

OUR COMPANY, OUR PRODUCTS, OUR VISION

Our Company

LANXESS is a world leader in polyurethane technology, with an excellent reputation for innovation and problem solving. Our name is well-recognized and respected in the urethanes chemicals markets, where we supply products via a global network of established distributors and agents. We pride ourselves in maintaining and developing our business through customer intimacy, by forging close personal contacts at both commercial and technical levels. Emphasis is placed on understanding the market environment and responding quickly to customer needs, often by tailoring products and processes to match specific requirements.



■ **Trixene® BI products** used as crosslinkers for various OEM coatings in the automotive industry

Our Products

We manufacture a wide range of polyurethanes (in various solvents, as aqueous dispersions and as 100% solids), urethane intermediates, crosslinking agents and associated materials for surface coatings, textile and leather finishes, composites, adhesives, sealants and foam applications.

Trixene® blocked isocyanate (BI) products are mainly used as latent crosslinking agents and/or adhesion promoters in industrial coating processes. These include electrostatic spraying, curtain and coil coating, electrodeposition and other manufacturing techniques employing a heat curing cycle. They can be formulated to provide one-pack (1-K) systems with good storage stability, which can be activated under specific thermal or chemical conditions. We are an innovator and leading supplier of polyisocyanates blocked with 3,5-dimethylpyrazole (DMP) for such applications.



■ **Trixene® Aqua BI products** used in aqueous water-repellent finishes for the weatherproofing of garments

OUR VISION

- To be a leading supplier of polyurethanes, urethane intermediates and associated products to industry
- To be our customers' first choice for current & future requirements, as a committed and responsible supplier
- To offer solutions that meet our customers' needs through product differentiation and true innovation
- To invest in line with our customers' growth strategies, regulatory compliances and corporate responsibilities
- To provide a timely, responsive and reliable service through our global network of agents and distributors

■ **5 Trixene® Blocked Isocyanates** for Urethane Surface Coatings

LANXESS
Energizing Chemistry

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QUALITY PERFORMS.



Urethane Systems

Trixene® Blocked Isocyanates
for Urethane Surface Coatings

X Trixene®
Urethane Prepolymers

QUALITY WORKS.

LANXESS
Energizing Chemistry

OUR TECHNOLOGY, BLOCKING GROUPS, PRINCIPLES AND EXPERTISE

Our Technology

Polyfunctional isocyanates have been used in the coating industry as crosslinking agents and adhesion promoters for more than 50 years. They are renowned for their high reactivity and selectivity towards various functional polymers, and absence of side reactions and by-products. However, their reactivity also leads to severe drawbacks for use:

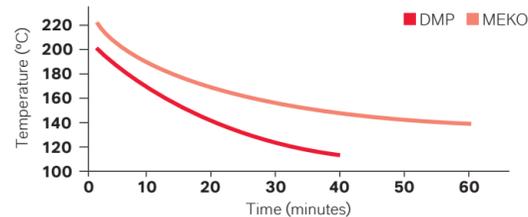
- Compounds containing multiple free isocyanate groups cannot be used in stable 1-K formulations
- Even freshly-mixed (2-K) systems can have severe pot-life issues, depending on ambient conditions
- They are highly sensitive to atmospheric moisture and traces of water e.g. in coating solvents/ingredients
- Free isocyanate compounds, especially diisocyanate monomers, can be extremely hazardous to health

Blocking technology was developed to overcome compounding limitations, and provide a safe working environment.

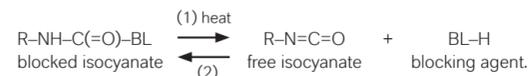
Blocking Groups

We manufacture a number of different combinations of polyisocyanates and blocking agents, in various solvents or aqueous dispersion. Customers can choose grades that meet their requirements, for example, in terms of suitable co-binder (e.g. hydroxyl or amine-functional, different polymer backbones), curing profile, method of application, end-use (e.g. primer or topcoat), substrate and regulatory compliance. Established blocking agents are tabulated below:

Blocking Agent	Unblocking Range (°C)	Melting Point (°C)	Boiling Point (°C)
ε-caprolactam (ε-CAP)	160–180	72	138
methylethylketoxime (MEKO)	140–160	-30	152
3,5-dimethylpyrazole (DMP)	110–120	106	218
diethylmalonate (DEM)	100–120	-50	199



Principles



The unblocking mechanism (1) is simply the reverse reaction of that used to manufacture the blocked isocyanate (2):

- Blocked isocyanate compounds are inert and non-hazardous at normal ambient temperatures
- They can be compounded into stable 1-K systems, stored and transported, and applied to the substrate
- The coating is dried, then cured at unblocking temperatures sufficient to liberate free isocyanate groups
- Transient free isocyanate groups react with hydroxyl or other functional groups on the co-binder polymer
- This leads to rapid crosslinking of the coating and/or increased covalent bonding with the substrate
- Freed blocking agent is either liberated as VOC, or as with DMP remains mainly trapped in the coating

Expertise

LANXESS pioneered and patented the use of DMP in solvent-based, waterborne and hybrid (DMP/DEM) blocked isocyanate systems. These products have proven advantages over other blocking technologies:

- They form coatings with improved resistance to chemical and environmental attack
- Better colour stability and resistance to yellowing, particularly on overbake and UV exposure
- Lower unblocking temperature and/or shortened dwell time, reducing energy requirements, see Graph below left.
- Reduced VOC emissions and less pinholing of coatings, due to lower volatility of blocking agent



TRIXENE® BLOCKED ISOCYANATES SELECTION GUIDE

We manufacture and supply an extensive range of blocked isocyanate crosslinkers, adhesion promoters and reactive prepolymers for the various coating industries. They are designed to unblock at specific curing temperatures and then react fully with other functional co-binders in the coating formulation. Key features include:

- Products delivered in solvent (with medium-high solids content) or as aqueous dispersions
- Chemical structures offering a range of flexibility, functionality and branching for the compounder
- A variety of blocking agents, allowing for unblocking temperature and cure speeds
- Compatibility and stability with co-binder components, e.g. many hydroxyl-functional resins
- Reaction stoichiometry that can be easily calculated from supplied data on equivalent weights
- Products that can be formulated for exceptional colour, colour retention and pigment tolerance
- Isocyanate monomer emissions during curing/unblocking that fall well below safety limits

Trixene® Blocked Isocyanates

These solvent-based grades are supplied mainly as crosslinkers for hydroxyl-functional resins (polyester, urethane, acrylic etc). They are typically formulated into 1-K coatings that are dried and cured under factory stoving conditions,

e.g. for OEM metal components used in the automotive and consumer goods industries. Generic products are listed below:

Trixene® No.	Isocyanate Type	Blocking Agent	Viscosity @ 25°C (mPAS)	Equiv. Wt. (as supplied)	Solids (%)	Solvent	Application
Aromatic Blocked							
BI 7641	TDI prepolymer	DMP	6,250	744	60	PMA/Xylene	Automotive, coil, Leather
BI 7642	TDI prepolymer	MEKO	25,000	737	60	PMA/Xylene	Coil, automotive, primer/base coat
BI 7674	TDI prepolymer	MEKO	<2,000	1135	58	PMA	Abrasive binder
BI 7675	TDI prepolymer	MEKO	<2,500	858	65	PMA	Abrasive binder
Aliphatic Blocked							
BI 7950	IPDI	DMP	1,200	567	65	PM	Automotive and coil coating
BI 7951	IPDI trimer	DMP	3,500	539	65	C9 Aromatic/BA	Automotive and coil coating
BI 7960	HDI biuret	DMP	1,100	410	70	PM/ethyl acetate	Coil and electrodeposition
BI 7961	HDI biuret	DMP	2,250	410	70	C9 Aromatic	Coil and electrostatic
BI 7963	HDI biuret	DEM	4,500	477	70	PM	Low temp curing or higher reactivity
BI 7982	HDI biuret	DMP	600	410	70	PM	Automotive and coil coating
Hybrid Aliphatic Blocked							
BI 7991	HDI biuret	DMP/DEM	2,000	456	70	PM	Automotive and coil coating
BI 7992	DI trimer	DMP/DEM	1,500	456	70	PM	Automotive and coil coating

Trixene® Aqua Blocked Isocyanates

Our new series of blocked isocyanate dispersions are designed for water-based 1-K and 2-K systems. They can be used as crosslinkers and adhesion promoters for coatings and finishes on textiles, leather, paper, certain plastics and films, as well as metals, glass and other hard substrates. The

current range includes anionic and nonionic types based on patented HDI trimer/DMP compounds. It provides a wide pH latitude for formulators and compatibility with a range of aqueous auxiliaries, co-binders, pigments and other additives.

Trixene® Aqua No.	Particle Type	pH Range (as supplied)	Viscosity @ 25°C (mPas)	Equiv. Wt. (as supplied)	Solids (%)	Solvent	Application
BI 200	anionic	7–8	100	933	40	NMP	Textiles and general coatings
BI 201	anionic	7–9	300	840	40	DPGDME	Textiles and general coatings
BI 220	nonionic	5–8	100	1000	40	Coasol	Textiles, leather, glass, paper

Trixene® Blocked Isocyanate Prepolymers

These products differ from standard blocked isocyanate crosslinkers by incorporating a more labile blocking agent. It allows them to cure by a chemical mechanism under ambient conditions, rather than by thermal dissociation at elevated temperatures. Their main application is to improve the flexibility, elongation and impact resistance of epoxy

coatings, without compromising chemical resistance. Our blocked prepolymers readily react with standard amine hardeners used in 2-K epoxy resin formulations. As such, they can be used to replace part of the epoxy resin component to achieve this desired increase in performance.

Trixene® No.	Isocyanate Type	Blocking Agent	Viscosity @ 25°C (mPAS)	Equiv. Wt. (as supplied)	Solids (%)	Solvent	Application
BI 7770	TDI	nonyl-phenol	68,000	1860	100	none	Epoxy flexibiliser
BI 7771	TDI	nonyl-phenol	80,000	1750	100	none	Epoxy flexibiliser
BI 7772	TDI	nonyl-phenol	35,000	2300	100	none	Epoxy flexibiliser
BI 7774	TDI	cashew-phenol	40,000	1945	100	none	Epoxy flexibiliser
BI 7779	TDI	nonyl-phenol	30,000	2170	90	dioctyl adipate (10%)	Epoxy flexibiliser

Trixene® Developments

Our R&D effort focuses on the health, safety and environmental impacts of polyurethane technology, as well as on purely technical advances. Primary aims are to minimize hazards associated with free isocyanates, reduce VOC emissions and to lower the energy requirements of typical processes for manufacturing and using our materials. Trixene® developments fit well into this concept on all counts.

In addition to standard Trixene® BI grades listed in the Tables above, we usually have a number of experimental products

at different stages of evaluation. Customers can keep abreast of these activities through their normal service channels, or by registering their interest using contact details provided on the back of this brochure. Data provided in the Tables above are characteristic of the product grade, and do not constitute a specification. Further information is given in technical and material safety data sheets for individual Trixene® BI products. Samples, supplementary data, formulating advice and papers/presentations giving further details of our blocked isocyanate chemistry can often be supplied on request.