternatives in a number of applications. It enhances performance and minimizes environmental impact in a wide range of end products including high performance alkyd paints and coatings, synthetic lubricants, cosmetic emollients, adhesives and printing inks.

What's more, Voxtar™ shares all these advantages, adding value all the way through the value chain to the end user. It all adds up to a winning formula for pure advantage.

Our Voxtar™ range:

Voxtar™ M100, Bio-based Penta Mono, from fully renewable sources

Voxtar™ M50, Bio-based Penta Mono, from partially renewable sources

Voxtar™ T100, Bio-based Penta Tech, from fully renewable sources

Voxtar™ T50, Bio-based Penta Tech, from partially renewable sources

Voxtar™ D100, Bio-based Di-Penta, from fully renewable sources

Voxtar™ D50, Bio-based Di-Penta, from partially renewable sources

"Voxtar™ makes it ingeniously simple to minimize environmental impact, differentiate your offer, sharpen your competitive edge, and demonstrate your commitment to your customers' success."

SUSTAINABLE DEVELOPMENT

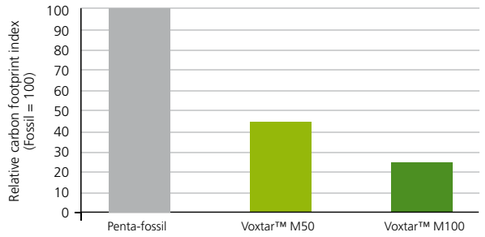
Seeing the bigger picture & acting on it

We believe in improving everyday life – making it safer, more convenient, more fun, and more environmentally sound for millions of people all over the world. And we achieve this through innovative chemistry. It is how we provide you with solutions that maximize performance and minimize environmental impact all at once, enabling you to create greater value for your business, your customers, their customers, and all the way through to end users. Here are some of the things we are doing to ensure it:

- A major part of our R&D work is focused on developing more efficient and environmentally sound products and processes, enabling cuts in environmental impact.
- We are in the process of systematically mapping the carbon footprints and lifecycle impact of our main products. Voxtar™ is just the first of about 15 products that we will provide complete carbon footprint information on by 2011.
- Renewable energy has been powering parts of our production since 1991. In 2008, for example, 58% of the fuel for steam production at our Perstorp, Sweden site, came from renewable sources.
- Our production sites in Sweden supplied a combined 169 GWh of energy back into the district heating grid in their respective municipalities in 2008.
- We actively search for sustainable alternatives to conventional technology.
- Many of our products replace or reduce the use of harmful substances, such as bromide in flame retardants, and lead in PVC products, and solvents in many applications. With Voxtar™ we take another step closer to our vision of sustainable solutions.

Minimizing impact, maximizing value every step of the way

Effect on carbon footprint (cradle to grave) when comparing Voxtar™ M100 & M50 with fossil-based pentaerythritol



Relative cradle to grave carbon footprint comparison between Voxtar™ M100, M50 and fossil-based Penta

$$CO_{2e\ (cradle\ to\ grave)*} = CO_{2e\ (cradle\ to\ gate)} + \frac{CO_{2c} \times n_{fossil}}{n_{tot}}$$

Where:
CO_{2e} = Carbon dioxide equivalent of a product, expressed in kg/kg
CO_{2c} = Carbon dioxide released at full combustion
n_{fossil} = Number of fossil carbons in molecule
n_{tot} = Total number of carbons in molecule

**Transports and down-stream processing excluded from the cradle to grave estimate*

Reduce carbon footprint by up to 75%

A carbon footprint is a declaration of a product's impact on climate change, calculated in terms of the greenhouse gases produced throughout its lifecycle. Carbon footprints are key environmental indicators to understand both how you impact climate change and how to reduce that impact. While our Penta is a product with a reasonable environmental profile compared to many chemicals, we have now improved it even further. One of the most effective ways to shrink the carbon footprint of a product is to replace fossil-based raw materials and energy with renewable alternatives. This is precisely how Voxtar™ cuts carbon footprint so significantly, by up to 75% compared to conventional Penta.

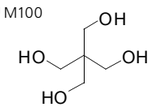
We are strongly committed to providing sustainable solutions that limit environmental impact and climate change. And with Voxtar™ we help enable a greener future. Further, carbon footprint declarations are quickly becoming a 'license to operate' in some markets. And proven reductions in carbon footprint can give you a clear advantage over competitors, let you sell your products at a premium, potentially save you money on carbon emission credits and even allow you sell surplus emission credits for a profit.

Renewable raw materials & energy inside

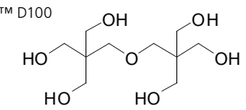
The raw materials we use to produce our Voxtar™ products are based fully or partially on renewable resources, depending on the grade. Naturally, our suppliers are certified according ISO 14040 and ISO 14020 environmental standards.

All grades are produced with the renewable energy that has been powering parts of our production since 1991 at our Perstorp, Sweden site.

Voxtar™ M100



Voxtar™ D100



Green credibility

Cradle to gate & an example of cradle to grave with Voxtar™

Today, we know that the cradle to gate carbon footprint of Voxtar™ is significantly smaller than that of fossil-based pentaerythritol. That covers upstream lifecycle, from extraction of natural resources and raw material production, down to all the energy production and transportation required until the final Voxtar™ product is leaves our gate. The Voxtar™ carbon footprint is well documented according to international standards and certified by a third party. And the underlying Life Cycle Assessment (LCA) has been prepared according to the ISO standard for environmental product declarations.

We care about minimizing the environmental impact of our products and their environmental impact in downstream usage. We look forward to supporting you to reduce your carbon footprint.

Independently certified renewability

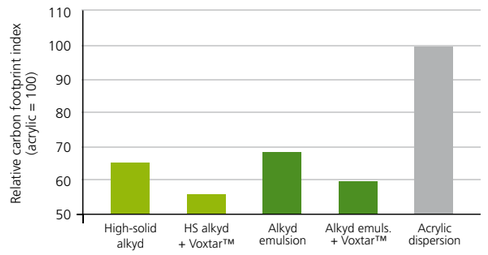
Our certification process will guarantee the renewability and full traceability of all Voxtar™ products. We understand that independent certification is vital to meeting your demands and the growing demands of your customers and the entire value chain for credible, traceable, renewable alternatives.

Voxtar™ segments in focus

The new benchmark in environmentally sound, high performance paints

The main application area of the Voxtar™ M series, like Penta, is as a branching monomer for alkyd resins used in paints, typically for architectural and joinery applications. With Voxtar™ technology, the renewable content of an alkyd resin can be even greater. Furthermore, waterborne alkyds based on Voxtar™ M100 or Voxtar™ M50 offer truly environmentally friendly paint, combining low VOC with exceptional renewable content. High-solid alkyds and alkyd emulsion paints based on Voxtar™ secure superior environmental performance with an even greater reduction in carbon footprint compared to traditional petroleum-based latex paints.

Relative carbon footprint comparison between high-solid alkyds & alkyd emulsion paints vs. acrylic dispersion paints



Carbon footprint comparison of high-solid alkyds- and alkyd emulsion paints compared to acrylic dispersion paints [1] plus Voxtar™ effect estimates

[1] Data based on Surface Coatings International, 1998, 10, 491-494

In line with our vision for sustainable solutions, we work hard at reducing environmental impact for coatings without compromising on performance. As complement to our Voxtar™ range, we have developed specialty resin additives that can help partially or fully replace solvent with water in alkyd resins. Visit **www.perstorp.com** for more information on these solutions.

Voxtar™ D100, our renewable Di-Penta, is a hexafunctional compound with primary hydroxyl groups. The high hydroxyl density and compact structure provide outstanding properties. This enables the production of high-solid alkyd paints with excellent balance between drying speed, viscosity, water resistance, and now even better environmental performance as well. Further, combined with water, a renewable Voxtar™-based resin is clearly unparalleled in terms of environmental performance.

Enhancing synthetic lubricants, cosmetic emollients & more

Voxtar™ products bring unique advantages to the production of fatty acid esters for synthetic lubricants and cosmetic emollients. They now enable the formulation of renewable synthetic lubricants for CFC-free cold storage and refrigerators, as well as for jet engines – all applications with a high focus on reducing environmental impact.

In the personal care segment, cosmetic formulators are now systematically working to replace all fossil-based ingredients with renewable alternatives, to meet the rapidly growing demands of consumers. That puts pressure on ingredient suppliers to find renewable raw materials for producing renewable ingredients. Cosmetic emollients specifically, typically make up 5 to 15% of an end product and Voxtar™ now enables ingredient suppliers to make high-performing emollients fully based on renewable materials.

Voxtar™ further enhances end-product performance and reduces environmental impact in a wide range of applications such as rosin esters for printing inks and adhesives used for food packaging and hygienic applications.

Product data summary

Product	Appearance	Reactive group	Renewable content [1]	Molecular weight (g/mol)	Hydroxyl number (mg KOH/g)	Melting point (°C)	Carbon footprint[2] (cradle to grave) CO_{2e} (kg/kg)
Voxtar™ M-series							
Voxtar™ M100	Crystals	4 hydroxyl	100*	136.4	1,645	260	1.2
Voxtar™ M50	Crystals	4 hydroxyl	40**	136.4	1,645	260	2.1
Voxtar™ T-series							
Voxtar™ T100	Crystals	4 hydroxyl	100*	142.5	1,615	248	1.2
Voxtar™ T50	Crystals	4 hydroxyl	40**	142.5	1,615	248	2.1
Voxtar™ D-series							
Voxtar™ D100	Crystals	6 hydroxyl	100*	254.1	1,325	222	1.2
Voxtar™ D50	Crystals	6 hydroxyl	40**	254.1	1,325	222	2.1

[1] For information only, not included in carbon footprint certification
* Allocated through mass balance and purchased certificates
** C_{14}-method (ASTM D6866)
[2] ISO 14,040, ISO 14,044 & ISO 14,067. Cradle to gate values in sales spec. upon purchase. Cradle to grave estimates acc. to equation on p. 4



Your Winning Formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on 130 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. This is how we enable you to meet market demands for safer, lighter, more durable and environmentally sound end-products – for the aerospace, marine, coatings, chemicals, plastics, engineering, and construction industries, as well as automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Consistent high quality, capacity and delivery security are ensured through strategic production plants in Asia, Europe and North America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of smarter and safer products and sustainable processes that reduce environmental impact and create real value in new chemical applications. This principle of proactive innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

Discover your winning formula at www.perstorp.com

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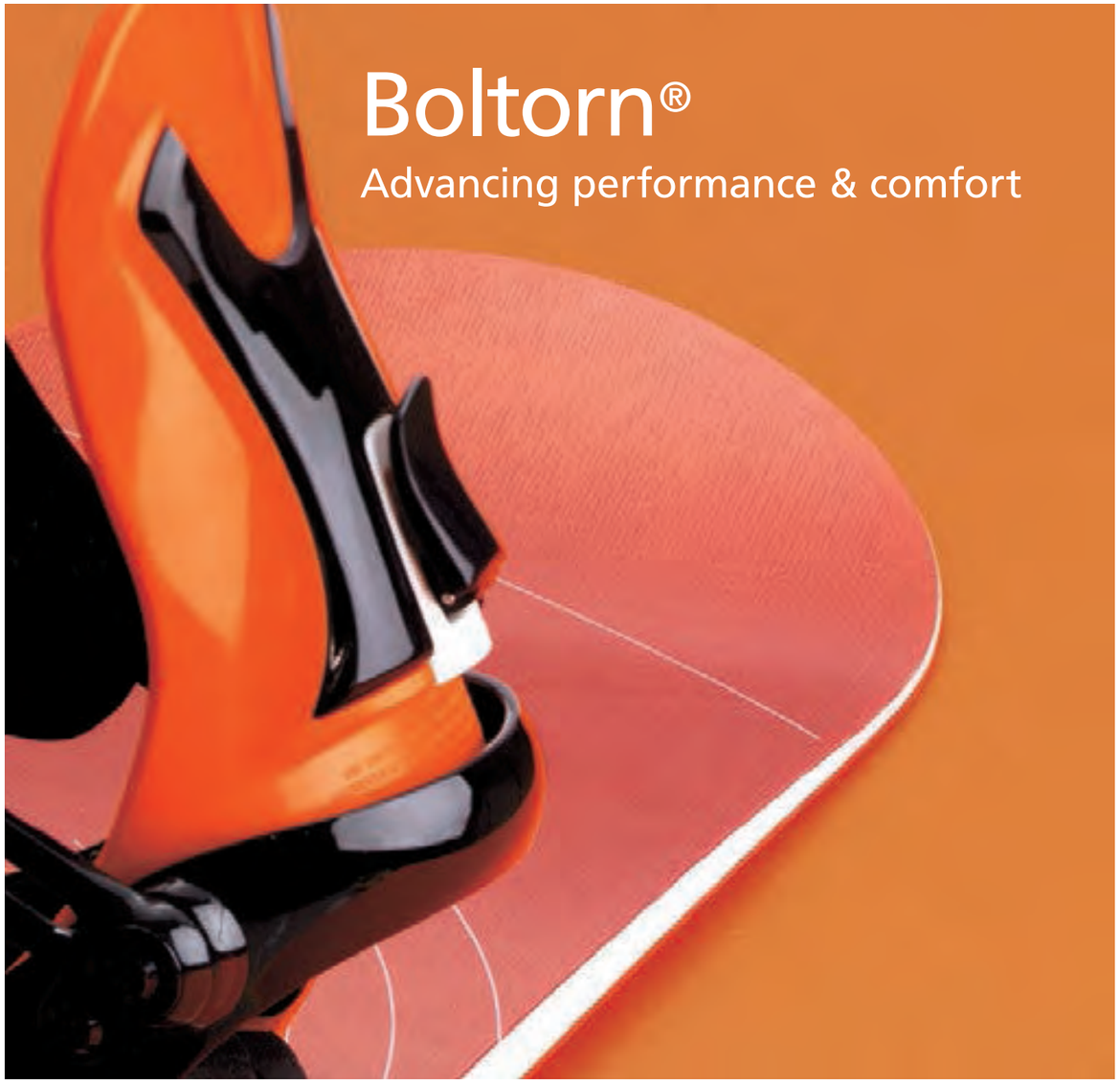


Boltorn®

Advancing performance & comfort

Our dendritic polymers

- Secure exceptional firmness and comfort in flexible polyurethane foam
- Improve the Tg/flexibility ratio of cast polyurethane elastomer products
- Ensure rapid curing, excellent durability and low toxicity in UV curing applications
- Provide reduced VOC and improved performance in architectural coatings

Perstorp
WINNING FORMULAS

Advancing performance & comfort

Sharpen your competitive edge by partnering with the global leader in bringing cost-effective dendritic polymers to the market. Dendritic polymers are characterized by a densely branched backbone and a large number of reactive groups. Their globular structures have excellent flow and processing properties at high molecular weight. The exceptional concentration of reactive groups facilitates customization of properties for a wide range of end uses.

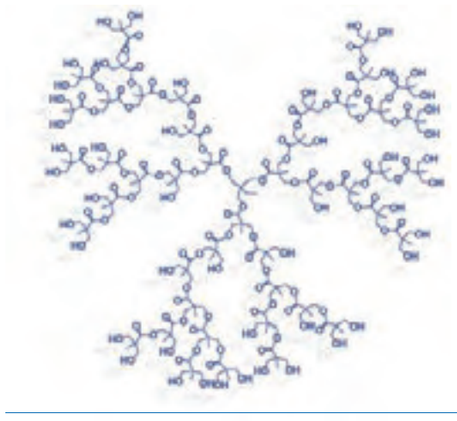
The main applications of Boltorn® dendritic polymers:

- Performance additives for flexible polyurethane foam such as in automotive seating applications
- Elastomer cross-linkers to improve the Tg/flexibility ratio of cast polyurethane elastomer products
- Oligomer precursors for UV curing applications to achieve very rapid curing and excellent properties
- Performance resins for architectural coatings to convert solvent borne resins to waterborne equivalents and reduce the VOC of solvent borne paints

Boltorn® technology

- Large number of primary hydroxyl groups
- Densely branched polymer backbone
- Extensive formulation possibilities

Boltorn® dendritic polymer



The cutting edge of technology

Our Boltorn® products are produced using polyalcohol cores, hydroxy acids and technology based on captive materials. The dendritic structures are formed by polymerization of the particular core and 2,2-dimethylol propionic acid (Bis-MPA). The base products obtained are hydroxyl-functional dendritic polyesters. Fully aliphatic and consisting only of tertiary ester bonds, they provide excellent thermal and chemical resistance. Extensive branching also improves reactivity, lowers viscosity and results in balanced mechanical properties. Five base products are available as polymer building blocks and elastomer cross-linkers representing a range in molecular weight, hydroxyl functionality, glass transition temperature (Tg) and polarity.

Our dendritic base products:

Boltorn® H20
16 terminal hydroxyl groups,
nominal molecular weight of 1,750 g/mol

Boltorn® H2003
12 terminal hydroxyl groups,
nominal molecular weight of 2,300 g/mol

Boltorn® H2004
6 terminal hydroxyl groups,
nominal molecular weight of 3,100 g/mol

Boltorn® H30
32 terminal hydroxyl groups,
nominal molecular weight of 3,600 g/mol

Boltorn® H40
64 terminal hydroxyl groups,
nominal molecular weight of 7,300 g/mol

We welcome your questions. More detailed information and specifications of each product are available on www.perstorp.com or through your Perstorp sales representative.

Fine-tuning with polyols

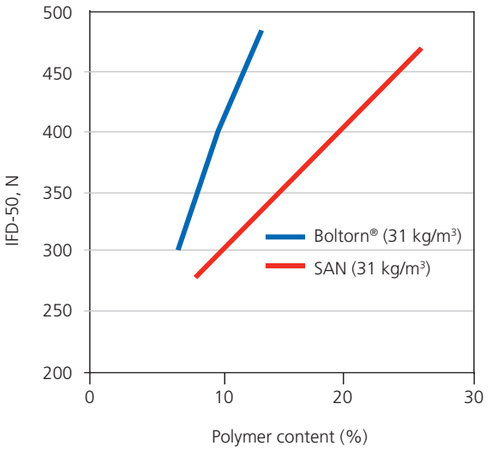
Boltorn® for polyurethanes

Millions of car owners already enjoy superior seating comfort with the help of Boltorn® technology. In partnership with a leading automotive foam supplier, we have developed a unique technology that improves the firmness of high-resilience foam articles with dendritic polymer polyols.

Boltorn® H311 – for exceptional firmness & stability

This liquid polymer polyol provides exceptional compressive load-building characteristics in flexible foam at very low addition levels. It is used as an additive, partially replacing conventional cross-linkers or graft co-polymer polyols of SAN-type. Compared to conventional technology, Boltorn® H311 offers considerable benefits:

- Two to three times the efficiency in providing compressive loads (IFD or CFD) at a given addition solids level, which allows lower average solids levels to be used
- Exceptional firmness, extending beyond current state-of-the-art technology
- Improved foam stability due to the cross-linking mechanism and reduced surface voids of finished parts



Compressive load as function of polymer content for Boltorn® H311 vs. co-polymer polyols

Boltorn® P500 – new release for high firmness at low compression set

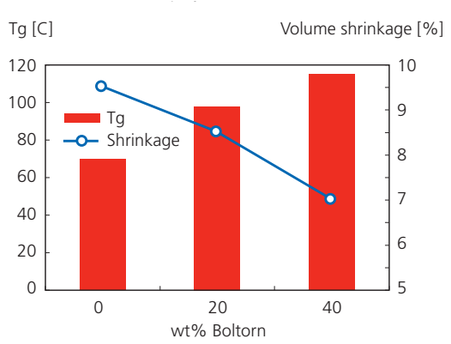
Our newly launched dendritic polymer polyol for molded foam is a liquid water-free product that yields exceptionally low compression set at high firmness when used with graft co-polymer polyols. The low compression set allows you to operate at reduced foam density and still meet the comfort specifications of end users.

Formulation	60-5	60-15	50-11-4
Polyol (Hyperlite 1656), pph	87.95	63.85	63.51
Co-polymer polyol (Hyperlite 1650), pph	12.05	36.15	36.49
Boltorn® P500, pph	0	0	4.19
DEOA-LF, pph	0.50	0.50	1.00
Glycerine, pph	0	0	0
H_20, pph	1.76	1.75	2.21
DABCO 33-LV, pph	0.10	0.10	0.36
NIAX A-1, pph	0.08	0.08	0.08
PC77, pph	0.20	0.20	0.00
Y10184, pph	1.00	1.00	0.70
TDI 80, pph	23.61	23.12	33.72
Total wet weight, g	127.25	126.75	142.26
Total dry weight, g	119.60	119.10	130.75
SAN, %	5	15	11
Boltorn® P500, %	0	0	4
Density, kg/m³	60	60	50
IFD-25, N	147	239	192
IFD-65, N	390	633	558
Dry set, %	4	4	2.9

Density reduction at reduced compression set when using Boltorn® P500

Cross-linkers for increased durability

We offer you two dendritic polyester polyols suitable as cross-linkers for cast polyurethanes and elastomers. Boltorn® H2003 is a polyol of relatively high molecular weight and high hydroxyl value. Added to a polyurethane formulation, it improves the Tg and Shore-hardness of some formulations with aliphatic isocyanates. Boltorn® H2004 is a liquid product with hydrophobic chain stoppers that is used to yield durable systems with high flexibility.



High molecular weight and functionality of acrylated Boltorn® oligomers improves hardness and Tg, yet reduces shrinkage and curl, when replacing polyether in polyether/PEOTA formulation

Boltorn® for radiation curing

Oligomer precursors for superior performance

Boltorn® products enhance radiation curing applications by providing oligomer precursors that significantly increase the average molecular weight of UV formulations at high acrylate concentration. Acrylates based on Boltorn® technology are typically used to partially or fully replace urethane acrylates, other top-end oligomers or acrylates of high functionality. Using Boltorn® dendritic polyols as starters for oligomer acrylates offers significant benefits:

- Excellent reactivity
- Improved scratch resistance and film hardness
- Low shrinkage and good adhesion
- Exceptional flow properties and good pigment wetting
- Improved labeling with low extractables
- Unique molecular weight/viscosity ratio

For coatings, the balance between flow and properties like reactivity, and chemical and scratch resistance, is crucial for meeting end-user demands. Environmental compliance is also a key competitive factor. Radiation curing systems, typically UV, have gained market share in the past decades as on very rapid curing and excellent film properties are obtained with low or no VOC emissions.

Acrylated polyol	Di-Penta (DPHA)	Acrylate of Boltorn® P500
Viscosity, mPas, 100% solids, 23°C	14,000	700
Min. UV-dose, tack-free, mJ/cm²	200	200
Erichsen-flex., aluminum, mm	0.4	2.2
Pencil hardness, PC- Sheet, 250µm	3H/4H	2H/3H
Scratch resistance (200 rubs), gloss 60° ret., %	90	91
Tape adhesion on PC-sheet, 0-5, 5 best	2	5
Adhesion, 180° bending test	No	OK

Properties of acrylated Di-Penta and acrylated Boltorn® P500 – all coating formulations cured with 3% Irgacure 500 from Ciba at 12µm film thickness with a UV-dose of 500 mJ/cm² unless otherwise stated

Designed to enhance

Boltorn® for architectural coatings

Boltorn® resins – safer performance

Our Boltorn® performance resins for solvent borne and water-borne architectural coatings help coating formulators comply with environmental demands without compromising coating performance. A number of patented technologies have been developed in which Boltorn® resins improve the performance of architectural coatings. Achieve excellent properties including reduced VOC, improved drying of woodstains and conversion of conventional solvent borne resins to waterborne equivalents.

Formulation	Conventional woodstain	+40wt% Boltorn® U3000
Type	oil/alkyd	oil/alkyd/dendritic alkyd
VOC, g/l	595	238
Viscosity, 23°C, mPas	28	72
Drying properties (45µm dry film)		
Film hardness-1 day, Ks	5	45
Film hardness-10 days, Ks	27	35
Film hardness-17 days, Ks	27	33
Film hardness-31 days, Ks	26	33

Effect on VOC and drying properties when adding Boltorn® U3000 to a conventional woodstain available in Scandinavia

Boltorn® U3000 – unique flow properties

For high-solid alkyds, the branched structure of Boltorn® U3000 provides unique flow properties, which allows woodstains and alkyd paints for outdoor applications to comply with recent VOC demands while still securing rapid drying and durability.

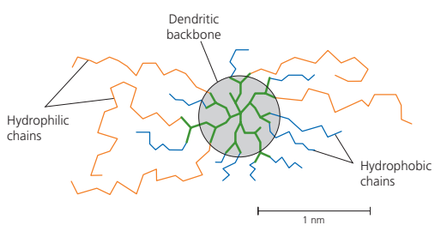
High-gloss paint for brush application	Boltorn® W3000 stabilized OL 65 alkyd emulsion	Solvent borne OL 65 alkyd (ref)	Conventional OL 65 alkyd emulsion
Boltorn® W3000, wt% in paint	2.3	-	-
Alkyd (OL65), wt% in paint	21.4	34.4	-
Alkyd OL65-internally emulsified	-	-	31.8
Solids content, wt%	49	67	51
PVC	17	17	13
VOC, g/l	0	270	0
Gloss, 60°	93	92	95
Drying*			
Dust-dry, h	0.5	0.5	0.5
Tack-free, h	4	3	1.5
Through dry, h	5	3.5	15.5
Hard, h	14	5	> 24

* Beck-Koller, glass panels at 23°C, 50% humidity, 25 µm DFT

The physical properties of a waterborne paint containing Boltorn® W3000 compared to a solvent borne counterpart and a conventional alkyd emulsion paint

Boltorn® W3000 – efficient & powerful by design

The unique structure of dendritic polymers offers extensive design possibilities. We have developed Boltorn® W3000, a dispersing resin for converting conventional solvent borne alkyd paints into waterborne equivalents. The amphiphilic dendritic structure of Boltorn® W3000 contains both non-ionic water-dispersible and hydrophobic air-drying groups. The result is a powerful high molecular weight surfactant, which also contributes to drying



Schematic structure of Boltorn® W3000

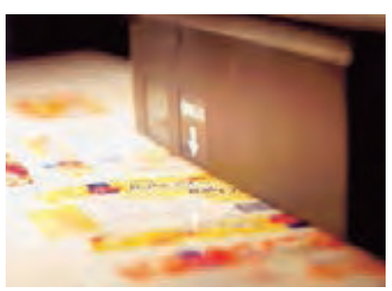
Product data summary

Product	Soluble in	Appearance	Functionality	OH-value mg KOH/g	Mw (GPC) g/mol	Tg (DMA) °C	Viscosity, Pas (°C)
Polymer building blocks & CASE polyols							
Boltorn® H20	NMP, Diglym Acetone, Glycols	Opaque pellets	16	490 – 520	2,100	30	7 (110)
Boltorn® H2003	EtOH, MEK, Toluen	Transparent	12	275 – 305	2,500	-5	0.5 (110)
Boltorn® H2004	EtOH, Toluene, Xylene	Yellow liquid	6.4	105 – 125	3,200	-35	15 (23)
Boltorn® H30	MeOH, Acetone, NMP	Opaque pellets	32	480 – 520	3,500	35	40 (110)
Boltorn® H40	MeOH, Acetone, MEK	Transparent pellets	64	470 – 500	5,100	40	110 (110)

Product	Soluble in	Appearance	Water cont. wt%	OH-value mg KOH/g	Mw (GPC) g/mol	Tg (DMA) °C	Viscosity, Pas (°C)
Molded flexible foam							
Boltorn® H311	Polyether/ polyester polyols	Yellow liquid	9.5 – 10.5	230 – 260	5,700	-5	40 (23)
Boltorn® P500	Polyether polyols	Clear liquid	<0.5	560 – 630	1,800		15 (23)

Product	Soluble in	Appearance	Functionality	OH-value mg KOH/g	Mw (GPC) g/mol	Tg (DMA) °C	Viscosity, Pas (°C)
Radiation curing							
Boltorn® H20	Acrylic acid + 15% toluene	Opaque pellets	16	490 – 520	2,100	30	7 (110)
Boltorn® H2003	EtOH, MEK, Toluen	Transparent	12	275 – 305	2,500	-5	0.5 (110)
Boltorn® P500	Acrylic acid + toluene	Clear liquid	Mixed hydroxyl	560 – 630	1,800 (bimodal)	–	15 (23)
Boltorn® P1000	Acrylic acid + toluene	Clear liquid	Mixed hydroxyl	430 – 490	1,500 (bimodal)	–	5 (23)

Product	Soluble in	Appearance	Functionality	Oil length % triglyc.	Mw (GPC) g/mol	Solids, %	Viscosity, Pas (°C)
Architectural, waterborne coatings							
Boltorn® U3000	Oils, coalescents, EtOH, Xylene	Yellow liquid	Air-drying	75	6,500	99	1 (23)
Boltorn® W3000	Emulsifying, soluble in alkyds, co-solvents, xylene	Yellow wax	Amphiphilic Air-drying	45 (fully aliphatic)	9,000	99	2 (35)



Precisely tailored end-product properties

Charmor™

Protecting people & property

Our Charmor™ range for intumescent systems

- Improves fire resistance with thick char barrier
- Secures supply with largest global production capacity
- Ensures high and consistent performance and polyol purity
- Non-toxic to provide safe, easy handling and storage

Perstorp
WINNING FORMULAS

Intumescent systems for fire protection

Growing demands on protecting people & property

Intumescent systems offer halogen-free fire protection for people and property. Today, the use of intumescent systems is growing thanks to their safe chemical profile in terms of handling and environment, as well as their efficient protection that meets stringent fire safety regulations.

Intumescent systems are ideal as protective coatings and sealants in the construction industry, for fire resistant plastics in electrical, electronics and transportation.

Intumescent systems work by forming a thick, stable carbon foam barrier when exposed to fire, and have three key components:

- Charmor™, the carbon source and critical component
- an acid donor such as APP (ammonium polyphosphate)
- a spumific/blowing agent such as melamine

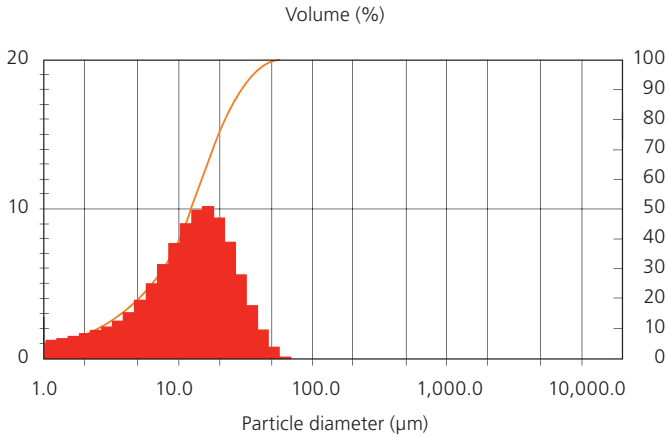
In protective coatings, this char formation insulates steel structures, preventing early collapse. In expandable sealants, the char formation forms a fire stop and prevents gas and heat from spreading. In plastic and textile materials, intumescents slow combustion, cut heat and smoke release rates and reduce melt dripping.

Charmor™ enhances intumescent systems

Charmor™ polyols are a rich carbon source for producing superior intumescent systems. Our production of Charmor™ is carried out at our plant in Germany with excellent global supply capability. High product quality is assured by ISO 9001 procedures, and our precise milling technology for polyol micronization and quality control procedures ensure that at least 98% of our Charmor™ products are below the stated particle size values, 40 µm and 15 µm.

Having our own production facilities allows us to tightly control the total quality chain from sensitive raw materials, through manufacturing and milling, to bagging and distribution. This ensures the consistent high polyol purity and narrow particle size distribution that are essential to achieving high and consistent performance every time. The absence of coarse particles also means fast incorporation rates into end products.

Charmor™ products are also easy to handle. Delivered as low density, white powder with controlled particle size, Charmor™ polyols are non-toxic and present minimal risks for personnel and the working environment. They are available in varying composition and particle size. Charmor™ products are also non-hygroscopic and can be conveniently stored in a cool warehouse with virtually no caking.



Particle size distribution of Charmor™ PM40
Typically 98% of particles are below 40 µm

Innovation & development in intumescent systems

Our technical service, R&D support and other hands-on activities help you discover the right Charmor™ product for your specific application.

The newest product in our range, Charmor™ PP100, is particularly suitable for intumescent systems in plastics.

Intumescent coatings win valuable time

Designed for the best performance & protection

Intumescent coatings and expandable sealants based on Charmor™ protect buildings and the people inside them, in the event of fire. Charmor™-based coatings and sealants slow the spread of fire, reduce heat and minimize dangerous smoke and fumes more effectively than any alternative products, facilitating safe evacuation and limiting structural damage. The Charmor™ range ensures the ultimate performance and protection on surfaces including steel and wood.

For example, in buildings with structural steel profiles, which are increasingly common, the very high temperatures cause steel profiles to distort and become weaker, potentially leading to collapse. Steel loses its strength at about 500°C. Here, the extra time provided by Charmor™ compared to alternative products slows and even potentially prevents this process.

Charmor™ offers a rich carbon source that forms a thick fire-resistant char barrier when the intumescent coating is exposed to high temperatures. When a layer of Charmor™-based intumescent coating, circa one millimeter thick, is exposed to 200°C heat or higher, it will swell up 10 to 100 times its size to build a foam char barrier that insulates the underlying material. And the high purity and consistency of Charmor™ improves the insulation effect of the intumescent coating and ultimately helps prevent the substrate from catching fire or distorting.

Development of the char barrier during the intumescent process

The intumescent reaction is activated by heat at approximately 200°C. It is an endothermic reaction that absorbs heat, emits inert gases and creates an effective insulation layer.

- Thermoplastic resin melts to allow further chemical reactions to take place in a soft matrix
- Acid donor (ammonium polyphosphate) decomposes to form polyphosphoric acid
- Polyphosphoric acid reacts with carbon donor (Charmor™) to form an inorganic/organic ester
- Blowing agent (e.g., melamine) releases gases causing the the ester to create a foam that form an insulating barrier which adheres to the substrate
- The ester decomposes to form a tough carbon matrix

The intumescent process
When an intumescent coating is exposed to heat, the intumescent effect initiates at approximately 200°C. Esterification, swelling and carbonization create an effective insulating layer.

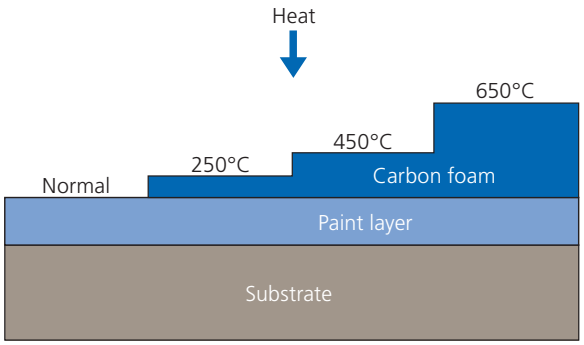
High performance polyols

Charmor™ polyols are high performers. But to achieve reliable performance in intumescent formulations it is important to have high consistency regarding both chemical and physical properties. Minor changes in individual compounds contained in coatings can significantly influence end-product performance. Coarse carbon donor particles can cause the inhomogeneous distribution of reactants, risking problems such as cracking and loss of adhesion during the intumescent process.

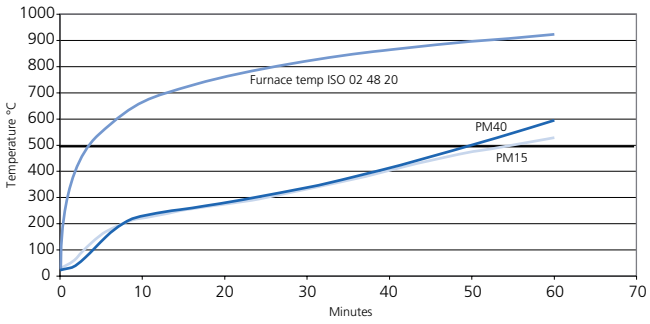
Fine-tuning particle size lets you customize the performance of an intumescent system with the precise structure of foam that best suits your application. For example, the standard grade Charmor™ PM40 creates foam with excellent swelling and robust properties for turbulent fire conditions. The finer particle size of Charmor™ PM15 creates foam with slightly higher volume and very good thermal insulation.

Fundamental paint formulation

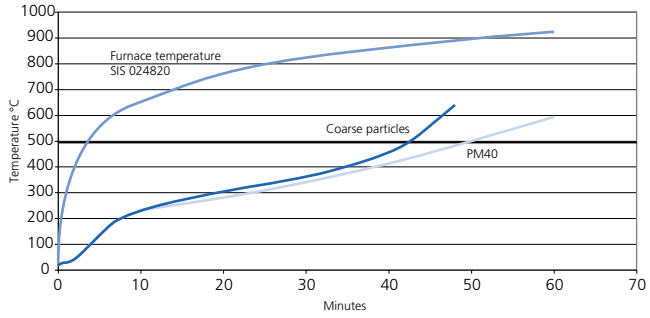
Raw material	Weight %
Thermoplastic resin (solid)	10-15
Charmor™	8-11
Ammonium polyphosphate (e.g., Exolit AP422)	20-30
Spumific, blowing agent (e.g., melamine)	8-11
Chlorinated paraffin (for solvent borne systems)	6-9
Titanium dioxide	6-8
Solvent (water or organic solvent)	30-40
Additives (thickener, dispersing agent, defoamer, etc.)	0.3-3



Charmor™ extends the time it takes for steel to reach the critical temperature of 500°C



Longer time obtained with Charmor™ compared to alternatives thanks to reduced cracking & loss of adhesion caused by coarse particles



Intumescent systems in plastics

Meet growing demands with new carbon donor polymer

Intumescent systems for plastics are a recent development, introduced to meet new fire regulations in the E&E and transportation sectors demanding lower smoke release, non-dripping plastics, and non-toxic fumes. The growth has also been driven by regulations on raw materials and recycling. Intumescent systems meet both of these demands and, with Charmor™ offer superior performance and fire protection. Intumescent systems also enable more lightweight plastic than mineral-based flame retardants for significant weight savings in applications such as transportation.

Charmor™ PM is the basic grade carbon source suitable for cost-efficient thermosets, such as unsaturated polyesters for gel coats and structural resins, where water sensitivity, thermal stability and compatibility are not the chief concern.

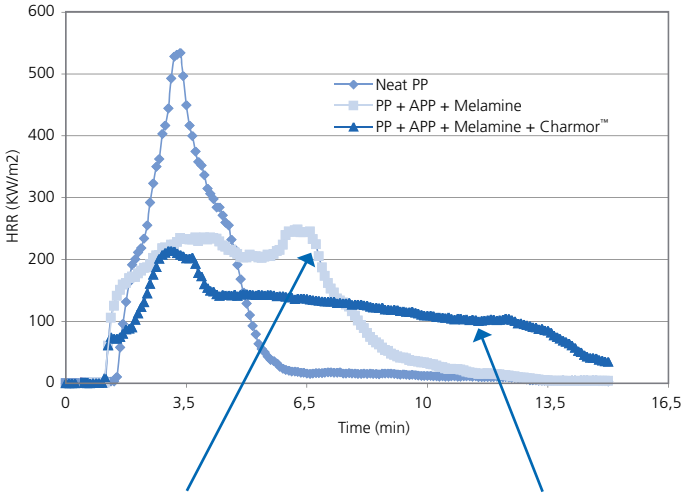
Charmor™ DP is the most thermally stable and least water sensitive grade, making it more broadly applicable to a wide range of thermoplastic processing for highest performance and durable end products.

Our new grade, Charmor™ PP100, offers a low melting point and the best polymer compatibility, which improves flow during thermoplastic processing and gives more robust, reproducible, reliable mechanical properties.

	Limited Oxygen Index (%)	UL 94 (0.8 mm)	HRR Peak (kW/m²)	THR (kJ)	Maximum char height (cm)
Virgin PA66	28	NC	923	97	No residue
Reference FR PA 66 (with 20% Exolit OP1311)	30	NC	359	71	No char
Reference FR PA 66 + 5% Charmor™ DP40	31	V0	327	38	0.9
Reference FR PA 66 + 5% Charmor™ PP100	34	V0	295	58	1.5

Charmor™ enhanced LOI, UL 94 ratings and heat release in Polyamide 66 with metal phosphinate and melamine polyphosphate

Charmor™ PP100 combined with ammonium polyphosphate and melamine in polypropylene reduce the heat release rate



PP + APP + Melamine

LOI: 22
UL94: NC

PP + APP + Melamine + Charmor™ PP100

LOI: 33
UL94: V1

Charmor™ is a rich carbon source for intumescent systems, allowing:

- Enhanced Limited Oxygen Index, UL94 ratings, less melt dripping and heat & smoke release rate reductions
- Minimized Intumescent Flame Retardant (IFR) package
- Improved flow and processing (depending on Charmor™/polymer grades), wider processing and formulation latitude
- High thermal stability (depending on Charmor™ grade), suitable for a wide range of thermoplastic processing
- Non-hazardous, heavy metal free and RoHS/WEEE compliant compounds

	Coatings	Sealants	Thermoset type UPR	Thermoplastic (e.g., PP, PE, TPE, etc.)	Engineering thermoplastic (e.g. PA, PC, PBT, etc.)
Charmor™ PM/PT	√ √	√	√ √	√	–
Charmor™ DP	√	√ √	√	√ √	√ √ √
Charmor™ PP100	√	√	√	√ √ √	√ √

Product data summary

Property	Charmor™ PM	Charmor™ PT	Charmor™ DP	Charmor™ PP100
Melting point	260°C	250°C	222°C	170°C
Water solubility (% at room temperature)	5.25	4.70	0.22	0.2
Typical hydroxyl number mg KOH/g	1,645	1,615	1,325	1,050
Density kg/m^3	1,400	1,400	1,370	1,320
Particle size	Particle size <40 µm typ. 98%	Particle size <40 µm typ. 98%	Particle size <40 µm typ. 98%	Particle size <250 µm



Your Winning Formula

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Products for polyurethane dispersions

Complete palette for high performance & low impact

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Complete palette for high performance & low impact

Limitless formulation freedom

Aqueous polyurethane dispersions (PUDs) are widely appreciated for their versatility, high performance, and low environmental impact – and because they enable formulators to customize precise properties, such as durability, hardness and flexibility, for each specific application including:

- Hard, highly durable coatings for wood parquet flooring
- Highly flexible and abrasion-resistant coatings for leather and textiles
- Weather-resistant, non-yellowing outdoor coatings for wood, metal and plastic surfaces
- Soft-feel coatings for plastics such as mobile phones and car dashboards
- Adhesives in footwear, wood products, furniture and automotive interiors

The low environmental impact of PUDs comes from their low VOC (volatile organic compound) content, since they are dispersed in water, rather than organic solvents. This means that PUD coating systems are more environmentally sound and increasingly attractive solutions, being both friendlier to the environment and to the people who use them.

Your complete polyurethane partner

As leading global suppliers of high-performance essentials and specialties, we offer you an extensive range of raw materials including polyols, isocyanate monomers, dispersing monomers, isocyanate cross-linkers and more – all dedicated to the formulation and differentiation of the full range of PUDs.

Polyurethanes is our largest product and development field and our dedicated polyurethane team supports you in developing and tailoring new polyurethane dispersion technology and applications.

Our wide range of products for polyurethane dispersions

Polyols

Capa® polycaprolactones – for PUD coatings with superior flexibility and high abrasion resistance

Oxymer® polycarbonate diols – for maximum UV and outdoor durability, chemical resistance and hydrolytic stability

Dispersing monomers

Bis-MPA (Dimethylolpropionic Acid) – anionic dispersing monomer of choice, key raw material for anionic PUDs

Ymer™ N120 – polymeric non-ionic dispersing monomer for non-ionic stabilization

Isocyanate monomers & cross-linkers

IPDI (Isophorone Diisocyanate) – key resin building block for exceptional weathering resistance, improved hardness and chemical resistance

HDI (Hexamethylene Diisocyanate) – for excellent flexibility, abrasion resistance and weathering resistance

Scuranate® TDI (Toluene Diisocyanate) – good balance of price and performance for adhesives and coating applications where yellowing is less of a concern

Easaqua™ – self-emulsifying isocyanate cross-linkers for waterborne polyurethane formulations

Polyalcohols

TMP, Neo & BEPD – fine-tuning polyalcohols for adjusting hardness, surface tension and branching

SUSTAINABLE DEVELOPMENT

Seeing the bigger picture & acting on it

We believe in improving everyday life – making it safer, more convenient, more fun, and more environmentally sound for millions of people all over the world. And we achieve this through innovative chemistry. It is how we provide you with solutions that maximize performance and minimize environmental impact all at once, enabling you to create greater value for your business, your customers, their customers, and all the way through to end users. Here are some of the things we are doing to ensure it:

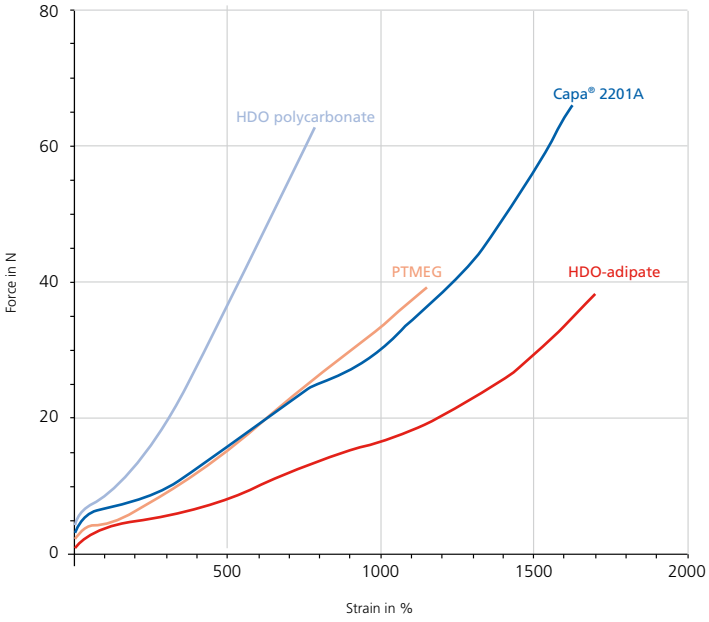
- Over 80% of our R&D work is focused on developing more efficient and environmentally sound products and processes, enabling cuts in environmental impact.
- We are in the process of systematically mapping the carbon footprints and lifecycle impact of our main products. We will provide complete carbon footprint information on about 15 by 2011, including TMP, Neo and selected isocyanates.
- We actively search for renewable alternatives to conventional raw materials and we focus on bringing the carbon footprint and lifecycle impact of the product to an absolute minimum.

Performance essentials & specialties

Capa® polycaprolactones – enable solvent-free PUDs, best flexibility & strength

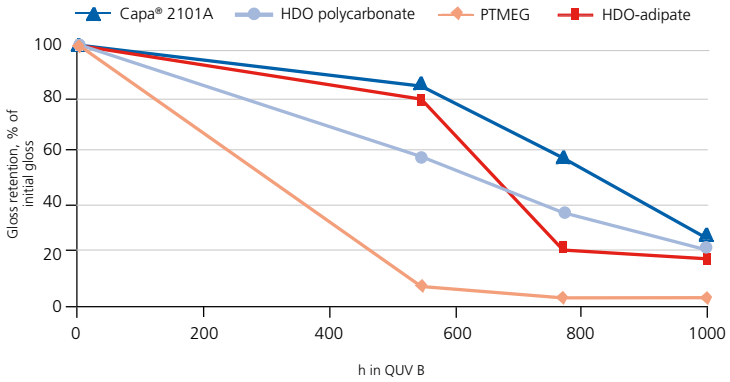
Capa® is our range of caprolactones, comprising monomer and polycaprolactones of varying molecular weight, functionality and initiating polyols. The unique chemical structure of Capa® polycaprolactones enables PUDs with very good hydrolytical stability and UV and outdoor durability, combined with excellent flexibility and abrasion and scratch resistance.

The unique ring-opening addition polymerization route used in the manufacture of polycaprolactones results in products with very low acid values and very narrow molecular weight distributions compared, for example, to adipate polyesters. The narrow molecular weight distribution enables products with very low viscosity, which is helpful in synthesizing PUDs with low or no solvent.



Graph showing flexibility/film stretch of various PUD coatings where Capa-based formulations show excellent balance between modulus and elongation

Accelerated weathering of PUDs
Cycle: succession of 4 hour periods of UV-B exposure at 60°C each followed by 4 hour periods of condensation at 40°C



Graph showing the gloss retention of various PUD coatings where Capa®-based formulation shows best performance

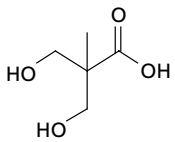
Dispersing moieties – key PUD raw materials

The hydrophilic dispersing monomer is one of the key raw materials for polyurethane dispersions, as it is essential for making the polyurethane resin waterborne. We offer dispersing monomers for both ionically and non-ionically stabilized PUDs.

Bis-MPA (Dimethylolpropionic Acid) – anionic monomer of choice

Bis-MPA, a key raw material for PUDs, is a crystalline solid with two primary hydroxyl groups and one tertiary carboxyl group. Bis-MPA is widely used in anionic PUDs, for example, in adhesives, industrial coatings, leather and textile finishes and typically makes up 2-3 wt% of a PUD-formulation.

Bis-MPA

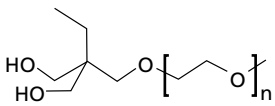


Ymer™ N120 – providing non-ionic stabilization

Ymer™ N120 is a ready-to-use polymeric non-ionic hydrophilic building block containing two primary hydroxyl groups and a long ethoxylated capped side chain. It can be built in along the polymer backbone to provide efficient non-ionic stabilization. Non-ionically stabilized dispersions display good shear and low temperature stability and excellent tolerance to electrolytes and low pH.

Ymer™ N120 may be combined with anionic stabilization, such as with Bis-MPA, in order to take full advantage of both technologies. This allows you to benefit from reduced amine content, insensitivity towards low pH and electrolytes and excellent low temperature stability all at once. By combining Bis-MPA and Ymer N120 is also possible to synthesize solvent-free PUDs thanks to the low viscosity of Ymer™ N120.

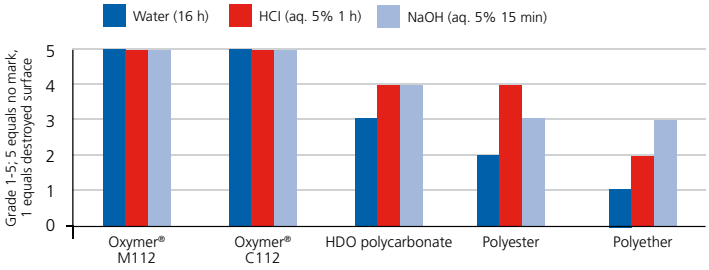
Ymer™ N120



Peak performance polyols

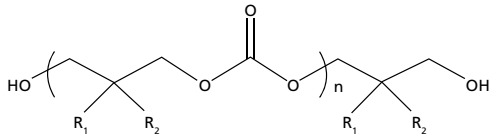
Oxymer® polycarbonate diols – durability & perfect finish for performance polyurethanes

Our unique new range of Oxymer® specialty polycarbonates are, unlike conventional aliphatic polycarbonates, based on substituted aliphatic diols. Oxymer® polycarbonates offer all the advantages of conventional polycarbonate diols, including superior hydrolytical stability and outdoor durability. Oxymer® polycarbonate diols offer the highest UV and chemical resistance, hydrolytic stability and outdoor durability combined with high hydrophobicity, low surface energy and excellent acid and alkali resistance.



Graph showing the level of damage to a coating after exposure to various liquids and where Oxymer® displays best performance

Oxymer®

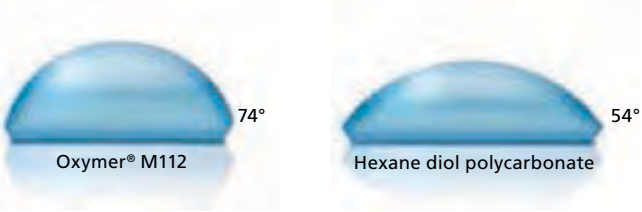


Oxymer® M grade

The Oxymer® M grade is a rigid, amorphous and highly hydrophobic polycarbonate diol with good wetting characteristics, suitable for low surface-energy coatings and substrates. With its high hydrophobicity, Oxymer® M grade also secures outstanding UV, water, acid and alkali resistance combined with excellent outdoor durability.

Thanks to the rigid carbonate-linkage and branched 1,3 diols, the Oxymer® M grade displays a relatively high glass transition temperature and high hardness compared to conventional polycarbonate diols. The Oxymer® M grade, a developmental product, is a non-crystalline aliphatic polycarbonate.

Contact angle of water droplets on PUD coatings based on Oxymer® M112 and hexane diol polycarbonate, with the Oxymer®-based coating displaying the highest hydrophobicity

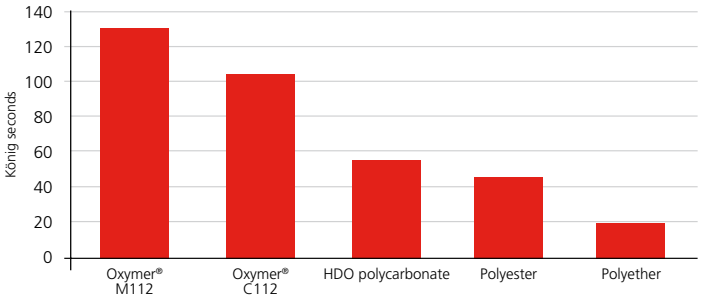


Oxymer® C grade

Our latest development, the experimental Oxymer® C grade, is an amorphous polycarbonate diol with a surface energy and hydrophobicity closer to that of conventional macrodiols. The Oxymer® C grade, displays the same advantages as the Oxymer® M grade but with improved abrasion resistance, flexibility and adhesive properties. The Oxymer® C grade is also a non-crystalline aliphatic polycarbonate.

Product	Appearance	OH-number mg KOH/g	Viscosity, Pas (°C)	Tg (°C)
Oxymer® M112	Viscous liquid	112	1.1 (75)	-23
Oxymer® C112	Viscous liquid	112	1.5 (75)	-33

Pendulum hardness of PUD coatings
Dry film thickness 30 µm ± 5 µm on glass

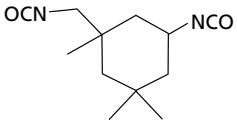


Fine-tuning with isocyanate monomers & polyalcohols

IPDI (Isophorone Diisocyanate) – the ideal monomer for PUDs

Thanks to the cycloaliphatic structure of IPDI and its good balance of reactivity between the two isocyanate groups, it is the ideal monomer for PUD synthesis and enables straightforward formulation and easy processing. The rigid cycloaliphatic structure improves chemical resistance, hardness,toughness and secures exceptional weathering in end products.

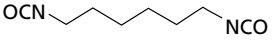
IPDI



HDI (Hexamethylene Diisocyanate) – significantly increased flexibility & exceptional durabilty

The linear aliphatic structure of hexamethylene diisocyanate significantly increases flexibility, improves abrasion and scratch resistance, and gives the exceptional weathering resistance that is often associated with aliphatic isocyanates. The flexibility and abrasion resistance that HDI enables makes it perfect for leather and textile applications.

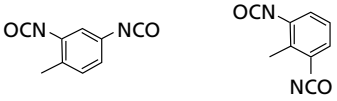
HDI



Scuranate® TDI – balanced price to performance ratio

Scuranate® TDI offers a balanced price to performance ratio for applications where performance is important but yellowing is less of a concern, for example, in primers, indoor coatings and adhesives.

Scuranate® 2,4 & 2,6 Toluene Diisocyanate



TMP, Neo & BEPD – fine-tuning hardness, surface tension & branching

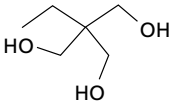
With the incorporation of Neo (Neopentyl Glycol) in the pre-polymer you increase the hardness of the PUD coating.

With the long aliphatic side chains of BEPD (Butyl Ethyl Propanediol) you lower the surface energy and increase the water resistance of the coating.

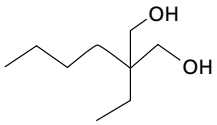
Finally, the incorporation of TMP (Trimethylolpropane) during the PUD synthesis achieves an increased and controlled degree of branching.

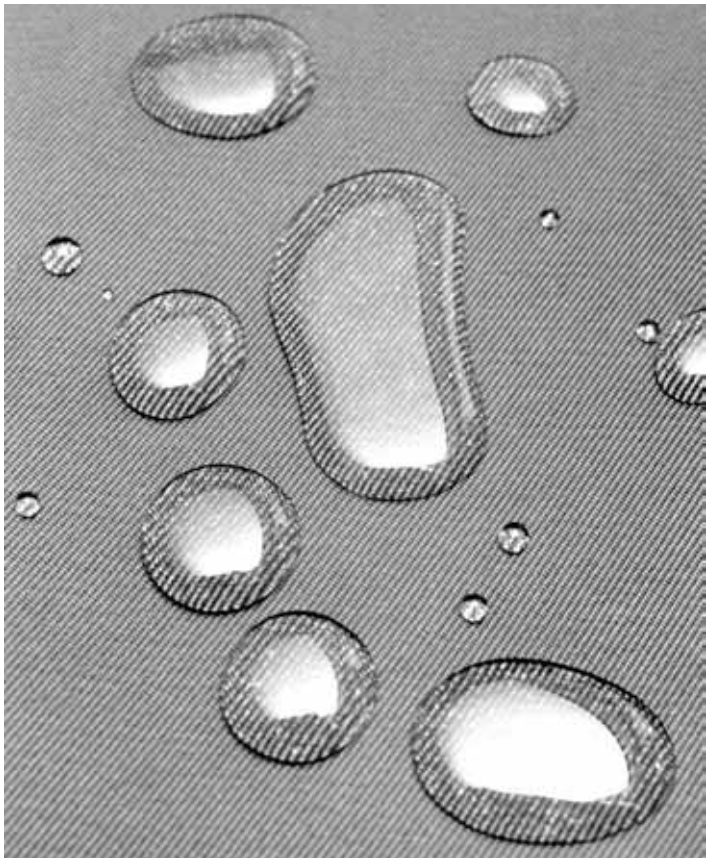
Neo

TMP



BEPD





Designed for low impact & efficiency

Easaqua™ – self-emulsifying cross-linkers for waterborne formulations

Our Easaqua™ product line is specifically designed for waterborne polyurethane formulators to tailor high performance 2K PUD coatings, and to meet the growing demand for easy-to-use and environmentally sound coating solutions. Our Easaqua™ range consists of hydrophilically modified polyisocyanates that self-emulsify in water. They work as cross-linkers in 2K formulations where they contribute to miscibility, fast drying, high gloss, low odor and low viscosity.

The main applications where our Easaqua™ range is ideal for waterborne polyurethane formulations are:

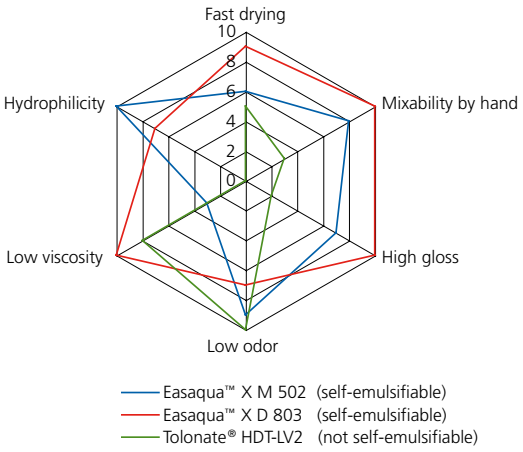
- Wood coatings for durable flooring and kitchen interiors
- Soft-feel coatings for plastics such as mobile phones and car dashboards
- Metal coatings for general industry
- Concrete coatings
- Automotive repair, transportation and agricultural equipment coatings

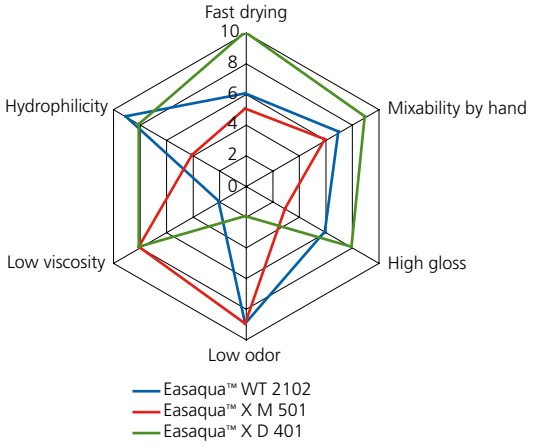
As formulation requirements have evolved, so has our line of Easaqua™ polyisocyanates. We now offer several new products for even easier mixing and faster drying.

Self-emulsifiable polyisocyanates:
- Easaqua™ WT 2102
- Easaqua™ X M 501
- Easaqua™ X M 502
- Easaqua™ X D 401
- Easaqua™ X D 803

Emulsion of blocked polyisocyanate:
- Easaqua™ WT 1000

Key properties





Product data summary

Polyols

	Appearance	Functional groups	Hydroxyl number, mg KOH/g	Molecular weight, g/mol	Viscosity, mPas (°C)	Polymer chemistry
Polycaprolactones*						
Capa® 2054	Liquid/paste	2 hydroxyl	204	550	60 (60)	Polyester
Capa® 2100	Wax	2 hydroxyl	112	1,000	150 (60)	Polyester
Capa® 2101A	Wax	2 hydroxyl	112	1,000	150 (60)	Polyester
Capa® 2200	Wax	2 hydroxyl	56	2,000	480 (60)	Polyester
Capa® 2201A	Wax	2 hydroxyl	56	2,000	390 (60)	Polyester
Capa® 2302A	Wax	2 hydroxyl	37	3,000	1,100 (60)	Polyester
Polycarbonate diols**						
Oxymer® M112	Viscous liquid	2 hydroxyl	112	1,000	1,100 (75)	Polycarbonate
Oxymer® C112	Viscous liquid	2 hydroxyl	112	1,000	1,500 (75)	Polycarbonate
Polyalcohols						
Neo (Neopentyl Glycol)	Flakes	2 hydroxyl	1,077	104.2	N/A	N/A
BEPD (Butyl Ethyl Propanediol)	Semi-crystalline	2 hydroxyl	695	161	N/A	N/A
TMP (Trimethylolpropane)	Flakes	3 hydroxyl	1,247	135.1	N/A	N/A

** For the complete range of Capa® polycaprolactones see the Capa® brochure*
*** Development and exprimental products*

Dispersing monomers

	Appearance	Functional groups	Hydroxyl number, mg KOH/g	Molecular weight, g/mol	Viscosity, mPas (°C)	Polymer chemistry
Bis-MPA	Crystals	2 hydroxyl, 1 carboxyl	835	134.4	N/A	N/A
Ymer™ N120	Waxy	2 hydroxyl	110	1,000	60 (50)	N/A

Isocyanate monomers

	Appearance	Isocyanate type	Color, APHA	Hydrolysable chlorine, ppm	Total chlorine, ppm
IPDI (Isophorone Diisocyanate)	Liquid	Cycloaliphatic	≤ 30	< 200	< 400
HDI (Hexamethylene Diisocyanate)	Liquid	Aliphatic	≤ 15	< 350	< 1,000
Scuranate® T80 (Toluene Diisocyanate, 80% 2,4 TDI)	Liquid	Aromatic	≤ 15	< 70	< 300
Scuranate® T65 (Toluene Diisocyanate, 68% 2,4 TDI)	Liquid	Aromatic	≤ 25	<100	< 300

Aliphatic polyisocyanates for waterborne PU formulations

	Viscosity, mPas (° C)	NCO, %	Solid content, %	APEO-free without nonyl phenol ethoxylate
For mono-component (1K) thermosetting formulation				
Easaqua™ WT 1000	3,200	9.4	63	
For two-component (2K) coating formulations				
Easaqua™ WT 2102	4,300	19.0	100	
Easaqua™ X M 501	1,100	21.6	100	•
Easaqua™ X M 502	3,600	18.3	100	•
Easaqua™ X D 401	1,050	15.8	85	•
Easaqua™ X D 803	200	12.2	69	•
For two-component (2K) adhesives, leather, textile & paper				
Easaqua™ WAT	4,000	19.0	100	
Easaqua™ WAT-1	1,400	21.7	100	
Easaqua™ WAT-3	1,150	21.5	100	•
Easaqua™ WAT-4	4,000	18.6	100	•



Your Winning Formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on over 125 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

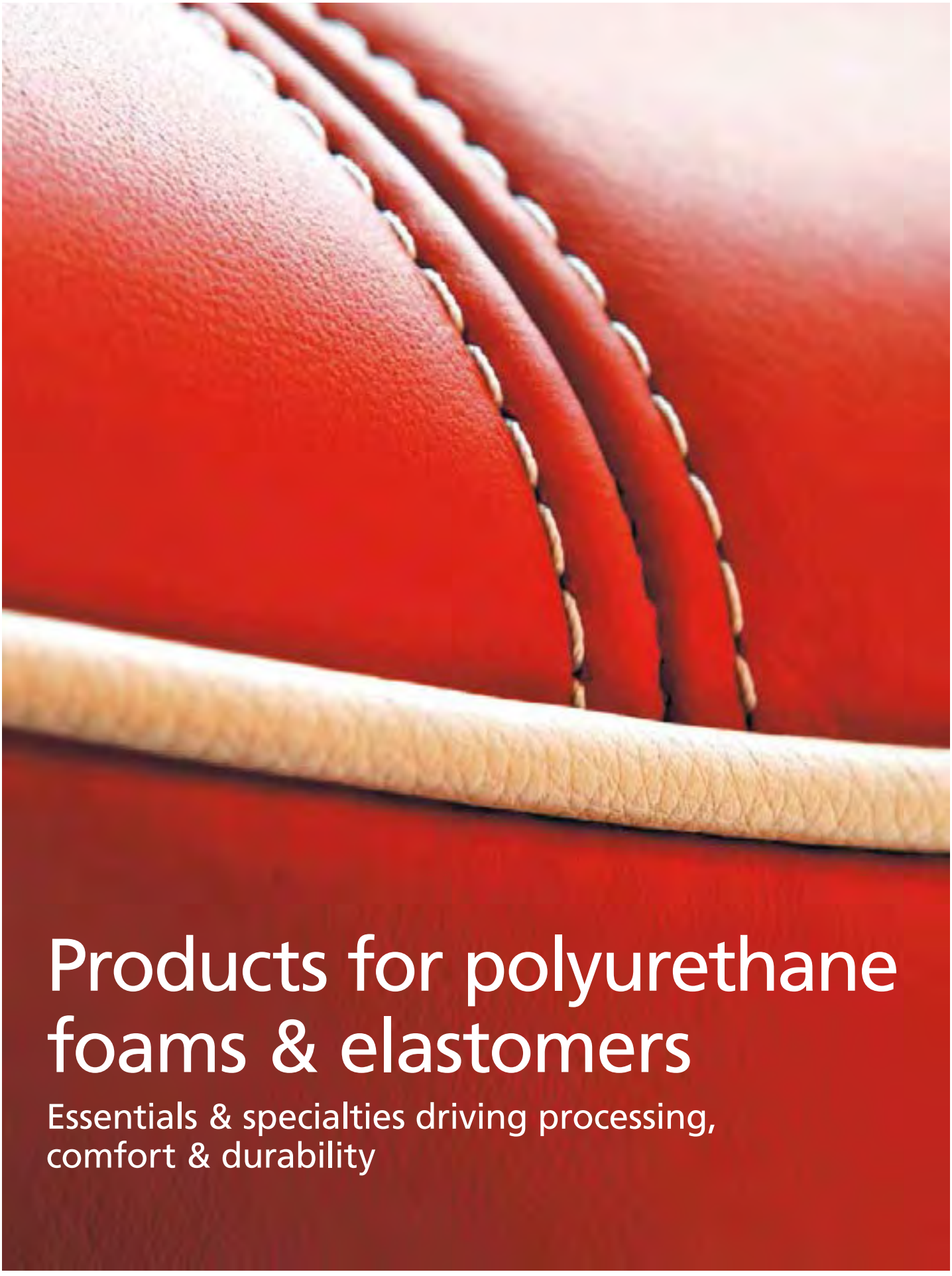
Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. Present in the aerospace, marine, coatings, chemicals, plastics, engineering and construction industries, they can also be found in automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Capacity and delivery security are ensured through strategic production plants in Asia, Europe and North America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of safer products and sustainable processes that reduce environmental impact. This principle of innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

Discover your winning formula at www.perstorp.com

Perstorp
WINNING FORMULAS



Products for polyurethane foams & elastomers

Essentials & specialties driving processing, comfort & durability

Perstorp

WINNING FORMULAS

The elements of success

You need a partner who can see the big picture when it comes to your products, your processes and your customers. Our experience and expertise in the special niches of organic chemistry, process technology and application development are at your service, providing you with a complete chain of solutions to enhance quality and profitability at every step.

Our versatile intermediates, an essential element of your winning formula, are specifically designed to add value and enhance end-product performance. Your solution to meeting the increasing demands for safer, lighter, more durable and environmentally friendly end-user products, begins here.

Innovation in everything we do

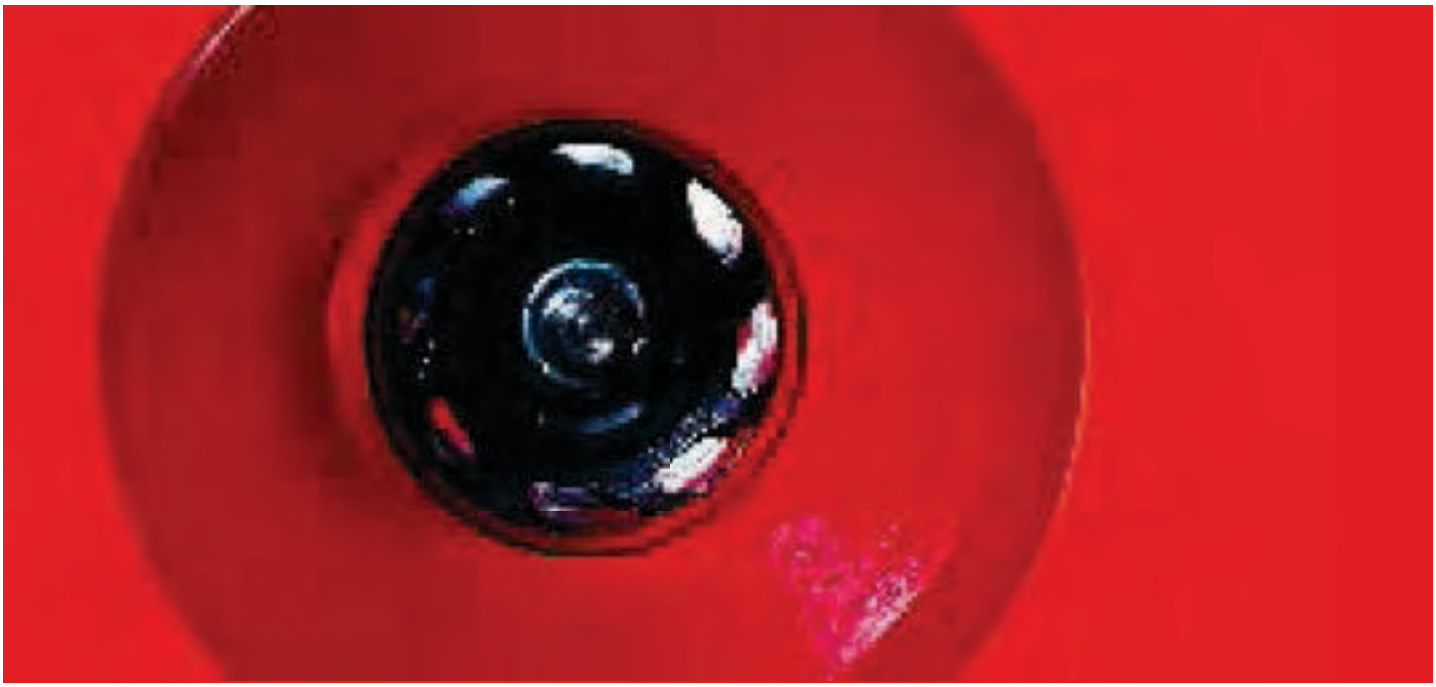
Innovation distinguishes every aspect of our business process. Developing smarter and safer solutions creates real value in new chemical applications. Focused innovation instills leadership and purpose in our business activities, improves internal processes and increases application and product competitiveness.

Delivering our promises globally

Our global presence provides you with reliable solutions and processes, consistent high quality, security of production and supply and delivery with precision. This commitment also means rapid response when product or application support is required and the very best in technical support.

Putting the care into chemicals

We take our responsibilities to heart and are committed to attentive, sustainable business practices. We minimize risks for our customers, our employees and the environment by working proactively to ensure safe products and processes.



Driving processing, comfort & durability

Your complete polyurethane partner

Our complete and continually expanding range of products for formulating high performance polyurethanes combines with our expertise in differentiating and tailoring them, to make polyurethanes our largest product and development field. Our dedicated polyurethane team supports you in developing and tailoring new polyurethane technology and applications.

Enhancing polyurethanes

The unique properties and virtually endless design possibilities of polyurethane foams and elastomers have ensured widespread use in many industrial and domestic applications. These include automotive seating, upholstery and bedding foam, high performance elastomers, various insulation material for buildings and refrigerated goods, packaging, electrical and electronic equipment, shoe soles in footwear, leisure and sports equipment and rollers in industrial and office equipment.

The main application areas where our products are ideal for polyurethane formulations and pre-polymers are:

- Foams – flexible to rigid foams and microcellular foams
- Elastomers – versatile cast elastomers, reaction injection molding and thermoplastic polyurethanes (TPU)

Polyurethanes are formed by the reaction of a polyol with a diisocyanate or polyisocyanate with suitable catalysts and additives, yielding products with a broad range of physical and chemical properties. They are among the most important classes of specialty polymers.

Our wide range of polyurethane essentials & specialties

Isocyanates:
Scuranate® TDI (Toluene Diisocyanate) – essential aromatic isocyanate monomers

Tolonate® – aliphatic isocyanates HDI and IPDI and polyisocyanate derivatives for light-stable end products

Polyols:
Capa® – high performance, low viscosity polyols

Oxymer® – our latest innovation, liquid polycarbonate diols for outstanding durability

Robrac® – affordable polyester polyols for rigid foam

Performance enhancers:
Boltorn® – high firmness, low compression set foam

Cross-linkers – TMP (Trimethylolpropane), Glycerine tech, trifunctional and tetrafunctional liquid polyethers and caprolactone polyols

Chain-extenders – specialty diols MPD (Methyl Propanediol), Neo (Neopentyl Glycol), BEPD (Butyl Ethyl Propanediol), Trimethylpentanediol, polyether and caprolactone liquid diols

We welcome your questions.
More detailed information and specifications of each product are available on **www.perstorp.com** or through your Perstorp sales representative.

The essential polyurethane foam components

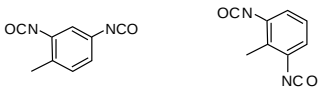
Scuranate® T80 & Scuranate® T65 – essential building blocks for flexible foam

TDI is an essential isocyanate used in the production of polyurethanes for flexible foam applications. TDI applications range from furniture, bedding and carpet underlay to transportation and packaging. We are a leading global supplier of TDI with responsible, reliable, innovative production at one of the safest TDI production units in the world, our Pont-de-Claix site in France. And we offer a complete range of TDI products for producing polyurethane foams.

Scuranate® T80 is a mixture of 80% 2,4-toluene diisocyanate and 20% 2,6-toluene diisocyanate and is the most reliable TDI grade.

Scuranate® T65 is a mixture of 2,4-toluene diisocyanate and 2,6-toluene diisocyanate isomer with high content of the 2,6-isomer. It is ideal for high load bearing and improved tear resistance, providing both improved sag factor and a latex feel.

Scuranate®, 2,4 and 2,6 toluene diisocyanate



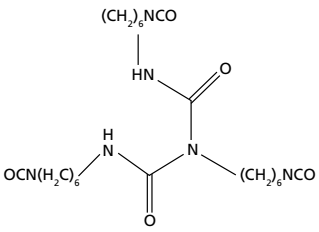
IPDI, HDI & Tolonate® alphatic polyisocyanates – for light-stable, non-yellowing foams

The aliphatic structure of IPDI, HDI and polyisocyanates is ideal for producing durable, non-yellowing foam that stands up to UV light exposure. This keeps outdoor and visible foam, looking and performing like new for longer. HDI provides good flexibility while IPDI provides improved hardness thanks to its alicyclic structure.

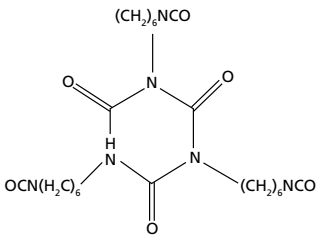
Solvent-free polyisocyanate biurets and trimers, with a higher safety profile than monomeric isocyanates, are also available. Tolonate® HDB LV offers a good compromise of viscosity, flexibility, and reactivity. And Tolonate® HDT gives higher rigidity thanks to its isocyanurate structure.

	General purpose	High load bearing & tear resistance	Light-stable foam
Scuranate® T80	•		
Scuranate® T65		•	
HDI, IPDI and Tolonate®			•

Tolonate® HDB



Tolonate® HDT



Comfort additives for foam

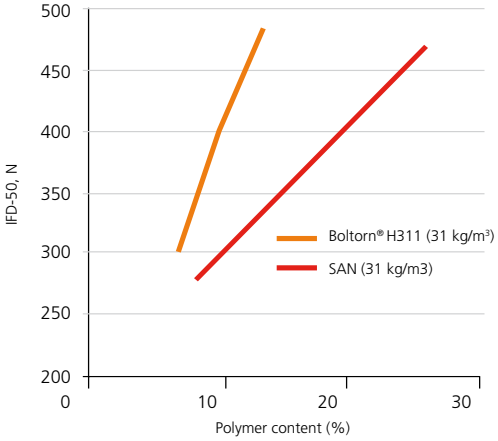
Achieve higher firmness and stability or lower compression set foam by replacing SAN-type co-polymer polyols with Boltorn® dendritic polymer polyols. And since Boltorn® is more efficient, a smaller amount is required to formulate the properties you demand, compared to SAN-type co-polymer polyols.

Boltorn® H311 – for exceptional firmness & stability

This liquid polymer polyol provides exceptional compressive load-building characteristics in flexible foam at very low addition levels. It is used as an additive, partially replacing conventional cross-linkers or graft co-polymer polyols of SAN-type.

Compared to conventional technology, Boltorn® H311 offers considerable benefits, including:

- More than twice the efficiency in providing compressive loads (CFD or IFD) at low addition level
- Exceptional firmness, extending beyond current state-of-the-art technology
- Improved foam stability



Compressive load as function of polymer content for Boltorn® H311 vs. co-polymer polyols

Boltorn® P500 – high firmness at low compression set

Our dendritic polymer polyol for foam is a liquid, water-free product that yields exceptionally low compression at high firmness when used with graft co-polymer polyols. The low compression set allows you to operate at reduced foam density and still meet the comfort specifications of end users.

Improved compression set at lower density with Boltorn® P500 when reducing density at IFD-25 ~380 N

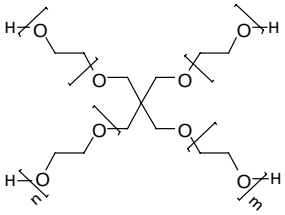
Formulation	Reference 40	Reference 35	Boltorn® P500
Density, kg/m³	40	35	35
SAN, %	35	35	29
Boltorn® P500, %	0	0	7.5
IFD-25%, N	388	372	363
IFD-65%, N	1,133	1,028	960
Compression set, %	14	28	12.2

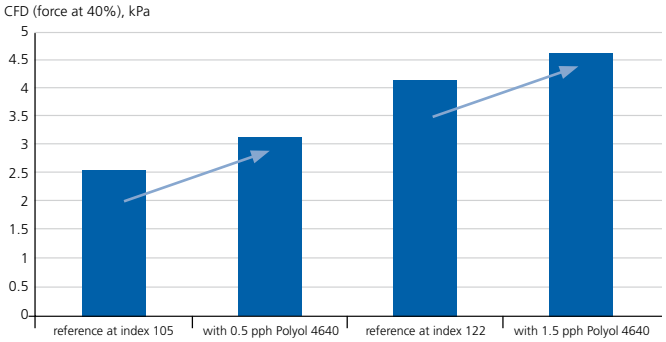
Specialty foam polyols

Polyol 3610 & Polyol 4640 – specialty cross-linkers for building hardness

We offer a range of alkoxylated polyols, including Polyol 3610 and Polyol 4640, which boost hardness while maintaining high resilience in flexible foams.

Tetrafunctional ethoxylated polyol





Hardness improvement in 20 kg/m³ density TDI flexible foam with addition of 0.5 to 1.5 parts of Polyol 4640

Robrac® – affordable polyester polyols

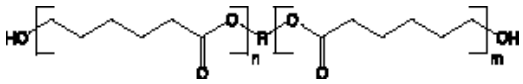
Competitively priced Robrac® polyester polyols meet market demand for lower cost while securing sufficient performance for rigid foam applications. Robrac® polyols replace conventional polyols in rigid foam applications and offer improved economy with maintained performance.

Capa® polyols – for microcellular & integral skin foams

Caprolactone-based rigid foams combine the toughness and excellent physical properties normally associated with polyesters, including a hydrolytic stability approaching that of polyethers.

In microcellular foam, Capa® polyols offer good resistance to heat build up and fatigue under dynamic loading, low-temperature flexibility and good wear resistance. This offers added comfort and durability in end-products such as shoe soles and suspension equipment. In integral skin products, Capa® polyols enable foams with durable skins for excellent resistance to weathering, solvents and chemicals, as well as a good combination of heat distortion temperatures and impact strength. The low-viscosity materials also achieve good flow characteristics and mold reproduction.

Polycaprolactone



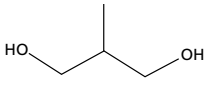
Products

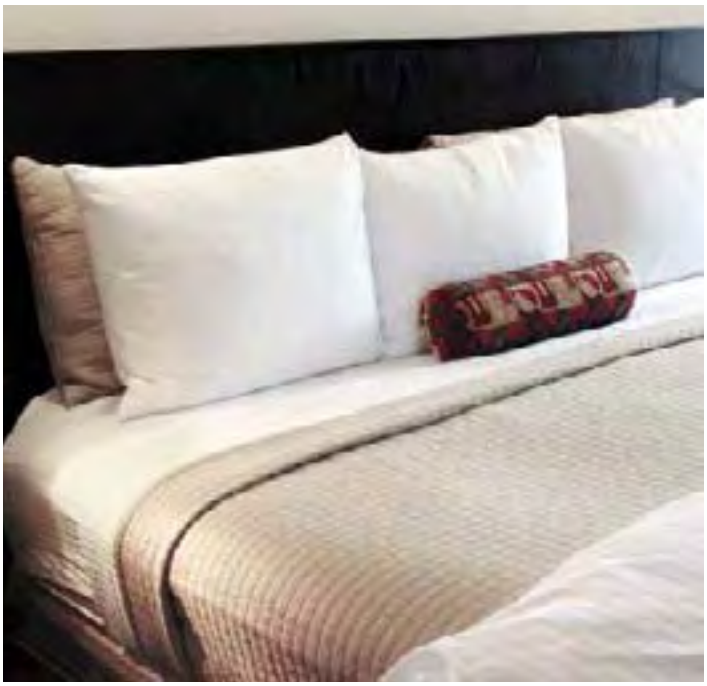
Application	Capa® 3022	Capa® 7201A	Capa® 4101
Rigid foam	•		•
Integral skin foam	•		
Microcellular foam		•	

MPD – for high comfort viscoelastic foam

Our MPD is ideal in the production of high comfort viscoelastic foam such as the foam used in exclusive high-density foam mattresses.

MPD





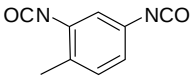
Elastomer essentials

Scuranate® T80 & Scuranate® T100 – essential elastomer building blocks

TDI is an essential isocyanate used in the production of pre-polymer for cast elastomers.

Scuranate® T100 contains more than 99% of 2,4-toluene diisocyanate, making it a pure 2,4 isomer with dual reactivity of the isocyanates groups. This allows the preparation of low free TDI monomer and well-controlled quality pre-polymers for cast elastomers for more reliable end-product consistency and quality.

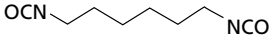
Scuranate® T100



IPDI & HDI – for light-stable, non-yellowing elastomers

Thanks to the stable aliphatic structure of IPDI and HDI, they are ideally suited for producing durable, non-yellowing polyurethane elastomers that stand up to UV light exposure. This keeps end products such as elastomers in the automotive segment, standing up to the elements, so they stay durable and last longer. Choose HDI for greater flexibility, or IPDI for a pre-polymer for higher rigidity in end-products. HDI is also suitable for thermoplastic elastomers.

HDI



Scuranate® T65 – for improved tear resistance

Our Scuranate® T65 provides elastomers with specific improved end-product properties, in particular, increased tear resistance.

Aliphatic polyisocyanates

Our range of solvent-free aliphatic polyisocyanate biurets and trimers are ideal for producing light-stable polyurethane casting systems. These are suitable alternatives to polymeric MDI or monomeric TDI wherever safety and handling is a prime concern.

Our offer for thermoplastic polyurethane elastomers

Capa® polyols – easy processing & high performance

We supply a wide range of premium and standard grade linear polycaprolactone diols with consistent and tightly controlled molecular weight, narrow molecular weight distribution, consistent reactivity and low viscosity to meet the demands of thermoplastic polyurethane producers.

Our Capa® polyols have a wide working temperature range and their low viscosity enables easy processing. They also improve the performance of thermoplastic polyurethane elastomer end-products such as gaskets, o-rings and seals, with excellent low-temperature flex fatigue, good hydrolysis and chemical resistance, excellent oil and solvent resistance, low compression set, low odor and good paintability.

The premium grades of Capa® go even further, with even lower viscosity, faster crystallization rate and narrow polydispersity as well as the performance benefits of increased hydrolytic stability, improved low-temperature flexibility and low fogging.

	Capa®	Polyether	Polyester adipate
Easy processing	•		
Hydrolytic stability	•	•	
Low and high temperature range	•		
UV resistance	•		•
Abrasion resistance	•		•
Resilience	•	•	
Compression set	•		•

% Resilience measured by lupke pendulum

Temp. °C	Capa® 2200/BD/MDI	Adipate/ BD/MDI	Adiprene L100
20	62.5	57.5	48
40	67.5	63	58.5
60	70	66	64.5
80	71	67	65
100	70	66	60.5
120	66.5	63	

Comparative resilience of 90 shore A polyurethane systems

Our offer for polyurethane cast elastomers

Capa® polyols – low density & high durability

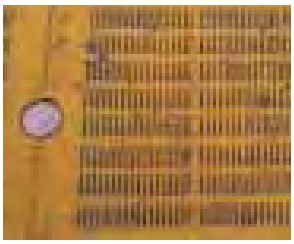
The low polyol viscosity of our Capa® polyols enable easy processing and since they posses all primary hydroxyl groups, they also ensure consistent and fast reactions. Polyurethane cast elastomers based on our Capa® polyols have lower density than those derived from polyadipates and outstanding resilience results in elastomers with low hysteresis properties.

In addition, Capa® polyols achieve very good low-temperature flex fatigue performance, excellent cut and tear properties, good hydrolysis resistance and high abrasion resistance in end products. We offer a complete range of premium and standard grade diols and triols that can be used with both aliphatic and aromatic isocyanates as main polyols or cross-linkers.

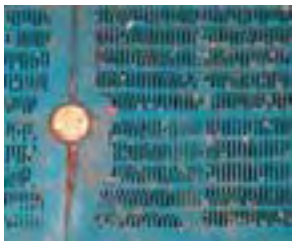
Comparative hydrolysis resistance at 100°C

Polyurethane system	Time required to halve tensile strength	Time required to reduce tensile strength to 100 Kg/cm²
Capa® 2200/BD/MDI	4.5 days	7 days
Capa® 2200A/BD/MDI	6.5 days	11 days
Polytetrahydrofuran (MW 2000)/BD/MDI	2 days	9.5 days
Polyethylene butylene adipate (MW 2000)/BD/MDI	3 days	5 days
Polyethylene adipate (MW 2000)/BD/MDI	2.7 days	4 days

Enhancing durability with Capa®



Evidence of improved durability thanks to our Capa® polyols, in applications such as mining screens, shown above, where water resistance and abrasion resistance are required



Polyester adipate-based end products show less durability in withstanding a harsh environment and, as seen above, this can lead to rapid deformation

Specialty elastomer cross-linkers

TMP – versatile elastomer cross-linker

Our superior supply capacity makes us the global leader in manufacturing TMP. This highly versatile product is used as a cross-linker for cast elastomers in some applications, where it partially replaces 1,4-butanediol to improve the hardness to compression set ratio.

Alkoxylated polyols – liquid cross-linkers for ease of handling

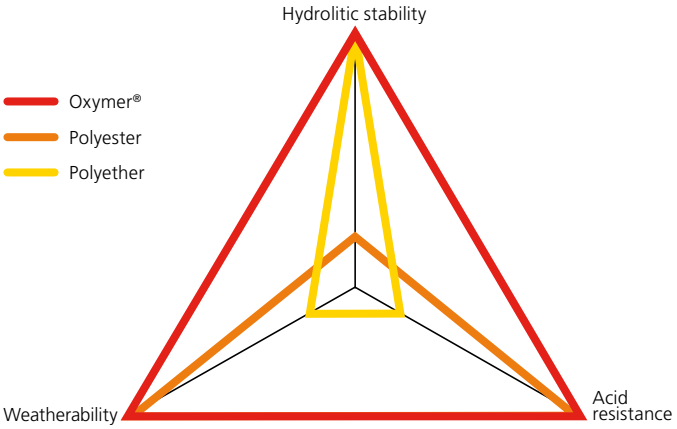
To facilitate the handling of TMP for our customers and improve the hardness to flexibility ratio of elastomers, we have developed a range of alkoxylated polyols with a low degree of alkoxylation. Polyol 3990, also called liquid TMP, has primary alcohol groups that need no heating, simplifying handling immensely. Polyol 3611 is a primary alcohol cross-linker facilitating good Shore A and resilience in elastomers. Polyol 3611 has lower water content and lower viscosity than Polyol 3990 and it is ideal for producing cast elastomers for roller applications. We offer a number of alternative alkoxylated polyalcohols of various functionalities (two to six) and reactivities to meet your requirements.

Formulation	Shore A	Ball rebound, %
BDO/TMP 4/0.3	50	50
Polyol 3990	58	45
Polyol 3610	56	49
Polyol 3165	53	61
Polyol 4800	60	45

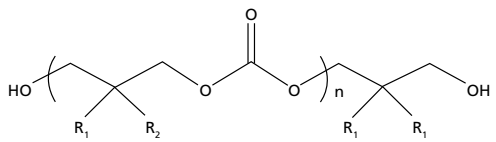
Specialties for ultimate performance

Oxymer® – the premium choice for outstanding durability

One of the most recent developments in our complete range for polyurethanes, are our Oxymer® polycarbonate liquid diols. They offer outstanding UV resistance in elastomers, in combination with both water repellency and acid resistance. Oxymer® is the premium macrodiol choice for top of the line durability and performance combining the hydrolytic resistance of polyethers with the acid resistance and UV resistance of polyesters.



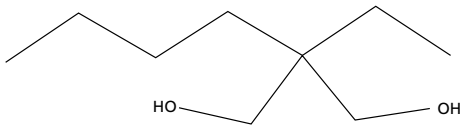
Oxymer®

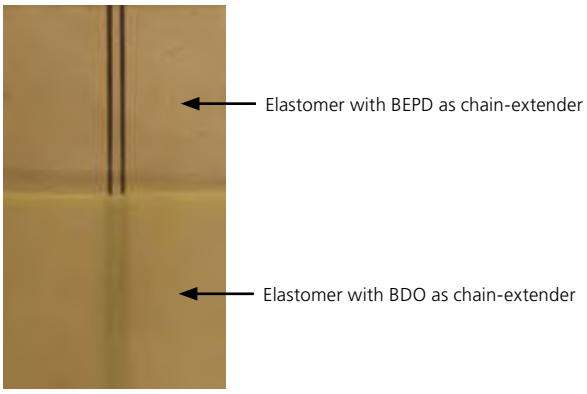


BEPD – chain-extender for increased clarity

BEPD is a hydrophobic and asymmetric glycol diol. As a chain-extender, it helps formulators increase the transparency of cast and thermoplastic elastomer parts and achieves outstanding hydrolytic resistance.

BEPD






POWER TRANSFER 3.0

Product data summary

Isocyanate monomers

	Isocyanate type	Hydrolysable chlorine (ppm)	Total chlorine (ppm)	Assay (%)	NCO content (%, approx.)
Scuranate® T80 (Toluene diisocyanate, 80% 2,4 TDI)	Aromatic	< 70	< 300	> 99.5	48.1
Scuranate® T65 (Toluene diisocyanate, 68% 2,4 TDI)	Aromatic	< 100	< 300	> 99.5	48.1
Scuranate® T100 (Toluene diisocyanate, > 99% 2,4 TDI)	Aromatic	< 150	< 700	> 99.5	48.1
Scuranate® TX (Toluene diisocyanate, > 95% 2,4TDI)		< 100	< 1,000	> 99.5	48.1
HDI (Hexamethylene diisocyanate)	Aliphatic	< 350	< 1,000	> 99.5	50.0
IPDI (Isophorone diisocyanate)	Cycloaliphatic	< 200	< 400	> 99.5	37.6

Solvent-free aliphatic polyisocyanates

	Viscosity (mPas, 25°C)	NCO (%)	Free monomer (%)	Flash point (°C)	Equivalent weight (g)
Tolonate® HDB-LV	2,000 ± 500	23.5 ± 1.0	< 0.3	> 120	179
Tolonate® HDT	2,400 ± 400	22.0 ± 0.5	< 0.2	> 120	191
Tolonate® HDT-LV	1,200 ± 300	23.0 ± 1.0	< 0.2	> 120	183
Tolonate® HDT-LV2	600 ± 150	23.0 ± 1.0	< 0.5	> 120	183

Caprolactone polyols

	Appearance	Reactive group	Molecular weight (g/mol)	Polymer chemistry	Hydroxyl number (mg KOH/g)
Capa® 2043	Liquid	2 hydroxyl	400	Polyester	280
Capa® 2100	Paste/wax	2 hydroxyl	1,000	Polyester	112
Capa® 2101A	Paste/wax	2 hydroxyl	1,000	Polyester	112
Capa® 2161A	Wax	2 hydroxyl	1,600	Polyester	70
Capa® 2205	Wax	2 hydroxyl	2,000	Polyester	56
Capa® 2201A	Wax	2 hydroxyl	2,000	Polyester	56
Capa® 2302	Wax	2 hydroxyl	3,000	Polyester	37
Capa® 2302A	Wax	2 hydroxyl	3,000	Polyester	37
Capa® 2402	Wax	2 hydroxyl	4,000	Polyester	28
Capa® 2403D	Wax	2 hydroxyl	4,000	Polyester	28
Capa® 2803	Wax	2 hydroxyl	8,000	Polyester	14
Capa® 3022	Liquid	3 hydroxyl	240	polyester	540
Capa® 3031	Liquid	3 hydroxyl	300	Polyester	560
Capa® 3031A	Liquid	3 hydroxyl	300	Polyester	560
Capa® 3050	Liquid	3 hydroxyl	540	Polyester	310
Capa® 3201	Wax	3 hydroxyl	2,000	Polyester	84
Capa® 4101	Liquid	4 hydroxyl	1,000	Polyester	218
Capa® 7201A	Paste/wax	2 hydroxyl	2,000	Polyester: Polyether	56
Capa® 7203	Paste/wax	2 hydroxyl	2,000	Polyester: Polycarbonate	56

Polycarbonate diols

	Appearance	Reactive group	Molecular weight (g/mol)	Hydroxyl number (mg KOH/g)	Viscosity Pas (°C)
Oxymer® M112	Viscous liquid	2 hydroxyl	1,000	112	20 (40)
Oxymer® M56	Viscous liquid	2 hydroxyl	2,000	56	65 (40)
Oxymer® C112	Viscous liquid	2 hydroxyl	1,000	112	30 (40)

Product data summary

Polyester polyols

	Appearance	Reactive group	Molecular weight (g/mol)	Hydroxyl number (mg KOH/g)	Viscosity Pas (°C)
Robrac® 650	Semi-solid	5 hydroxyl	480	700	35 (50)
Robrac® 1200	Liquid	4 hydroxyl	Blend	1,150	18 (23)

Dendritic polymer polyols for foam

	Appearance	Molecular weight (g/mol)	Hydroxyl number (mg KOH/g)	Viscosity Pas (°C)
Boltorn® H311	Viscous liquid	5,700	245	40 (23)
Boltorn® P500	Viscous liquid	1,800	600	12 (23)

Trifunctional polyether cross-linkers

	Appearance	Molecular weight (g/mol)	Hydroxyl number (mg KOH/g)	Viscosity (mPas, 23 °C)
TMP	Flakes	135.1	1,247	59
Glycerine tech	Liquid	92.1	1,800	Liquid
Polyol 3990	Liquid	170	990	4,500
Polyol 3610	Liquid	275	610	700
Polyol 3165	Liquid	1,014	165	350

Polyether cross-linkers

	Appearance	Molecular weight (g/mol)	Hydroxyl number (mg KOH/g)	Viscosity (mPas, 23 °C)
Polyol 4800	Liquid	282	800	2,200
Polyol 4640	Liquid	355	640	1,100
Polyol 4525	Liquid	426	525	2,600
Polyol 4360	Liquid	629	360	1,300

Chain-extenders

	Appearance	Molecular weight (g/mol)	Hydroxyl number (mg KOH/g)	Melting point (°C)
Neo	Flakes	104.2	1,077	129
BEPD	Semi-crystalline	161.0	695	44
Trimethylpentanediol	Semi-crystalline	146.2	765	50
Polyol R2490	Liquid	220	490	Liquid
MPD	Liquid	90.8	1,230	Liquid

Focused innovation for polyurethanes

Your Winning Formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on over 125 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. Present in the aerospace, marine, coatings, chemicals, plastics, engineering and construction industries, they can also be found in automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Capacity and delivery security are ensured through strategic production plants in Asia, Europe and North America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of safer products and sustainable processes that reduce environmental impact. This principle of innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

Discover your winning formula at www.perstorp.com

Perstorp
WINNING FORMULAS

Products for powder coatings

Long-lasting environmentally friendly esthetics

Long-lasting environmentally friendly esthetics

Sustainable solutions for quality & cost-effectiveness

Is it possible to achieve the best quality and most durable, esthetic finish in a coating with a cost-effective and environmentally friendly solution?

Powder coating is one of the most economical coating solutions and is also one of the most environmentally friendly. We offer the powder coatings industry raw materials for the production of resins. We also offer specialty resins and additives for coating formulators. Our products have a range of quality enhancing properties that help you create coatings with a uniform, durable and attractive finish.

The growth of the powder coatings industry during the last twenty years has been dramatic, with new applications continually being developed to ensure ever expanding market penetration in a wide range of industries.

The powder used for the process is a mixture of finely ground particles of pigment and resin, which is sprayed onto the surface to be coated. The charged powder particles adhere to the electrically grounded surfaces until heated and fused into a smooth coating in a curing oven or under infrared radiation.

Powder coatings are increasingly used in:

- architectural applications
- domestic appliances
- transportation/automotive applications
- general industrial applications

Our products for powder coatings:

Polyols for resins

Neopentyl Glycol (Neo)
An essential glycol for durable and high quality powder polyesters

Butyl Ethyl Propanediol (BEPD)
A unique glycol for enhancing outdoor durability of polyesters

Trimethylolpropane (TMP)
Branching monomer for powder polyesters

Polyester for coatings

Curalite® 2300
A specialty carboxyl functional polyester for low temperature curing and as matting agent

We welcome your questions. More detailed information and specifications of each product are available on www.perstorp.com or through your Perstorp sales representative.

Perstorp
WINNING FORMULAS

Expanding choice

The building blocks of quality

Neo – essential for quality & durability

Neo is the glycol of choice for most polyesters, imparting improved hydrolytic stability and superior weathering and chemical and water resistance. Its symmetric structure is the most adequate for achieving the required glass transition temperature (Tg) of powder polyesters.

Neo can be delivered globally, in solid form as flakes at ambient temperature, in molten form at elevated temperatures or as Neo 90, a 90% solution in water.

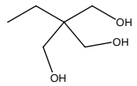
Neopentyl Glycol (Neo)

TMP – the safe branching monomer

TMP is an important raw material for high-quality industrial resins, typically used in concentrations of between 1% and 5% in order to branch the polyester to increase functionality. It has a low melting point and is available in flaked form or as hot liquid. TMP is a non hazardous chemical and easy to handle and easy to process.

Our superior supply capacity makes us the global leader in manufacturing TMP.

Trimethylolpropane (TMP)

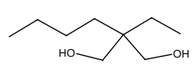


BEPD – outstanding outdoor performance

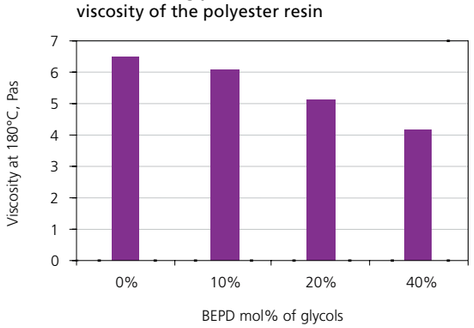
Butyl Ethyl Propanediol (BEPD) is a branched hydrophobic glycol that imparts outstanding durability to powder polyester resins used in outdoor conditions.

Using BEPD as a co-glycol with Neo lowers the viscosity of polyesters while retaining suitable Tg, which allows better leveling and a wider processing window. It also enhances the outdoor durability of polyester based powder coatings. The product is available as solid or molten BEPD or as BEPD70L, which is more adequate for bulk delivery. BEPD70L is a blend of 70% BEPD, 25% Neo and 5% water.

Butyl Ethyl Propanediol (BEPD)



BEPD as a co-glycol decreases the viscosity of the polyester resin



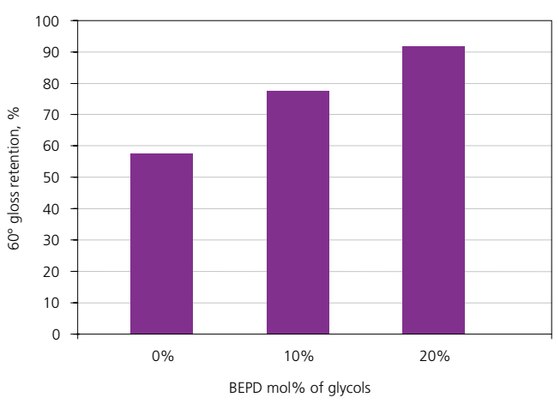
Sharing ideas

How can you develop new environmentally friendly resins?

You will find us a unique partner for exchanging ideas to develop new resins that are kind to the environment. We have extensive know-how in resin technologies such as polyester, urethane or epoxy used in radiation curing, waterborne coatings and powder resins. Our range of allyl ethers, oxetane, dihydroxy acids and other specialties can give you new opportunities in your development of innovative powder resins to respond to market demands.

BEPD improves the weatherability of Primid powder coatings

1 year Florida exposure, gloss 60° retention



Specialty resin with enhance performance

Curalite® 2300 – low temperature curable matte powder polyester

Curalite® 2300 is a specialty linear polyester with an exceptional acid number and functionality. It has been specially developed to provide low gloss hybrid powder coatings that can be cured at a temperature as low as 140°C.

	Acic number (mg KOH/g)	Tg (°C)	Viscosity range 150°C (Pas)	Particle size (mm)
Curalite® 2300	213-246	45	15-28	<3

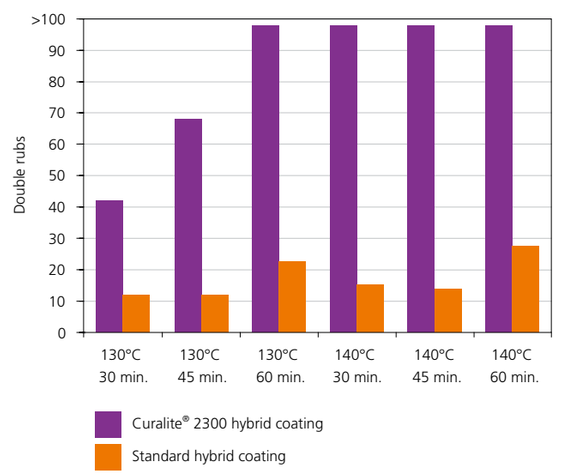
Material, parts by weight	Formulation
Curalite® 2300	28
Epikote 1002	72
Catalyst (MIA5)	1.5
Irganox 1010	0.1
Kronos 2310	30
Modaflow Powder III	1.5
Benzoin	0.8

Coating properties, cured 25 min. at 140°C	
60° gloss after storage of the powder coating	
Initial	2.5
3 months, climate room	3.6
6 months, climate room	5.5
Erichsen flexibility (mm)	8
Buchholz hardness, DIN 53 153	118
Cross-cut, 0 – 5, 0 best	0
Surface resistance to cold liquids (EN 12720), where 5 is best	
Distilled water, 24 hrs	5
Ethanol 48 w%, 16 hrs	5
Acetone, 2 min.	4

Curalite® 2300 increases the reactivity of the formulation and thereby allows lower temperature curing within an acceptable processing time. The choice of catalyst in the powder formulation is very important in order to achieve storage stability.

Reactivity comparison Curalite® 2300 – standard hybrid coating, identical additives & catalyst package

MEK resistance



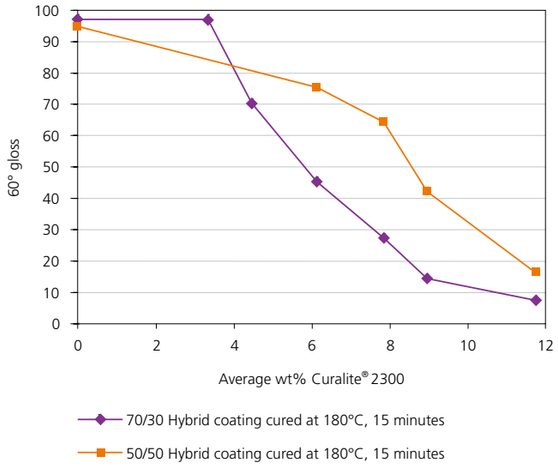
Curalite® 2300 – a versatile matting additive

How matte or glossy do you prefer your finish to be? You have the choice to decide.

Reaching a desired gloss may be difficult to obtain if you are dependent on a matting agent that requires very narrow processing conditions. Curalite® 2300 features an almost linear 'gloss to additive level' relation, which allows you to easily achieve the level of gloss you desire.

Full gloss control with addition level of Curalite® 2300

Curalite® 2300 as matting agent for conventional hybrid systems



Full gloss control over wide curing conditions

Curing conditions	Thickness (µm)	Gloss, 60°
140°C, 30 min.	55±5	18
180°C, 20 min.	70±5	17
200°C, 6 min.	75±5	17

7 wt% Curalite® 2300 in a conventional hybrid system

Curalite® 2300 frees you from over-dependence on processing conditions to reach your desired gloss level. The gloss is consistent with concentration on a large processing window (from 140°C to 200°C).

Further opportunities

Can we help you open up new markets?

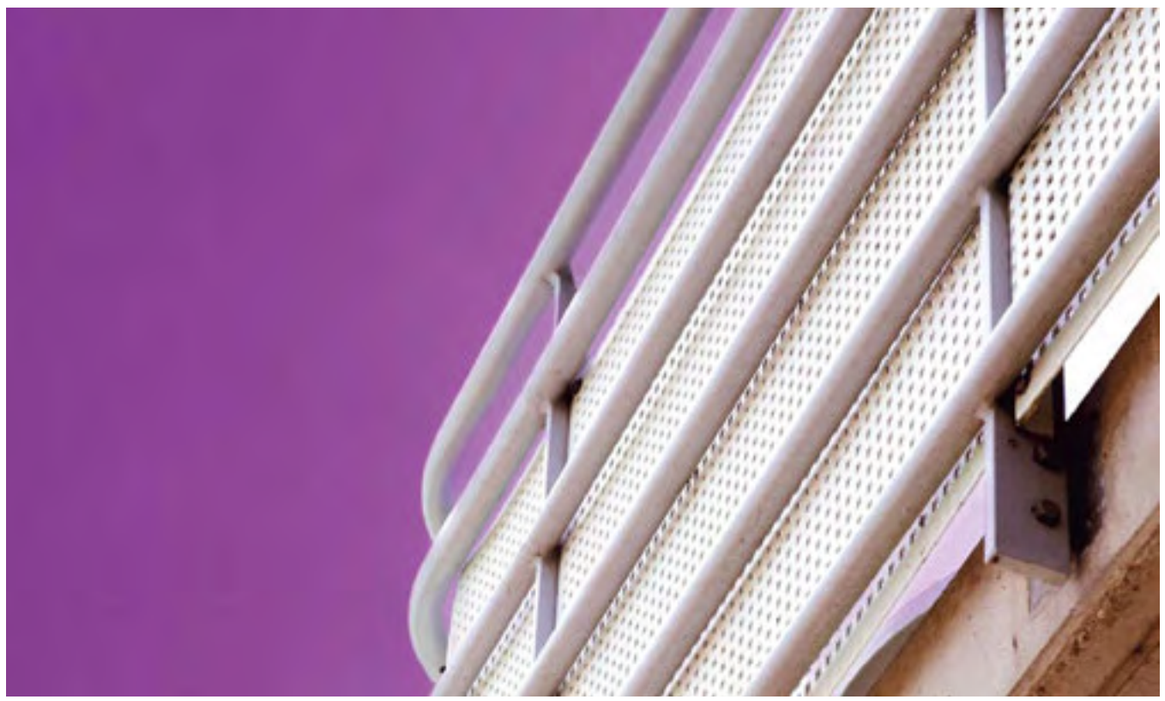
We have a range of products and know-how to help you develop powder coatings to meet new demands. For example, our specialty polymers such as Boltorn® dendritic polymers feature unique high functionality and low viscosity. The Charmor® range of micronized polyols is used for intumescent coatings. These are just some of the solutions we offer for developing new powder coatings in order to respond to new market potential.

Product data summary

Polyols for resins				
Glycols				
Products	**Appearance**	**OH-value (mg KOH/g)**	**Molecular weight (g/mol)**	**Melting point (°C)**
Neopentyl Glycol (Neo)	Flakes	1,075	104.2	129
Neo 90	Liquid (90% in water)	1,075*	104.2	35
Butyl Ethyl Propanediol (BEPD)	Semi-crystalline	695	161.0	44
BEPD70L	Liquid		146.1	<21
Branching monomer				
Trimethylolpropane (TMP)	Flakes	1,247	135.1	59

* Water free

Polyester for coatings				
Specialty carboxyl functional polyester				
Product	**Acid number (mg KOH/g)**	**Tg (°C)**	**Viscosity range 150°C (Pas)**	**Particle size (mm)**
Curalite® 2300	213-246	45	15-28	<3



Products for waterborne coatings

Making first impressions last

Perstorp
WINNING FORMULAS

Making first impressions last

Enhancing waterborne coatings

The environmentally friendly profile and broad spectrum of technologies available have helped waterborne coatings make large inroads into applications such as architectural paints, industrial wood coatings and metal coatings for OEM applications. We have developed intermediates for use in waterborne coatings, including raw materials for producers of waterborne polyesters and polyurethane dispersions, as well as niche resins and additives for coating formulators.

Our products for waterborne coatings:

Bis-MPA & DMBA
dispersing monomers for polyurethane dispersions and waterborne polyesters

Oxymer® range
polycarbonate diols for PUD

BEPD & Neo
glycols for waterborne polyesters

Boltorn® W3000
emulsifying resin for making waterborne alkyd paints

NX 795 & NX 800
coalescing agents for aqueous latex dispersions

TMP & Penta
branching monomers with excellent hydrolytic resistance for waterborne polyesters and alkyds

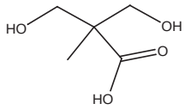
We welcome your questions. More detailed information and specifications of each product are available on www.perstorp.com or through your Perstorp sales representative.

Designed to enhance

Bis-MPA & DMBA – anionic monomers of choice

We are the leading supplier of Bis-MPA (2,2-dimethylol-propionic acid), the anionic monomer of choice when preparing polyurethane dispersions for wood, industrial coatings, leather and textile surface finishes. Bis-MPA is a critical raw material in this application area as it enables polyurethane oligomers to disperse in water. It is a crystalline, high melting point solid containing two primary hydroxyl groups and one tertiary carboxyl group.

The tertiary carboxylic acid group of Bis-MPA is also useful for preparing waterborne polyesters. Linear or branched polyesters can easily be prepared by direct esterification, where Bis-MPA is incorporated as a diol with pendant carboxy groups into the polyester backbone.

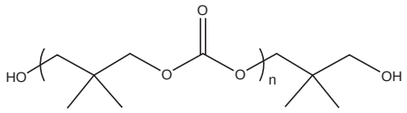


Chemical structure of Bis-MPA

We also offer DMBA (2,2-dimethylolbutanoic acid), a low melting point alternative to Bis-MPA with good solubillity. It is an ideal complement to Bis-MPA for selected PUD-applications, where improved solubility is important.

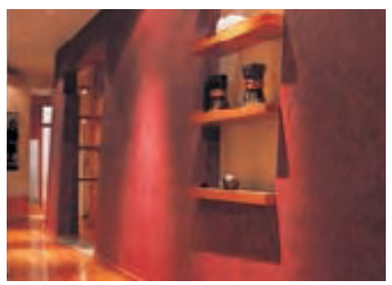
Oxymer® – new polycarbonate diols

Our recently launched Oxymer® range of OH-functional macrodiols for waterborne coatings applications consists of polycarbonate diols based on captive glycol technology. These macrodiols are offered with different molecular weights and compositions to ensure that your unique requirements for adhesion, water and weathering resistance and general mechanical performance are met.



Chemical structure of a polycarbonate diol

A winning formula for coating performance



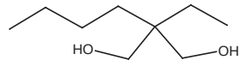
BEPD & Neo – outstanding glycols

Achieve outstanding hydrolytic resistance in polyester resins and coatings with BEPD (2-butyl, 2-ethyl propanediol), an asymmetric, hydrophobic glycol. It is a solid amorphous (semi-crystalline) diol with a low melting point. The pendant hydrophobic groups and the glycol structure further achieve a unique balance between flexibility, film hardness and low viscosity of the polyester resin. This polyalcohol is FDA-approved as a diol for waterborne polyesters used in internal can-coating applications, see table.

Neo (Neopentyl glycol) is the glycol of choice for most polyesters, both waterborne and solvent borne, as it provides good hydrolytic resistance in combination with good overall film properties. Neo is also used in liquid saturated polyesters for coatings and polyurethanes. In unsaturated polyesters, mainly gel coats, Neo improves water and chemical resistance. The product is a white crystalline polyhydric alcohol containing two primary hydroxyl groups.

Sample ID	C3	Ref 1
Binder system	WB polyester for can	Epoxy/Phenolic
Polyols used	BEPD/TMP	-
Pencil hardness	HB	HB
Clemen scratch (g)	700	900
IWB* (crack length mm)	15	32
T-bend	0-1T	2T
MEK double rubs	>100	>100
Boiling water test (blush) 60 minutes		
Appearance	No blush	No blush
IWB* (crack length mm)	10	26
Clemen scratch (g)	400	700

* Impact Wedge Bend

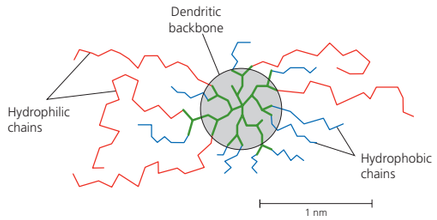


Chemical structure of BEPD

Chemical structure of Neo

TMP & Penta – branching monomers for Mw-control & water resistance

These key branching monomers are widely used for production of waterborne polyesters and alkyd emulsions. Our quality and technical support will help you stay competitive whenever or wherever you intend to introduce branched systems for waterborne resins.



Schematic structure of Boltorn® W3000

Boltorn® W3000 – efficient & powerful by design

Dendritic polymers offer extensive design possibilities due to their unique structures. With Boltorn® W3000 we have developed an amphiphilic dendritic structure that contains both non-ionic water-dispersible groups and hydrophobic air-drying groups. The result is a poweful emulsifying air-drying resin that enables traditional high molecular weight solvent-borne alkyds to be easily converted to their waterborne equivalents. High dispersing efficiency and high reactivity is combined in Boltorn® W3000, facilitating the production of fast-drying alkyd emulsion-based paint, see table.

High-gloss paint for brush application	Boltorn® W3000 stabilized OL 65 alkyd emulsion	Solvent-borne OL 65 alkyd (ref)	Conventional OL 65 alkyd emulsion
Boltorn® W3000, wt% in paint	2.3	-	-
Alkyd (OL65), wt% in paint	21.4	34.4	-
Alkyd OL65-internally emulsified	-	-	31.8
Solids content, wt%	49	67	51
PVC	17	17	13
VOC, g/l	0	270	0
Gloss, 60°	93	92	95
Drying*			
Dust-dry, h	0.5	0.5	0.5
Tack-free, h	4	3	1.5
Through dry, h	5	3.5	15.5
Hard, h	14	5	> 24

* Beck-Koller, glass panels at 23 °C, 50 % humidity, 25 µm DFT

The physical properties of a waterborne paint containing Boltorn® W3000 compared to a solvent-borne counterpart and a conventional alkyd emulsion paint

Safer performance

Coalescing agents for aqueous latex dispersions

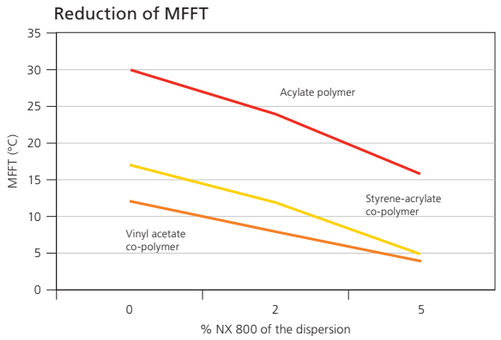
Perstorp offers two high-performance coalescing agents, NX 795 and our latest product, NX 800. Both products are non-VOC compliant according to European legislation. NX 795 and NX 800 effectively reduce the minimum film-formation temperature (MFFT), and provide further benefits in end-product properties including higher coating gloss, increased film integrity, reduced film porosity and less cracking.

NX 795 – environmentally friendly paint

This ester alcohol acts as an effective coalescing agent for latex paint formulations such as acrylic dispersions, styrene acrylics and vinyl acetate co-polymer dispersions. The addition of NX 795 reduces the MFFT of dispersion paint and NX 795, with a boiling point of 254°C, is not classified as a HAP substance.

NX 800 – fresher, cleaner air

This product satisfies your need for a low-odor coalescing agent without compromising performance. NX 800 complies with the EU VOC directive for decorative paints and has a boiling point of 282°C.



Reduction of the MFFT with addition of NX 800 in an acrylate polymer, a styrene acrylate and a vinylacetate co-polymer dispersion

Product data summary

Dispersing monomers for PUD & waterborne polyesters

Product	Appearance	Reactive group	OH-value mg KOH/g	Acid value mg KOH/g	Molecular weight g/mol	Melting point °C
Bis-MPA	Crystals	2 hydroxyl 1 carboxyl	835	415	134.4	180
DMBA	Crystals	2 hydroxyl 1 carboxyl	755	377	148.2	110

Polycarbonate diols for PUD

Product	Appearance	Reactive group	OH-value mg KOH/g	Color APHA	Molecular weight g/mol	Viscosity Pas (°C)
Oxymer® M112	Viscous liquid	2 hydroxyl	112	150	1,000	20(40)

Glycols for waterborne polyesters

Product	Appearance	Reactive group	OH-value mg KOH/g	Acid value mg KOH/g	Molecular weight g/mol	Melting point °C
BEPD	Semi-crystalline	2 hydroxyl	695	-	161.0	44
Neopentyl Glycol (Neo)	Flakes	2 hydroxyl	1,077	-	104.2	129

Branching monomers for waterborne polyesters & alkyds

Product	Appearance	Reactive group	OH-value mg KOH/g	Acid value mg KOH/g	Molecular weight g/mol	Melting point °C
Penta Mono grade	Crystals	4 hydroxyl	1,645	-	136.4	262
TMP	Flakes	3 hydroxyl	1,247	-	135.1	59

Dispersing resin & anti-blocking agent for waterborne paints

Product	Appearance	Reactive group	OH-value mg KOH/g	Acid value mg KOH/g	Molecular weight g/mol	Viscosity mPas at 35 °C	Melting point °C
Boltorn® W3000	Semi-crystalline	Non-ionic Air-drying	15	5	9,000	2,000	30

Coalescing agents for latex products

Product	Appearance	Type	Acid value mg KOH/g	Molecular weight g/mol	Density Kg/m³	Boiling point °C
NX 795	Clear liquid	Ester alcohol	0.5	216.2	947	254
NX 800	Clear liquid	Ester			945	282

Putting environmental care into coatings

Automotive & transportation coatings

Toughest protection around

Perstorp

WINNING FORMULAS

Performance you can trust

The automotive and transportation industries both place very high demands on coating performance. With Perstorp you can be sure you get the highest value products on the market for the creation of superior performing formulations for the rail, aerospace and automotive industries, including coatings for buses, trucks, motorbikes and bicycles.

Our offer includes:

- Easaqua™ polyisocyanate cross-linkers for 2K waterborne PU coatings
- Tolonate™ polyisocyanate cross-linkers for high solids 2K solvent-based PU coatings
- Capa™ polycaprolactones to improve VOC-level and flexibility of both solvent-based and waterborne 2K PU coatings
- Charmor™ polyols for intumescent fire protection

For any further information, please consult the specific brochures on these ranges.

2K polyurethane formulations for transportation coatings

To meet the high requirements of the transportation industries, 2K polyurethane coatings are the first choice technology for high performance coating applications. Over the past 50 years, polyurethane based materials have proven their superiority in terms of:

- Outstanding appearance for high gloss and leveling
- Protection for chemical resistance and very good impact and scratch resistance
- Durability for non-yellowing performance and exceptional gloss retention upon ageing
- Fast drying time for better productivity and reduced dust contamination

Automotive industry

Rail industry

Aerospace industry

Our offer for:

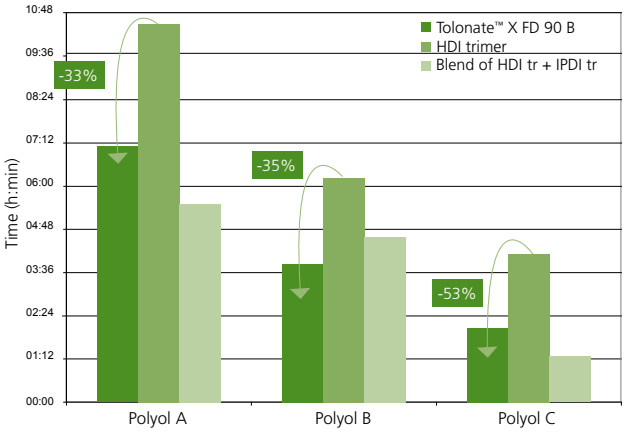
Automotive coatings

Automotive coatings need to meet some very stringent requirements of the automotive market in terms of aesthetics and protection. Perstorp's offer enables you to meet and exceed these demands by setting new standards for gloss, appearance, acid etch and bird-dropping resistance, weathering and UV resistance, as well as low VOC-levels. Our wide-range offer is ideal for automotive OEM and repair.

Products:

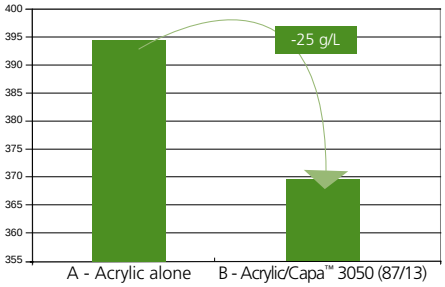
- Tolonate™ HDT 90 standard trimer used for many years
- Tolonate™ IDT 70 B or Tolonate™ X FD 90 B to speed up drying, thus adding to productivity and preventing dust contamination
- Tolonate™ HDT-LV and Tolonate™ HDT-LV2 for high solid clearcoats
- Easaqua™ X L 600 and Easaqua™ X D 401 for environmentally friendly waterborne formulations
- Capa™ polyols to reduce VOC-level and improve scratch resistance

Better dust-free time with Tolonate™ X FD 90 B compared to standard HDI trimer



Tolonate™ X FD 90 B gives a faster drying time compared to HDI trimer. Use Tolonate™ X FD 90 B for high productivity and to prevent dust introduction.

Lower VOC thanks to the addition of Capa™



By adding Capa™ polycaprolactones to a 2K solventborne formulation you can lower VOC with maintained viscosity.

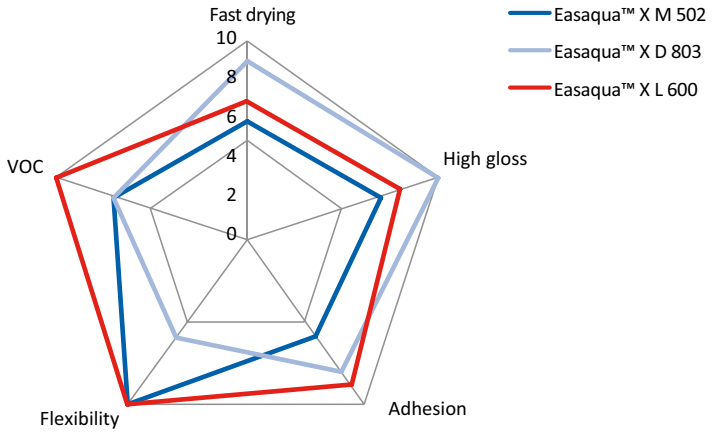
Our offer for:

Rail vehicle coatings

Rail vehicle coatings have their very own unique requirements, which include demands for anti-graffiti performance and fire protection. For railway companies, the environmental aspect is becoming more and more important, and there is a trend to switch to high solids and waterborne technologies. At the same time as meeting environmental criteria, these coatings also need to provide a nice aesthetic finish. To meet this target, Perstorp provides Easaqua™ polyisocyanates for waterborne formulations which bring excellent anti-graffiti properties together with good appearance and hardness development. By introducing Capa™ polyols the gloss level can be increased even further.

Products:

- Easaqua™ X D 803 for excellent anti-graffiti performance
- Easaqua™ X D 401 for very high gloss
- Easaqua™ X L 600 a new low viscosity grade with high NCO content
- Capa™ polyols to increase gloss level and open time



Whatever your needs are, you will find a suitable solution with our Easaqua™ grades.

Excellent anti-graffiti performance with Easaqua™

Anti-graffiti performance	Gloss at 60°	Average ΔE obtained	Requirement on ΔE (NF F31-112)
Neocryl XK 541 with Easaqua™ X D 803	96	0.75	< 1

Clearcoats based on Easaqua™ deliver anti-graffiti performance compliant with the railway industry's requirements, together with excellent appearance. The addition of Capa™ polyols in waterborne formulation can even improve the gloss further.

Superior fire protection with Charmor™

Intumescent coatings and expendable sealants based on Charmor™ protect buildings and transportation vehicles. Coatings and sealants based on Charmor™ slow the spread of fire, reduce heat and minimize dangerous smoke and fumes more effectively than any alternative products.

Perstorp's offer for intumescent systems includes various grades of Charmor™ that meet the above demands and offer superior performance and fire protection.

- Charmor™ PM/PT
- Charmor™ DP

For more information, please see our Charmor™ brochure.

The intumescent process
When an intumescent coating is exposed to heat, the intumescent effect initiates at approximately 200 °C. Esterification, swelling and carbonization create an effective insulating layer.

Our offer for:

Aerospace coatings

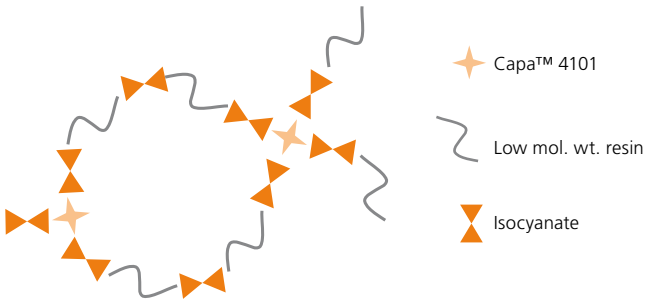
Aerospace coatings represent one of the most challenging categories of coating systems. Not only do they need to withstand wide temperature fluctuations and strong UV-exposure, but also rapid changes in air pressure that may cause cracking and high speed air drag that can cause erosion. On the ground, aircraft need to show chemical resistance to harmful fluids such as fuels, de-icing fluids and hydraulic fluids, e.g. Skydrol.

Perstorp's Capa™ is a key product in aerospace coatings because of the strength it adds, including cold flexibility. Our isocyanates Tolonate™ and Easaqua™ both provide high gloss retention and exceptional weathering resistance for solventborne and 2K waterborne coatings.

Products:

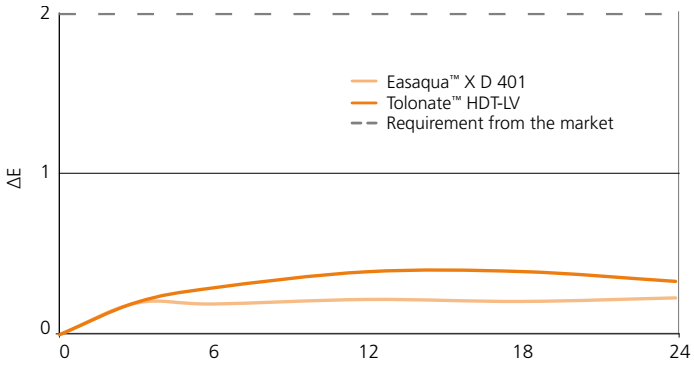
- Capa™ 4101 for excellent flexibility and chemical resistance
- Tolonate™ HDT-LV/HDT-LV2 for high solids and durable clear/top coats
- Tolonate™ X FD 90B to improve chemical resistance and buffability
- Easaqua™ range for 2K PU waterborne formulations
- Charmor™ range to ensure fire protection

Cross-linking achieved with Capa™ 4101



The high functionality of Capa™ 4101 leads to good chemical resistance (e.g. resistance to Skydrol).

Similar weatherability resistance for waterborne (Easaqua™) and solventborne (Tolonate™) 2K PU



Low yellowing after 24 months of Florida exposure while maintaining very high gloss (approx. 95 GU).

Better cold flexibility with the addition of Capa™

Acrylic / 10% of Standard Polyester

Acrylic / 10% of Capa™ 3050

Conical mandrel test done on coatings heated during 24h at 80 °C and then cooled to -25 °C for 3h.

Product data summary

Tolonate™ for solvent-based & solvent-free PU formulations

	Type	Solids content (%)	Viscosity avg (mPas)	NCO avg (%)	Equivalent weight (g)	Free solids monomer content (%)
Tolonate™ HDB 75 MX*	HDI biuret	75	3,000	22.0	191	< 0.3
Tolonate™ HDT 90	HDI trimer	90	500	19.8	212	< 0.2
Tolonate™ HDT-LV	HDI trimer	100	1,200	23.0	183	< 0.2
Tolonate™ HDT-LV2	HDI trimer	100	600	23.0	183	< 0.5
Tolonate™ X FD 90B	HDI trimer	90	2,000	17.4	240	< 0.5
Tolonate™ D2	NCO blocked	70	60	12.3	342	< 0.5

** other solvent types available: B = butyl acetate, M = methoxypropyl acetate, X = xylene*

Easaqua™ self-emulsifying for two-component formulations

	Viscosity* (mPas at 25°C)	NCO* (%)	Solids content* (%)	APEO-free
Easaqua™ WT 1000	3,200	9.4**	63	No
Easaqua™ X M 502	3,600	18.3	100	Yes
Easaqua™ X L 600	1,500	20.6	100	Yes
Easaqua™ X D 401	1,050	15.8	85	Yes
Easaqua™ X D 803	200	12.2	69	Yes

** average value*
*** NCO blocked*

Capa™

	Type	MW	OH (%)	Viscosity at 23 °C (mPas)
Capa™ 2043	Diol	400	8.5	240
Capa™ 3031	Triol	300	17.0	1,320
Capa™ 3050	Triol	540	9.4	1,190
Capa™ 3091	Triol	900	5.5	1,246
Capa™ 4101	Tetrol	1,000	6.6	1,850

Charmor™

	Melting point (°C)	Water solubility (% at room temperature)	Typical hydroxyl number (mg KOH/g)	Density (kg/m³)	Particle size
Charmor™ PM	260	5.25	1,645	1,400	< 40 µm typ. 98%
Charmor™ PT	250	4.70	1,615	1,400	< 40 µm typ. 98%
Charmor™ DP	222	0.22	1,325	1,370	< 40 µm typ. 98%



Your Winning Formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on 130 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. This is how we enable you to meet market demands for safer, lighter, more durable and environmentally sound end-products – for the aerospace, marine, coatings, chemicals, plastics, engineering, and construction industries, as well as automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Consistent high quality, capacity and delivery security are ensured through strategic production plants in Asia, Europe and North America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of smarter and safer products and sustainable processes that reduce environmental impact and create real value in new chemical applications. This principle of proactive innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

Discover your winning formula at www.perstorp.com

Perstorp
WINNING FORMULAS

Easaqua™

Polyisocyanates for easy waterborne polyurethane coatings

Our Easaqua™ aliphatic polyisocyanates

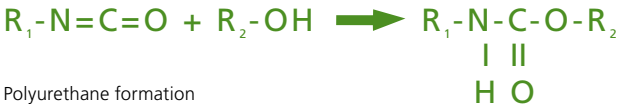
- Enable easy mixing and fast drying
- Meet demands for environmentally friendly performance
- Deliver innovative technology with broad compatibility
- Include ready-to-use grades

Perstorp
WINNING FORMULAS

Innovative & easy to use technology

Polyurethane coating technology

Polyurethane coatings are based on binders formed by the reaction between a (poly)isocyanate (-NCO) and another polymer containing hydroxyl groups (-OH), commonly called polyol.



Polyurethane formation

The choice of raw materials, both polyols and (poly)isocyanates, is very large, enabling many combinations with a wide variety of properties. Polyurethanes based on aliphatic polyisocyanates are well-known for their outstanding properties, especially for their exceptional resistance to weathering.

Our Easaqua™ product line has been specifically designed for waterborne polyurethane formulations to meet the growing need for easy-to-use and environmentally-friendly coatings. As formulation requirements have evolved, so has our line of products, which includes several new additions offering faster drying, lower viscosity and improved humidity resistance.

The main applications where our Easaqua™ range is ideal for waterborne polyurethane formulations are:

- Wood coatings
- Plastic coatings (including soft-feel formulations)
- Coatings for automotive repair, transportation & agricultural equipment
- Metal coatings for general industry
- Concrete coatings

Our Easaqua™ range

Self-emulsifiable polyisocyanates

Easaqua™ WT 2102
Easaqua™ X M 501
Easaqua™ X M 502
Easaqua™ X D 401
Easaqua™ X D 803
Easaqua™ X L 600 New

Emulsion of blocked polyisocyanate

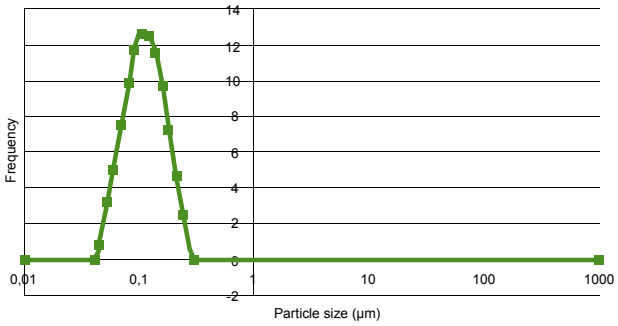
Easaqua™ WT 1000

New Easaqua™ X L 600:

Easy dispersibility with improved humidity resistance

Our latest innovation, Easaqua™ X L 600, has been specifically designed to meet your highest demands for humidity resistance combined with the same easy mixing that our Easaqua™ range is widely appreciated for. Easaqua™ X L 600 shows a very narrow particle size distribution after emulsification into waterborne media (see graph 1 below).

New Easaqua XL 600 provides very low and monodisperse particle size distribution into aqueous media



Thanks to its lower hydrophilicity it also provides high resistance to moisture, offering greater protection of the substrate that the final coating is applied to. In addition, Easaqua™ X L 600 has one of the lowest viscosities of all the products in the Easaqua™ range and thus has a reduced need for solvent (it can even be used without any solvent at all). Easaqua™ X L 600 shows a very interesting balance between viscosity and NCO content.

Improved adhesion on metal

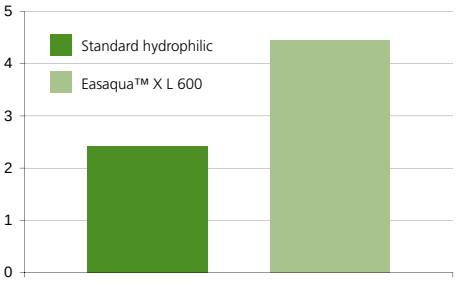
A 2K waterborne polyurethane topcoat based on the new Easaqua™ X L 600 shows better adhesion after immersion into water at 40 °C for ten days, compared to standard hydrophilic polyisocyanate (see graph to the right).

Focus on innovation

The latest development in our Easaqua™ range, Easaqua™ X L 600, is an innovatively modified polyisocyanate that:

- Combines easy dispersibility and improved humidity resistance
- Ensures very narrow particle size distribution after emulsification into water
- Achieves the best balance between low viscosity and functionality
- Improves adhesion onto a wide range of substrates

New Easaqua™ X L 600 provides excellent adhesion on metal, even after immersion into hot water



White topcoat, applied over a commercial primer, quotation of crosshatch cut test from 0 to 5 where 5 is best

Easy waterborne solutions for coating applications

Easaqua™ polyisocyanates are ideal for formulating waterborne high-performance polyurethane coatings.

Hydrophilically modified polyisocyanates

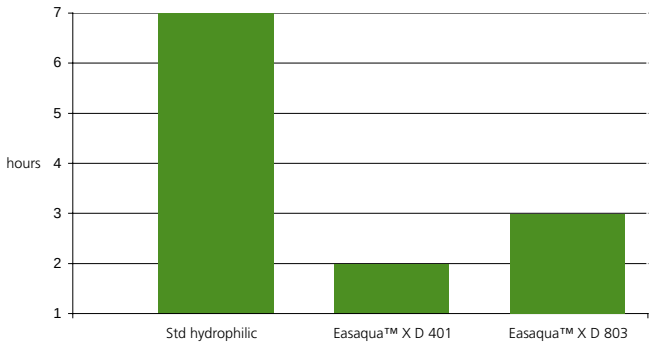
All our Easaqua™ grades, except WT 1000, are hydrophilically modified polyisocyanates and self-emulsifiable into water. They are used as cross-linkers of two-pack (2K) formulations, where they contribute to excellent miscibility, fast drying, high gloss, outstanding durability and excellent chemical resistance of the polyurethane film.

Easy mixing

No high speed mixing equipment is required. Easaqua™ products are self-emulsifying and very easy to incorporate into waterborne coating formulations. Hand mixing is sufficient: Easaqua™ grades do not require high-shear or high-speed special equipment (see picture 1).

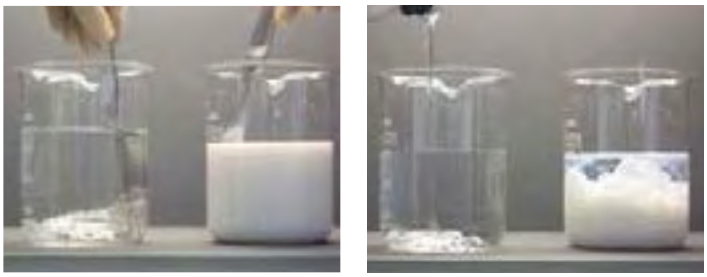
Fast drying

Better hardness and thus, improved stackability. Coatings based on Easaqua™ X D 401 and X D 803 show a dust free time 25% to 60% shorter, resulting in higher efficiency in terms of application process and less film defects.



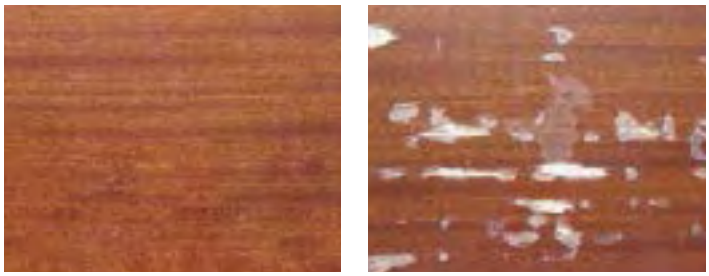
Easaqua™ X D 401 also gives improved stackability of the coated panels (see picture 2).

Picture 1. Self-emulsification of Easaqua™



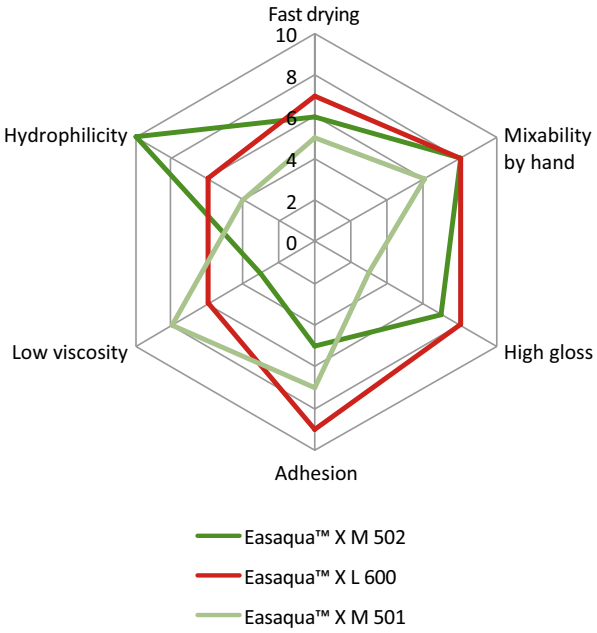
Shows hand mixing of Easaqua™ (right) and standard hydrophobic isocyanate (left)

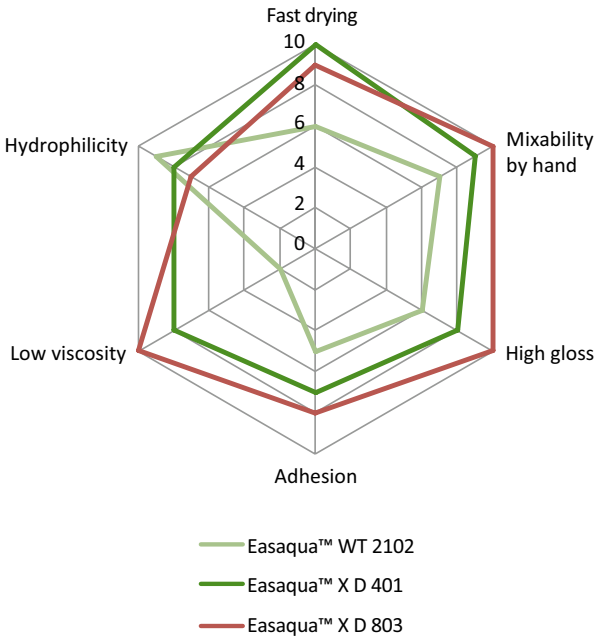
Picture 2. Wood panels after stackability test



Shows contact between coated panels under 1200 kg/m² for 16 hours with Easaqua™ X D 401 (left) and with a standard hydrophilic hardener (right)

Key properties





Ultra low-VOC & APEO-free options

Easaqua™ products are the environmentally-responsible choice for high performing, ultra low VOC and APEO-free coating formulations. Our products support sustainable development and meet the ever-increasing environmental protection regulations around the world.

Worldwide registered

All Easaqua™ products are designed to meet global regulations and are registered in the following inventories:

- EINECS (Europe)
- TSCA (USA) and DSL (Canada)
- ENCS (Japan, MITI agency), ECL (South Korea)
- AICS (Australia, China)

Wide compatibility with most polyols

Easaqua™ products are compatible with most waterborne polyols (acrylics, polyesters, PUDs etc.), maximizing your options for formulating primers, clearcoats and pigmented topcoats, while minimizing costs.

Blocked polyisocyanate emulsion

Easaqua™ WT 1000 is a stabilized emulsion of blocked polyisocyanate.

Uses

- 1K industrial coatings
- Glass coatings
- Containers, metal coatings
- 1K primers for automotive OEM
- Can and coil-coatings

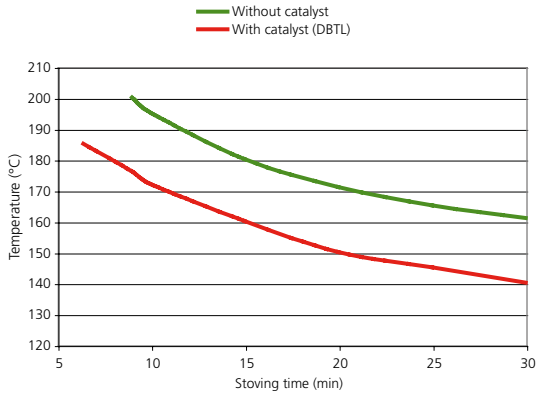
Advantages

- Easy-to-use into waterborne formulations
- High solids, low viscosity
- Very low organic solvent content
- Widely compatible with other resins
- Good flexibility, stonechip resistance

The prime solution for 1K & 2K waterborne systems

1K formulations with Easaqua™ WT 1000

- Easaqua™ WT 1000 is used as a cross-linker of one pack heat-activated waterborne coatings (as the only cross-linker or in conjunction with amino-resins).
- Typical curing conditions are 20-40 minutes at 140-150 °C (280-300 °F), or shorter curing times at higher temperatures. Tin catalysts can be used to reduce baking temperatures or time. Other safer catalysts can be used to replace tin catalyst, with the same effect in decreasing cure time.



Curing conditions of 1K formulations

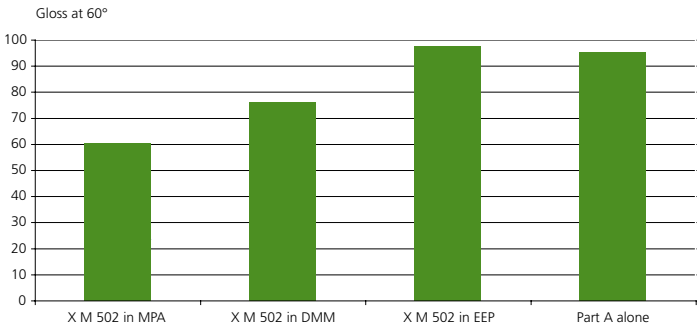
2K formulations with self-emulsifiable Easaqua™

NCO/OH ratio: In most cases an NCO/OH ratio between 1.0 and 1.4 is used. If the ratio is too high, this may reduce pot-life and film defects such as foams and haze may occur. If the ratio is too low, this may lead to lower hardness and poorer chemical resistance. In the case of non-hydroxylated PUDs, the quantity of Easaqua™ to be added is empirically determined.

Blending Easaqua™ with other polyisocyanates: It is generally recommended to use one grade of Easaqua™ as the only cross-linker. However, self-emulsifiable Easaqua™ is fully compatible with hydrophobic Tolonate™ and it is possible to make blends in order to obtain a wide range of properties. Low viscosity HDI trimers, Tolonate™ HDT-LV and Tolonate™ HDT-LV2 are the most widely used grades in conjunction with Easaqua™.

Dilutions of Easaqua™ with solvents: Adding organic co-solvents to Easaqua™ polyisocyanates is usually not necessary, but it can help incorporate the hardener into very low viscous formulations, such as clearcoats, and improve optical properties of the film. Solvents containing -OH groups (alcohols, water, etc) must not be used.

Dispersibility properties: When the solvent used to dilute an Easaqua™ grade is properly selected, very small particles and very narrow distribution are obtained after emulsification in water. The solvent type and quantity used to dilute the Easaqua™ based cross-linker will influence film properties, such as gloss.



Gloss of 2K waterborne clearcoat for parquet: comparison of cross-linkers based on Easaqua™ X M 502 diluted with 30% of various solvents

Depending of the type and quantity of solvents used to dilute Easaqua™ products, quality of the self-emulsification varies.

Easaqua™/solvent (wgt)	Butyl acetate	Shellsoll A	MPA	PGDA	DIB	DMM	EEP	BGA	BGDA	NMP
Easaqua™ WT 2102										
80/20	5	5	5	5	5	1	5	5	5	1
70/30	5	1	4	5	4	NM	5	5	5	NM
Easaqua™ X M 502										
90/10	5	5	5	5	5	5	5	5	5	4
70/30	1	1	5	5	1	5	5	5	5	4
Easaqua™ X D 401										
88/12	5	1	5	5	4	5	5	5	5	5

Rating from 5: excellent to 0: not self-emulsifiable - NM: not measured
MPA: Methoxy Propyl Acetate PGDA: Propylene Glycol DiAcetate DIB: Di Iso Butyl Esters DMM: Di Methyl Di Propylene Glycol EEP: Ethyl 3-EthoxyPropionate
BGA: Butyl Ethylene Glycol Acetate BGDA: Butyl Diethylene Glycol Acetate NMP: N-Methyl Pyrrolidone

Safety instructions

Formulating Easaqua™ and Tolonate™ in waterborne systems is not hazardous but requires following a few simple instructions:

- Never add water to the hardener, but always pour Easaqua™ into the aqueous coating containing the polyol resin
- Never keep the ready-to-use coating hermetically sealed once the mixture (polyol + hardener) has been made
- Never put the waste into a hermetically sealed collecting tank; use a tank equipped with a safety valve to enable the release of gases
- Before any modification of the hardener, previous lab tests need to be run on small quantities

Product data summary

	Viscosity* (mPa.s at 25 °C)	NCO* (%)	Solids content* (%)	APEO-free (1)
Self-emulsifiable polyisocyanates				
Easaqua™ WT 2102	4,300	19.0	100	No
Easaqua™ X M 501	1,100	21.6	100	Yes
Easaqua™ X M 502	3,600	18.3	100	Yes
Easaqua™ X D 401	1,050	15.8	85	Yes
Easaqua™ X D 803	200	12.2	69	Yes
Easaqua™ X L 600 New	1,500	20.6	100	Yes
Hydrophobic polyisocyanates				
Tolonate™ HDT-LV	1,200	23.0	100	NA
Tolonate™ HDT-LV2	600	23.0	100	NA
Emulsion of blocked polyisocyanate				
Easaqua™ WT 1000	3,200	9.4**	63	No

* average value ** blocked NCO (1) APEO-free: without any alkyl phenol ethoxylate NA: not applicable



Your Winning Formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on 130 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. This is how we enable you to meet market demands for safer, lighter, more durable and environmentally sound end-products – for the aerospace, marine, coatings, chemicals, plastics, engineering, and construction industries, as well as automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Consistent high quality, capacity and delivery security are ensured through strategic production plants in Asia, Europe and North America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of smarter and safer products and sustainable processes that reduce environmental impact and create real value in new chemical applications. This principle of proactive innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

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Scuranate® TDI

Polyurethane essentials

Our Scuranate® TDI range

- The essential aromatic polyurethane raw material for bedding, furniture and automotive
- Key component for adhesives, sealants, elastomers and coatings
- Four grades available tailored for different end-user needs
- Secure and reliable supply

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WINNING FORMULAS

The essential polyurethane component

Toluene diisocyanate (TDI) is an essential isocyanate used in the production of polyurethanes for flexible foam applications. TDI applications range from furniture, bedding and carpet underlay to transportation and packaging. TDI is also used in the manufacture of coatings, sealants, adhesives and elastomers.

Scuranate® TDI is manufactured in France at the Pont-de-Claix site.

Scuranate® T80

The two principal isomers of TDI are classified as 2,4-toluene diisocyanate and 2,6-toluene diisocyanate. Scuranate® T80 is a mixture of 80% 2,4-toluene diisocyanate and 20% 2,6-toluene diisocyanate.

Scuranate® T65

T65 is a mixture of 2,4-toluene diisocyanate and 2,6-toluene diisocyanate isomer with high content of the 2,6-isomer.

Scuranate® T100

T100 contains more than 99% of 2,4-toluene diisocyanate.

Scuranate® TX

Scuranate® TX is a mixture of the 2,4 and 2,6 isomers with a high concentration of 2,4 isomer.

Toxicology/Regulatory

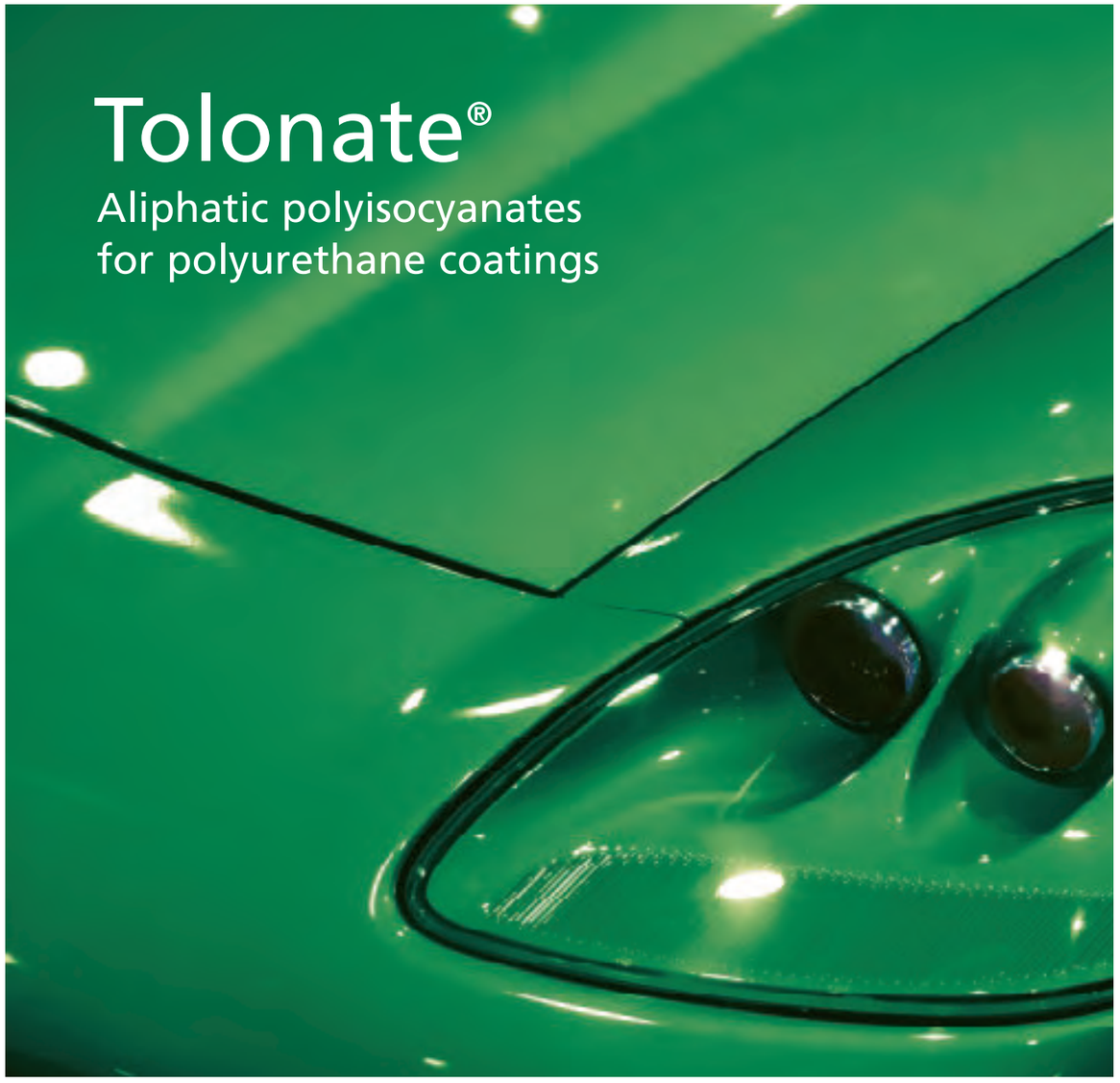
TDI (as well as other isocyanates) are toxic and reactive chemicals, which require proper handling to ensure that they are used safely. Exposures by inhalation, skin contact or ingestion should be avoided. In particular, inhalation of vapors, aerosols, and dust should be avoided, since this can lead to irritation and in extreme cases to a reduction of lung function and/or sensitization. Users or handlers should obtain and carefully review a material safety data sheet (MSDS). Additional information regarding the responsible management of empty TDI drums, as well as the loading/unloading, transportation and storage of TDI (bulk) should be reviewed in the Toluene Diisocyanate Handling Guide.

TDI	Applications						
Product Code	General Purpose	High-Load Bearing	High Resiliency	Industrial Purpose	Cast Elastomer	Paint Coating	Adhesive Binder
Scuranate® T80	•	•	•	•	•	•	•
Scuranate® T65		•	•	•			
Scuranate® T100					•	•	•
Scuranate® TX						•	•

TDI	Typical Properties					
Product Code	Chemical Description	Specific Gravity 25°C	Viscosity mPa.s 25°C	Hydrolysable chlorides %	Total acidity %	Colour APHA
Scuranate® T80	TDI 80/20	1.22	3	<0.007	<0.004	<40
Scuranate® T65	TDI 68/32	1.22	3	<0.010	<0.005	<40
Scuranate® T100	2,4 TDI	1.22	3	<0.015	<0.013	<30
Scuranate® TX	TDI 95/5	1.22	3	<0.010	<0.0015	<40

Tolonate®

Aliphatic polyisocyanates for polyurethane coatings



Our Tolonate® aliphatic isocyanates

- Outstanding appearance
- Exceptional gloss retention
- Non-yellowing upon ageing
- High-solids low VOC options
- Fast drying possibilities

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Leveraging the performances of polyurethane coatings

Polyurethane coating technology

Polyurethane coatings are based on binders formed by the reaction between a (poly)isocyanate (-NCO) and another polymer containing hydroxyl groups (-OH), commonly called polyol.

$$R_1\text{-}N{=}C{=}O + R_2\text{-}OH \longrightarrow R_1\text{-}\underset{\underset{H}{|}}{N}\text{-}\underset{\underset{O}{||}}{C}\text{-}O\text{-}R_2$$

Polyurethane formation

The choice of raw materials, both polyols and (poIy)isocyanates, is very large, enabling many combinations with a wide variety of properties. Polyurethanes based on aliphatic polyisocyanates are well-known for their outstanding properties, especially for their exceptional resistance to weathering.

The main applications where Perstorp Tolonate® range are ideal for polyurethane formulations are:

- Automotive primers and clearcoats (both OEM and refinish)
- Transportation coatings for buses, trucks, railway carriage and aerospace
- Marine & protective coatings
- Plastic coatings
- General industrial coatings on metal and glass
- Wood coatings
- Can & coil coatings
- Concrete coatings

Our Tolonate® range

Tolonate® HDB-series

Due to internal hydrogen bonds (see figure 1), Tolonate® HDB-series are more polar than the other HDI derivatives. As a result, they show:

- good compatibility with a wide range of resins (especially polyester polyols and alkyds)
- very good adhesion to a lot of substrates

Tolonate® HDT-series

Thanks to their aliphatic nature and to their isocyanurate ring structure (see figure 2), Tolonate® HDT-series show:

- exceptional UV and weathering resistance (non yellowing and very high gloss retention)
- chemical and solvent resistance
- ideal balance between high functionality and low viscosity, which explains their increasing usage in low VOC systems (high solids and solvent free formulations)

Tolonate® IDT-series

Due to their cyclo-aliphatic structure (see figure 3), Tolonate® IDT-series:

- facilitate fast drying and improve initial and final hardness
- produce coatings with improved resistance to acids and solvents

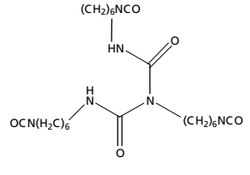


Figure 1. Tolonate® HDB

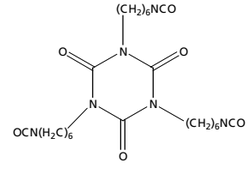


Figure 2. Tolonate® HDT

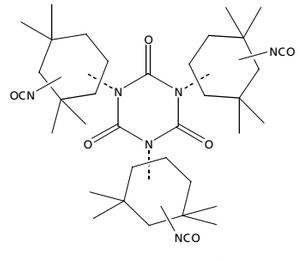


Figure 3. Tolonate® IDT

Tolonate® key benefits

Outstanding appearance

Thanks to their high transparency and very low color, Tolonate® polyisocyanates are ideal for producing polyurethane clearcoats and topcoats when aesthetic and durability of the coatings are critical.

Exceptional gloss retention and non-yellowing properties

Polyurethane coatings with Tolonate® show exceptional gloss retention and non-yellowing properties upon ageing (see Graph 1).

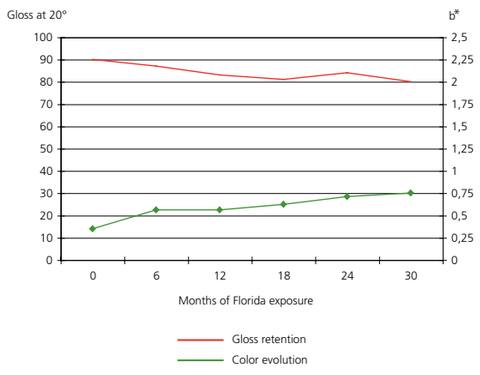
High solids low VOC options

We have implemented a special process for Tolonate® low viscosity LV grades (see Graph 2). These 100% solids products are particulary well adapted for low VOC formulations.

Fast drying possibilities

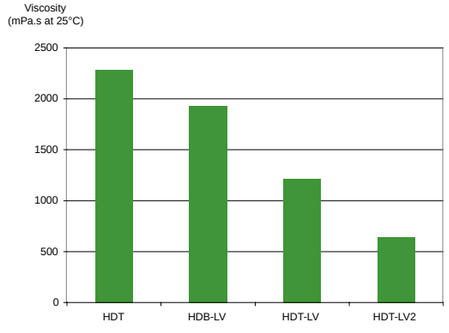
We offer special grades, like the Tolonate® IDT-series, which reduce the drying time of coatings, improving painting productivity.

Graph 1: Gloss retention and color evolution



Gloss and color evalutions of a Tolonate®-based clearcoat over a waterborne metallic basecoat applied on steel panels during months of ageing in Florida.

Graph 2: Viscosity of 100% solids Tolonate® grades



Formulating recommendations

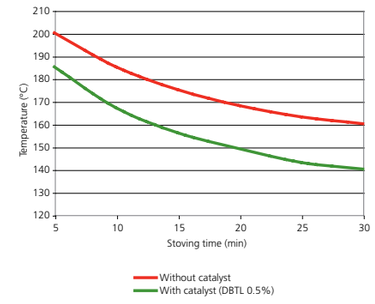
1K formulations with Tolonate® D2

Tolonate® D2 is used as a crosslinker of one-pack heat-activated coatings (as the only crosslinker or in conjunction with amino-resins).

Since Tolonate® D2 is temporarily blocked, these 1K formulations show no reactions to humidity and do not have a limited pot-life during application. They are ready-to-use (the end-user does not have to add prior to use a hardener in precise quantity).

Typical curing conditions are 20-40 minutes at 140-150°C (280-300°F). Higher temperatures result in shorter curing times. Therefore, 1K formulations based on Tolonate® D2 can only be used on metal or glass substrates. Tin catalysts can be used to reduce baking temperatures or time (see graph).

Curing conditions of 1K formulations with Tolonate® D2



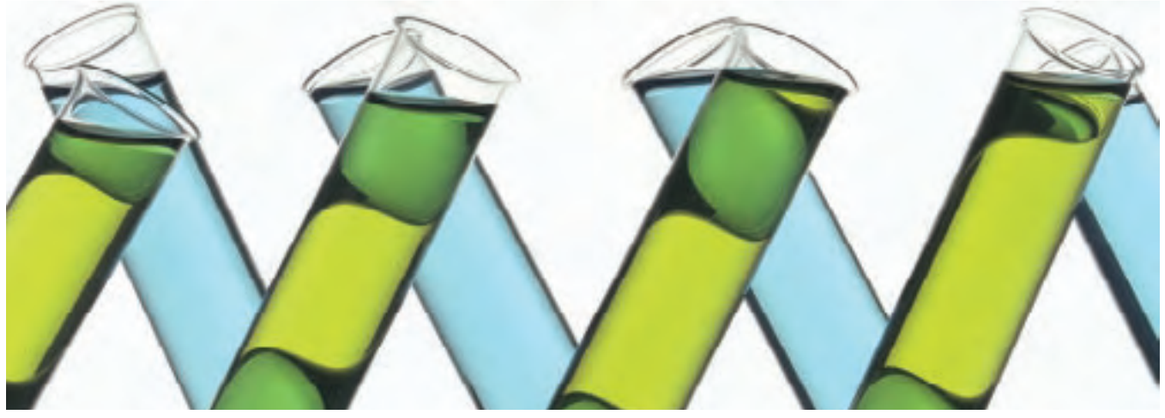
2K formulations with other Tolonate® grades

Except Tolonate® D2, the other Tolonate® grades are used as crosslinkers of two-pack (2K) polyurethane formulations. The paint applicators have two separated components. The pot containing the polyol is usually called part A, while the Tolonate® based hardener is called part B.

Just prior to use, end-users have to mix the two parts in a specified ratio (see processing recommendations, page 8). As soon as the two packs are mixed, the NCO- groups of the polyisocyanate start to react with the OH-groups of the polyol leading to a slow, continuous and not reversible increase of viscosity. The time during which the coating can be used is called "pot-life". The end of the pot-life is usually achieved once the initial viscosity of the ready-to-use coating has doubled.

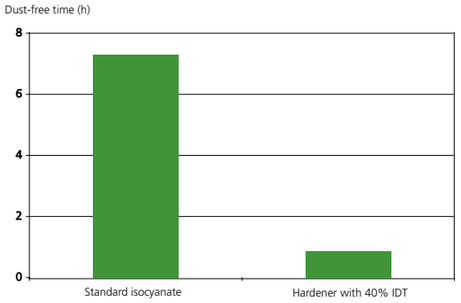
Since the NCO + OH reaction takes place at room temperature, the 2K polyurethanes are used on all the substrates which are sensitive to heat (like wood and plastics) and on all the objects which are too big to be stoved (airplanes, bridges, railway carriage, etc.).

2K polyurethane coatings are either cured at room temperature or forced dried at 50 to 80°C or even baked at 140°C, depending of the final applications and paint line equipment.



Fast drying 2K formulations

Fast drying is a key parameter to increase paint productivity and to minimize dust issues. Physical drying time can be strongly reduced and the rate of hardness development increased by using Tolonate® IDT 70 series (see Graph). In order to keep an acceptable level of coating flexibility, Tolonate® IDT 70 series shall be used in blends with Tolonate® HDT or HDB grades.

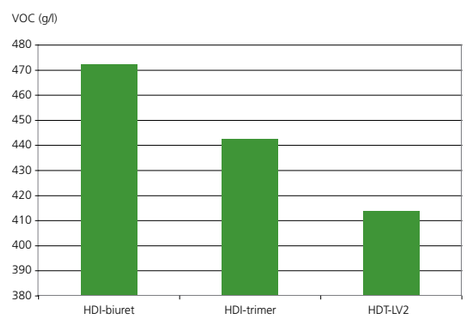


Effect of Tolonate® IDT 70 on dust free time

High solids, low VOC 2K formulations with Tolonate® HDT-LV2

- In order to comply with new regulations, formulators have to offer low VOC (Volatile Organic Compounds) formulations.

- We have developed a unique process leading to low viscosity, 100% solids HDI-trimer Tolonate® HDT-LV2. Thanks to Tolonate® HDT-LV2, high solids, VOC compliant coatings can be prepared (see Graph). These formulations show similar properties to the ones based on standard polyisocyanates.



Comparison of VOC level of clearcoats based on various hardeners

Dilutions of Tolonate® with solvents in 2K formulations

In order to reduce the viscosity of Tolonate® and obtain simple mixing ratio between part A and part B, formulators usually dilute Tolonate® using one or more solvents.

Type of solvent(s)

Some of the most common solvents of the paint industry can be used to dilute Tolonate®, with the exception of those that may react with the polyisocyanate, such as alcohol or glycol monoethers. Besides, Tolonate® are not fully soluble in aliphatic hydrocarbons (like White Spirit), which should not be used.

The best solvents for Tolonate® are esters (like butyl acetate) and ketones (like MIBK: methyl isobutyl ketone). Ether esters (like MPA: methoxy propyl acetate) and aromatic hydrocarbons (such as xylene or naphta solvents) are also commonly used.

Dilutions using hydrophilic solvents, such as ketones, are more sensitive to atmospheric humidity than those produced with hydrophobic solvents such as aromatic hydrocarbons.

Water content of the solvent(s) and impurities reacting with NCO

Like all isocyanates, Tolonate® react with water. It is therefore essential to use solvents with a water content lower than 500 ppm (preferably lower than 300 ppm), which are referred to as "urethane grade solvents."

We also recommend to carefully check the quantity of impurities likely to react with NCO groups, such as butanol and/or acetic acid in butyl acetate.

Dilution level

It is theoretically possible to dilute Tolonate® to a high degree. However, the higher the quantity of solvent, the greater the risk that traces of water from the solvent may cause problem with the diluted polyisocyanate.

That is why it is recommended to go no lower than 35-40% solids by weight. Below this level, there is a higher risk of obtaining turbidity, precipitates and even gels.

It should be noted that trimers can generally withstand higher dilution levels than biurets.

Processing recommendations

NCO/OH ratio: calculation and impact on final properties

Polyurethane network is created by the reaction between the Tolonate® – based hardener and the polyol. In theory a stoichiometrical ratio should be used (NCO/OH = 1), i.e. an equal number of NCO-groups of Tolonate® will have to react with the OH- groups of the polyol*.

➡ But in practice the NCO/OH ratio varies, depending of the required end properties.

In the case of primer coats – NCO/OH is usually lower than 1 (0.7 to 0.9 for example), to obtain a better film flexibility and a better inter-coat adhesion with the topcoat.

In the case of topcoats – NCO/OH is usually higher than 1 (1.1 to 1.5 for example) in order to ensure a perfect crosslinking of the film, and thus durability and protection against UV light, humidity and chemicals.

➡ An easy way to calculate the quantities of each component (Tolonate® and polyol) is obtained by using the so called "equivalent weights". They are either indicated on the product technical data sheets or can be calculated from the NCO content (%) and OH content (%), as explained here after:

Tolonate®

EW_{NCO} = equivalent weight of NCO in grams = 42x100/(% NCO)

Polyol

EW_{OH} = equivalent weight of OH in grams = 17x100/(% OH)

Technical data sheets of polyols sometimes only mention the OH index (I_{OH} in mg KOH per gram of dry resin). OH content (%) can be calculated from this using the following formula:

% OH = I_{OH} / 32.94

➡ The ratio between the two components can then be obtained by using:
- quantity of Tolonate® (in grams) = NCO/OH x EW_{NCO} (as supplied)
- quantity of polyol (in grams) = EW_{OH} (as supplied) = EW_{OH} (on solids) / (solids content)

➡ Example:
For a polyol with an OH% = 4% (on solids) and a solids content of 60% by weight:

EW_{OH} (on solids) = 17x100/4 = 425g
EW_{OH} (on delivery form) = 425/(60/100) = 708g

Quantity of Tolonate® HDB 75 MX to be used to have NCO/OH = 1.1:
As NCO% = 16.5% then EW_{NCO} (as supplied)
= 42 x 100/16.5 = 255g

We therefore need 255 x 1.1 = 280g of Tolonate® HDB 75 MX for 708 g of polyol, which means 39.6 g of Tolonate® HDB 75 MX for 100 g of polyol.

* Formulators have to make their own tests in order to define the best NCO/OH ratio depending of their formulation and final application.

Performance you can trust

Designed to enhance

The unique properties and the virtually endless design possibilities of polyurethanes have ensured widespread use in many applications.

Coatings for automotive OEM and repair

Coatings for automotive applications serve to protect the substrates from the effects of corrosion and weathering.
They also provide an attractive appearance and are considered as critical component.
Automotive's requirements are very stringent and set high standards for gloss, appearance, acid etch and bird dropping resistance, weathering and UV resistance. Thanks to their exceptional appearance and long durability, polyurethane coatings made from aliphatic polyisocyanates enable formulators to address these tough specifications.

Industrial coatings

Industrial coatings cover a wide type of paints (can and coil, aerospace, concrete flooring, plastic and wood coatings), which means a lot of different substrates and various end-used requirements are involved. They usually have to show outstanding appearance (color, gloss and levelling) and bring long lasting protection (durability and chemical resistance). In addition, industrial
coatings have to dry quickly, in order to follow the productivity requirements of the industry.

Polyurethane based materials are widely used in industrial coatings because they have proven in the past 30 years their superiority in terms of durability (no yellowing and exceptional gloss retention upon weathering), mechanical properties (balance between hardness and flexibility) and chemical resistance.

Product data summary

	Tolonate ®	Colour [1]	Viscosity Avg. mPa.s[2]	NCO Avg. % [3]	Free Monomer %	Solid content Avg. %	Solvent type	Bulk density kg/m³ [2]	Flash point °C [4]	Equivalent Weight g [3]	Refractive index [2]
HDI Derivatives	**Biurets – Polyesters Compatibility**										
	Standard grades										
	HDB	≤ 40	9000	22	< 0.3	100	-	1120	> 120	191	1.505
	HDB 75 B	≤ 40	150	16.5	< 0.3	75	B	1150	35	255	1.4747
	HDB 75 M	≤ 40	250	16.5	< 0.3	75	M	1083	55	255	1.4761
	HDB 75 MX	≤ 40	250	16.5	< 0.3	75	MX	1067	38	255	1.4894
	Low viscosity										
	HDB-LV	≤ 40	2000	23.5	< 0.3	100	-	1120	> 120	179	1.5013
	Trimers – Durability										
	Standard grades										
	HDT	≤ 40	2400	22	< 0.2	100	-	1160	> 120	191	1.5039
	HDT 90	≤ 40	500	19.8	< 0.2	90	SB	1120	53	212	1.4988
	HDT 90 B	≤ 40	450	20	< 0.2	90	B	1132	48	210	1.4923
	Fast drying										
	X FD 90 B	≤ 60	2000	17.4	< 0.5	90	B	1130	48	240	1.4960 [5]
	Low viscosity										
	HDT-LV	≤ 40	1200	23	< 0.2	100	-	1160	> 120	183	1.5004
	HDT-LV2	≤ 40	600	23	< 0.5	100	-	1131	> 120	183	1.4986
	For thermosetting formulation (NCO-Blocked)										
	D2	≤ 40	3250	11.2	-	75	S	1060	49	370	1.5103
IPDI Derivatives	IDT 70 S	≤ 60	1830	12.3	< 0.5	70	S	1040	45	342	1.5156
	IDT 70 B	≤ 60	600	12.3	< 0.5	70	B	1060	29	342	1.48
	IDT 70 SB	≤ 60	1000	12.3	< 0.5	70	SB	1054	49	342	1.5038

B = butyl acetate X = xylene M = methoxpropyl acetate S = aromatic hydrocarbon NM = not measured
(1) = Hazen or APHA (2) = at 25°C (3) = on delivery form (4) = in closed cup

Influence of temperature on viscosity

	Tolonate ®	Viscosity (mPa.s) at various temperatures						
		-20°C	-10°C	0°C	10°C	20°C	40°C	60°C
HDI Derivatives	**Biurets**							
	Standard grades							
	HDB	NM	NM	241470	66310	22730	3540	860
	HDB 75 B	4440	1810	800	390	210	80	35
	HDB 75 M	NM	NM	1450	600	310	110	45
	HDB 75 MX	11000	3850	1820	700	340	110	50
	Low viscosity							
	HDB-LV	NM	65680	19660	7190	2910	665	200
	Trimers							
	Standard grades							
	HDT	NM	75400	26680	8530	3410	770	250
	HDT 90	27430	9070	3420	1440	690	200	80
	HDT 90 B	NM	NM	2700	1090	570	180	75
	Fast drying							
	X FD 90 B*	NM	36700	12550	6470	2950	1470	NM
	Low viscosity							
	HDT-LV	NM	27400	9380	3810	1640	410	140
	HDT-LV2	NM	15580	5170	2180	1000	280	105
	Blocked							
	D2	NM	NM	10100	24060	6370	960	250
IPDI Derivatives	IDT 70 S	NM	NM	NM	10300	3260	310	150
	IDT 70 B	NM	NM	NM	2320	820	160	76
	IDT 70 SB	NM	NM	NM	6000	1950	330	100

* Tolonate X FD 90 B is only available in Europe and Asia



Your Winning Formula

The Perstorp Group is the world leader in several sectors of the speciality chemicals market. Few chemical companies in the world can rival its 125 years of success. Today we have a rich performance culture distilled from our long history and extensive knowledge in the chemical industry. That culture and knowledge base enables us to produce Winning Formulas for a wide variety of industries and applications.

Our products are used in the aerospace, marine, coatings, chemicals, plastics, engineering and construction industries. They can also be found in automotive, agricultural feed, food, packaging, textile, paper and electronics applications.

Our production plants are strategically located in Asia, Europe and North and South America and are supplemented by sales offices in all major markets. We can offer you a speedy regional support and a flexible attitude to suit your business needs.

If you want a chemical partner who can offer you focused innovation to enhance your product or application, which is delivered reliably and responsibly look no further. We have a winning formula waiting for you.

www.perstorp.com

Perstorp
WINNING FORMULAS

Specialties for adhesives & sealants

High-quality ranges for strength & flexibility

Perstorp

WINNING FORMULAS

Global partner for adhesive performance

As a leading global producer of high-performance essentials and specialties, we offer you an extensive range of raw materials including polyols, isocyanate monomers, dispersing monomers, isocyanate cross-linkers and more – all dedicated to the formulation and differentiation of a full range of adhesives and sealants. Whether your area of interest lies in the automotive, footwear, furniture or floor industry, just to name a few, Perstorp will be able to supply you with the right raw materials adjusted to meet your specific requirements and applications.

Over the last years we have completed a number of key acquisitions that have significantly enhanced our offering to the polyurethane chain and to adhesives and sealants manufacturers. In our portfolio you will find products that offer excellent and long-lasting adhesion, fast bonding times, low VOC content, non-yellowing qualities and many other desirable properties needed to make your adhesives or sealants stand out in a competitive market.

Our sales offices and production sites worldwide give us the resources and global network for short lead times and local support and service. With Perstorp as your partner, you can be sure to get performance you can trust, wherever you are in the world.

Specialties for high-quality adhesives & sealants

Perstorp's offer includes a range of specialty products, focused on some key segments for adhesives and sealants manufacturers:

- Solvent-based polyurethanes adhesives and sealants
- Thermoplastic and reactive hot-melt adhesives
- Waterborne polyurethane adhesives
- Expandable sealants

	Solvent-based polyurethane adhesives & sealants	Thermoplastic & reactive hot-melt adhesives	Waterborne polyurethane adhesives	Expandable sealants
Capa™ polyols	•	• [1)]	•	
Capa™ thermoplastics		•		
Isocyanate monomers (HDI, IPDI, TDI: Scuranate™)	•	• [2)]	•	
Dispersing monomers: Bis-MPA, Ymer™			•	
Tolonate™ polyisocyanates	•			
Easaqua™ polyisocyanates			•	
Alkoxylates	•			
Oxymer™ carbonate diols			•	
Charmor™ polyols				•

• = Recommended use

[1)] binder for non-wowen adhesives, scatter coat interlining adhesives and toe and heel counters

[2)] for structural adhesives, textile bonding, bookbinding and shoes

Our offer for:

Solvent-based polyurethane adhesives & sealants

Finding solutions with solvent-based adhesives

Solvent-based adhesives and sealants need to meet demands on bond strength and flexibility in application. For example, they should demonstrate a good creeping and an open time that is easy to calculate to allow a perfect positioning of the joints. They should also provide good adhesion on several substrates with an acceptable bonding time.

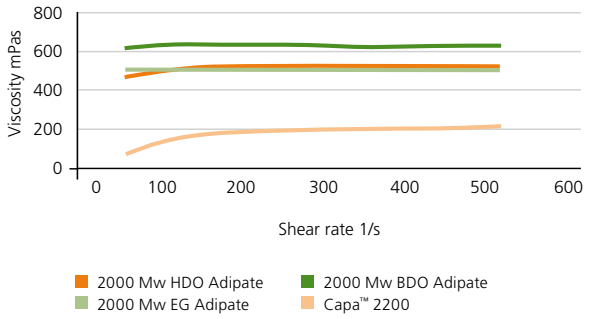
Perstorp's offer provides specialties to formulate successful solvent-based polyurethane adhesives with the use of Capa™ polyols, isocyanate monomers, Tolonate™ aliphatic isocyanates and alkoxylate liquid polyols.

Capa™ polyols – spearheading solvent-based adhesive performance

Capa™ polyols are particularly useful due to their wide range of molecular weight. Typical end-uses include laminated packaging, 3D lamination, bonding shoe soles and uppers, textile bonding, magnetic tapes, adhesive tapes, automotive interiors and exteriors.

Top benefits:

- Very good hydrolysis resistance
- Excellent low-temperature flexibility and wide working temperature range
- Excellent oil and UV stability
- Provides an excellent shear resistance
- Low viscosity for easy processing and reduced VOC



Tolonate™ polyisocyanates – cross-linkers of 1K & 2K solvent-based formulations

Our Tolonate™ range includes Tolonate™ D2, a blocked polyisocyanate for 1K heat activated formulations, and HDI derivatives (trimers and biurets of various functionalities) for 2K applications. They are used in adhesives for a range of fields such as flexible packaging, wood and furniture, automotive applications, footwear and sports goods.

Top benefits:

- Versatility/exceptional ability to stick different materials together
- Outstanding durability/long-lasting adhesion
- Non-yellowing upon ageing
- High transparency
- Low viscosity

	Tolonate™ HDB types (HDI biuret)	Tolonate™ HDT types (HDI trimer)
Lower VOC	•	••
Stability to dilution	•	•
Compatibility with polyols	+ with polyesters	+ with acrylics
Durability	•	••
Adhesion	••	•

Scuranate™ TDI & aliphatic isocyanate monomers – for durable & non-yellowing formulations

For the chemical synthesis of polyurethane pre-polymers, we offer Scuranate™ TDI grades with different mixtures of 2,4 and 2,6 isomers and the two main types of aliphatic isocyanates, HDI (Hexamethylene Diisocyanate) improving resin flexibility and IPDI (Isophorone Diisocyanate) offering superior hardness and chemical resistance.

Alkoxylate polyether polyols – promoting superior end performance

Our polyether polyols, alkoxylates, comprise a range of liquid polyols that are mainly used as reactive diluents for radiation curing systems. Alkoxylates reduce the viscosity of the formulated system to obtain the desired processing conditions and required properties. Alkoxylates create opportunities for demanding adhesives manufacturers to achieve specific performance benefits including improved wetting and adhesion to difficult substrates.

Our offer for:

Waterborne polyurethane adhesives

When low VOC emission is essential

When you are working in an area where the use of solvent-based adhesives is unfavorable or a potential risk, for example in sustainable design interiors or explosive risk zones, waterborne adhesives can provide a good solution. Waterborne adhesives have the environmental advantage of being either VOC-free or with very low VOC, thus contributing to a healthy and safe indoor environment.

Our offer for waterborne polyurethane adhesives includes our complete offer for the synthesis of aqueous polyurethane dispersions (PUDs), which includes Capa™ polyols as soft segments, Oxymer™ carbonate diols, HDI, IPDI, TDI monomers and the dispersion monomers Bis-MPA and Ymer™. In addition, we offer Easaqua™ WAT series of self-emulsifying polyisocyanates, which are used as cross-linkers of 2K waterborne polyurethane formulations. Applications for PUD adhesives include adhesives in footwear, wood products, furniture, automotive interiors and automotive exteriors.

Capa™ in waterborne adhesives – improving strength & flexibility

Capa™ polyols are widely used as the soft segments in aqueous polyurethane dispersions.

Top benefits:

- Good high-temperature resistance
- Controlled, consistent open time
- Wide temperature performance
- Good hydrolysis resistance
- Good bond strength

	Capa™ polyols	PTMEG	Butylene adipate
Compression set	+	– –	–
Tensile strength	+	–	+
Hydrolysis resistance	+	+ +	–
Oil resistance	+	–	+
Effective temperature range high	+	– –	–
Cold flex	+	+	–
Cut and tear	+	–	+
UV resistance	+	–	+
Viscosity	+	+	–
Polydispersity	+ +	–	–

* NEO: Neopentyl glycol; BDO: Butane diol
Performance benefits imparted to prepolymers and PUDs by soft segment polyols.

Oxymer™ – peak performance polyols

Oxymer™ polycarbonates grades offer all the advantages of conventional polycarbonate diols, including superior hydrolytic stability and outdoor durability. The Oxymer™ C grade displays the same advantages as the Oxymer™ M grade but with improved flexibility and adhesive properties.

Scuranate™ TDI, HDI & IPDI isocyanate monomers – essential building blocks for PU synthesis

TDI, HDI and IPDI monomers are widely used in PU pre-polymer (including PUDs) synthesis. IPDI shows excellent light and weather resistance and HDI, in addition, is of special interest due to its extreme flexibility. TDI is preferred for its faster reactivity compared to aliphatic isocyanates and is used when light-fastness is not required.

Bis-MPA & Ymer™ N120 dispersion monomers – easy formulation of waterborne PU resins

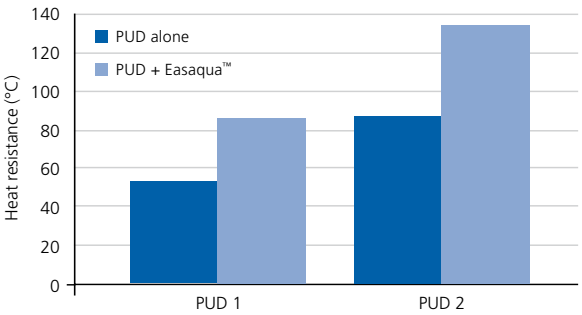
Perstorp offers dispersing monomers for both ionically and non-ionically stabilized PUDs. Bis-MPA is widely used in anionic PUDs in adhesives and typically makes up 2-3 wt% of a PUD-formulation. Ymer™ N120 provides non-ionic stabilization and can be built in along the polymer backbone to provide efficient non-ionic stabilization.

Easaqua™ series – easy waterborne solutions with aliphatic isocyanates

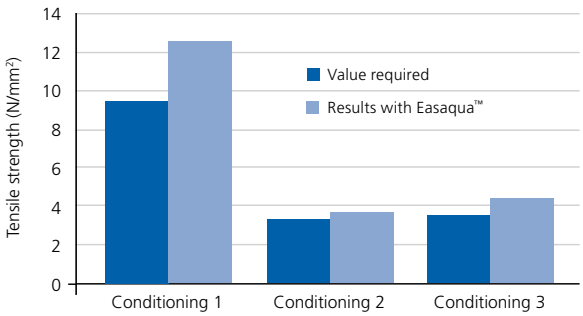
The Easaqua™ WAT series are self-emulsifying isocyanate cross-linkers for 2K waterborne polyurethane formulations or 1K waterborne stoving formulations (Easaqua™ WT 1000). Easaqua™ products are the environmentally-responsible choice for high performing, ultra low VOC and APEO-free formulations. Adhesives based on Easaqua™ can be used in for example wood and furniture, automotive applications, footwear and sports goods.

Top benefits:

- Compatible with a wide range of waterborne resins
- Excellent initial bonding strength => high productivity
- Long-lasting adhesion
- Non-yellowing performance upon ageing/high aesthetics
- Best-in-class for heat and humidity resistance



PUD + 3% Easaqua™ WAT-1 for Wood
HEAT RESISTANCE: adding Easaqua™ WAT products in PUDs greatly improves heat resistance.



Dispersion of VA homopolymer + 5% Easaqua™ X WAT-4
HEAT & HUMIDITY RESISTANCE: D4 class is obtained by adding Easaqua™ WAT products in waterborne resins.

Our offer for:

Thermoplastic & reactive hot-melt adhesives

The fast bonding challenge

Hot-melt adhesives are either reactive (i.e. moisture-cured or 2K) or thermoplastic. Due to their typical characteristics, they are reactivated by heat and bond fast. As no solvent is needed these adhesives provide a key advantage over solvent-based adhesives in terms of VOC content (volatile organic compounds), which is reduced or even eliminated.

Thermoplastic and reactive hot-melt adhesives are essential for products of daily use, for example in footwear, textile, automotive, packaging, wood, electronic applications and in many other fast growing segments. Perstorp's offer for thermoplastics includes various grades of Capa™. Please see the product data summary on p.10 for further information.

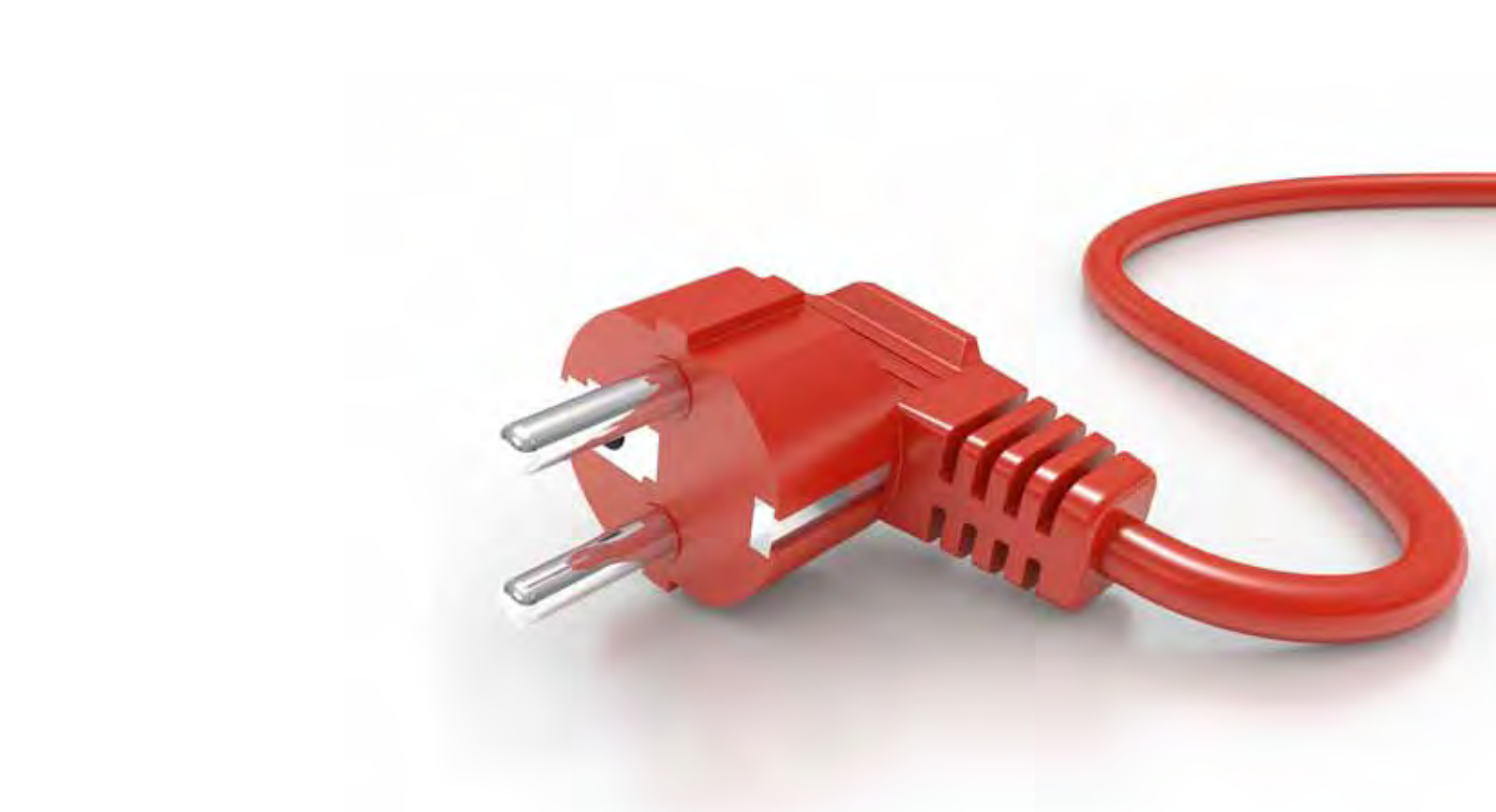
Capa™ thermoplastics – unique performance benefits for thermoplastic adhesives

Capa™ thermoplastic grades can be used either as 100% resin or combined with other polymers or fillers. Typical end-uses include hot-melt adhesives for non-wovens, binders for non-wovens, scatter coat interlining adhesives and toe and heel counters.

Top benefits:

- Low melt viscosity for ease of application and penetration into substrate
- Low Tg (-60 °C) good low temperature performance
- Excellent adhesion to leather and other greasy substrates
- Crystalline (50%), rigid polymer with high elongation
- Biodegradable and non-toxic

Capa™ can also be used in laminating adhesive film and in reactive hot-melt adhesives.



Our offer for:

Expandable sealants

Charmor™ – intumescent system for expandable sealants in fire protection

Intumescent systems are ideal as protective sealants in the construction industry and for fire resistant plastics in the electrical, electronics and transportation sectors. Expandable sealants based on Charmor™ form a char barrier to protect buildings and the people inside them. This barrier slows the spread of fire, reduces heat and minimizes dangerous smoke and fumes more effectively than any alternative products, facilitating safe evacuation and limiting structural damage.

The Charmor™ range ensures the ultimate performance and protection on surfaces including steel and wood. To learn more about Charmor™ for intumescent systems, please see the Charmor™ brochure.

Please discuss your requirements regarding formulations and properties with our specialists available on www.perstorp.com

Product data summary

Capa™ for solvent-based systems

	Type	Initiator*	Approx. MW	OH value (mg KOH/g)	Acid value (mg KOH/g)	Viscosity at 60 °C	Melting range (°C)
Capa™ 2302	Diol	BDO	3,000	37	< 0.25	1,100	50-60
Capa™ 2302A	Diol	BDO	3,000	37	< 0.05	1,100	50-60
Capa™ 2304	Diol	DEG	3,000	37	< 0.25	1,050	50-60
Capa™ 2402	Diol	BDO	4,000	28	< 0.25	1,670	55-60
Capa™ 3050	Triol	TMP	540	310	< 1.00	160	0-10

** BDO: Butane diol, DEG: Diethylene glycol, TMP: Trimethylpropane*

Capa™ in hot-melt & reactive hot-melt adhesives & laminating adhesive film

	Approx. MW	Delivery form	OH value (mg KOH/g)	Melt flow index*
Capa™ 6250	25,000	Granules	circa 5	9
Capa™ 6400	37,000	Granules	circa 4	40
Capa™ 6430	43,000	Granules	circa 5	13
Capa™ 6500	50,000	Granules	circa 2	7
Capa™ 6506	50,000	Powder	circa 2	7
Capa™ 6800	80,000	Granules	circa 1	3

** Measured with 1 "PVC die, 2.16 kg, g/min, at 80 °C for Capa™ 6250, 6400 and 6430 and at 160 °C for the other grades*

Capa™ in waterborne systems

	Type	Initiator*	Approx. MW	OH value (mg KOH/g)	Acid value (mg KOH/g)	Viscosity at 60 °C	Melting range (°C)
Capa™ 2200A	Diol	NEO	2,000	56	< 0.05	480	40-50
Capa™ 2302	Diol	BDO	3,000	37	< 0.25	1,100	50-60
Capa™ 2402	Diol	BDO	4,000	28	< 0.25	1,670	55-60
Capa™ 3050	Triol	TMP	540	310	< 1.00	160	0-10

** NEO: Neopentyl glycol, BDO: Butane diol, TMP: Trimethylolpropane*

Dispersing monomers

	Appearance	Functional groups	Hydroxyl number (mg KOH/g)	Molecular weight (g/mol)	Viscosity, mPas (°C)
Bis-MPA	Crystals	2 hydroxyl, 1 carboxyl	835	134.4	N/A
Ymer™ N120	Waxy	2 hydroxyl	110	1,000	60 (50)

Aliphatic isocyanate monomers

	Appearance	Isocyanate type	Color, APHA	Hydrolysable chlorine, ppm	Total chlorine, ppm
IPDI (Isophorone Diisocyanate)	Liquid	Cycloaliphatic	≤ 30	< 200	< 400
HDI (Hexamethylene Diisocyanate)	Liquid	Aliphatic	≤ 15	< 350	< 1,000

Aromatic isocyanate monomers

	Chemical description	Specific gravity 25 °C	Viscosity mPas 25 °C	Hydrolysable chlorides (%)	Total acidity (%)	Color APHA
Scuranate™ T80	TDI 80/20	1.22	3	< 0.007	< 0.0015	< 15
Scuranate™ T65	TDI 68/32	1.22	3	< 0.010	< 0.003	< 25
Scuranate™ T100	2,4 TDI	1.22	3	< 0.015	< 0.013	< 25
Scuranate™ TX	TDI 95/5	1.22	3	< 0.010	< 0.0010	< 30

Product data summary

Tolonate™ for solvent-based & solvent-free PU formulations

	Colour [1]	Viscosity [2] (mPas)	NCO [3] (%)	Free monomer (%)	Solids content (%)	Solvent type	Bulk density at 25 °C (kg/m²)	Flash point [4] (°C)	Equlvalent weight (g) (3)
Tolonate™ HDB	≤ 40	9,000±2,000	22.0±1.0	< 0.3	100	–	1,120	> 120	191
Tolonate™ HDB-LV	≤ 40	2,000±500	23.5±1.0	< 0.3	100	–	1,120	> 120	179
Tolonate™ X FD 90 B	≤ 60	2,000±1,000	17.4±0.6	< 0.5	90	B	1,130	48	240
Tolonate™ HDT	≤ 40	2,400±400	22.0±0.5	< 0.2	100	–	1,160	> 120	191
Tolonate™ HDT-LV	≤ 40	1,200±300	23.0±1.0	< 0.2	100	–	1,160	> 120	183
Tolonate™ HDT-LV2	≤ 40	600±150	23.0±1.0	< 0.5	100	–	1,131	> 120	182
Tolonate™ D2	≤ 40	3,250±750	11.2*	–	75±2	S	1,060	49	370

*[1] Hazen or APHA [2] at 25 °C [3] on delivery form [4] in closed cup, S: Aromatic hydrocarbon, B: Butyl acetate, * blocked NCO*

Waterborne aliphatic isocyanates

	Viscosity at 25 °C (mPas)	NCO (%)	Solid content (%)	APEO-free without nonyl phenol ethoxylate
Easaqua™ WT 1000	3,200	9.4	63	
Easaqua™ WAT	4,000	19.0	100	
Easaqua™ WAT-1	1,400	21.7	100	
Easaqua™ X WAT-3	1,150	21.5	100	•
Easaqua™ X WAT-4	4,000	18.6	100	•

Alkoxylates

	Functionality	Hydroxyl number (mg KOH/g)	Molecular weight (g/mol)	Viscosity (mPas, 23 °C)	Recommended application		
					General	Radcure	Polyurethane
Polyol R2395	2	395	276	350		•	•
Polyol R2490	2	490	220	170		•	•
Polyol 3165	3	165	1,014	350	•		•
Polyol 3380	3	380	444	360	•	•	
Polyol 3610	3	610	275	700			•
Polyol 3611	3	611	275	700			•
Polyol 3940	3	940	179	4,000			•
Polyol 3990	3	990	170	4,500	•		•
Polyol R3215	3	215	795	340	•	•	
Polyol R3430	3	430	398	400		•	
Polyol R3530	3	530	308	2,000	•	•	•
Polyol R3600	3	600	275	700		•	

Oxymer™ carbonate diols

	Appearance	Functional groups	Hydroxyl number (mg KOH/g)	Molecular weight (g/mol)	Viscosity, mPas (°C)	Polymer chemistry
Polycarbonate diols*						
Oxymer™ M112	Viscous liquid	2 hydroxyl	112	1,000	1,100 (75)	Polycarbonate
Oxymer™ C112	Viscous liquid	2 hydroxyl	112	1,000	1,500 (75)	Polycarbonate

** Development and exprimental products*

Charmor™ for expandable sealants

	Melting point (°C)	Water solubility (% at room temperature)	Typical hydroxyl number (mg KOH/g)	Density (kg/m³)	Particle size
Charmor™ PM	260	5.25	1,645	1,400	< 40 µm typ. 98%
Charmor™ PT	250	4.70	1,615	1,400	< 40 µm typ. 98%
Charmor™ DP	222	0.22	1,325	1,370	< 40 µm typ. 98%
Charmor™ PP100	170	0.2	1,050	1,320	< 250 µm

Your Winning Formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on 130 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. This is how we enable you to meet market demands for safer, lighter, more durable and environmentally sound end-products – for the aerospace, marine, coatings, chemicals, plastics, engineering, and construction industries, as well as automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Consistent high quality, capacity and delivery security are ensured through strategic production plants in Asia, Europe and North America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of smarter and safer products and sustainable processes that reduce environmental impact and create real value in new chemical applications. This principle of proactive innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

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Where to go for more information:

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