

HUNTSMAN

Enriching lives through innovation



COATINGS

Polyurethane Spray Technology



SUPRASEC® MDI

FOR PROTECTIVE SYSTEMS



Your profit and success with SUPRASEC® MDI

Huntsman Polyurethanes is one of the world's leading producers of diphenylmethane diisocyanate (MDI).

The company has been at the forefront of this specialist polyurethane technology since pioneering it 40 years ago and today offers an extensive portfolio of MDI-based products. This range includes the highest quality grades of polymeric and pure MDI, together with many variants and prepolymers tailor-made for specific uses in rigid and flexible foams, adhesives, coatings, elastomers and composite wood products.

Applications

Coatings based on Huntsman technology vary from paints where aesthetics in combination with adhesive properties and durability are paramount, through heavy duty protection for bridge and car park surfaces, to protective finishes for metal and concrete, pipelines, truck bed liners and other end-uses.

These high performance materials are to be found in many different sectors including aircraft, automotive, building, and civil engineering, commercial vehicles, electrical and electronic industry, general industry and maintenance, marine/offshore, plastics, textile/leather, wood and furniture.

SUPRASEC® products for polyurethane spray technology

Polyurethane spray technology is used for industrial applications such as belting for mining, pipe linings for handling abrasive slurries and as protective membranes in building. The combination of toughness and high elasticity with the capability of forming seamless membranes is particularly useful in buildings where spray coatings are used to seal insulated flat roofs. It provides a solvent-free 'thick coating', which combines excellent physical properties, including crack bridging and waterproofing properties as well as abrasion and chemical resistance.

Spray coatings have a high curing speed, high liquidity and can be applied under lower temperature conditions.

SUPRASEC® MDI-based, solvent-free formulations for polyurethane spray coatings provide a favourable cost/performance ratio and can be an alternative to polyurea coatings for several applications, including tank coatings, bridges, flat roof repair, roof coatings, secondary containments and truck bed liners.

Processing of polyurethane spray coatings requires experienced applicators and specialised equipment. Spraying can only be done under dry conditions with the right substrate temperature. Formulators can supply the technical service support and work with their applicator customers to supply materials that are designed to meet the specific needs of those applications. An important element in adhesion of coating is the type and condition of the surface. Clearly, good surface preparation can improve adhesion and either cleaning the surface to remove contamination, or priming or roughening to activate the surface, should provide a good surface for chemical or mechanical bonding. Specific preparation may depend on the exact substrate i.e. concrete, metal etc.

Definition and chemistry

The urethane coatings chemistry can be divided into three subsegments: Each segment deals with systems which can be aromatic, aliphatic, or a blend of both aromatic and aliphatic. Pigments, fillers, solvents and/or additives can be introduced to all of them.

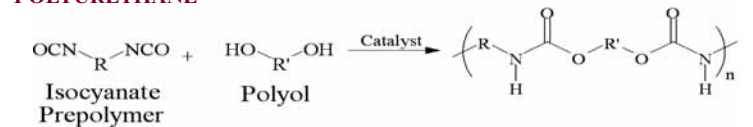
1. Polyurethane coatings

A purely polyurethane coating is the result of a reaction between an isocyanate component and a resin blend made with only hydroxyl-containing resins. The final coating film will contain no intentional urea groups. A polyurethane system will most probably contain one or more catalysts.

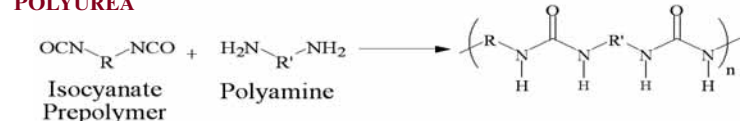
2. Polyurea coatings

A polyurea coating is the result of a one-step reaction between an isocyanate component and a resin blend component. The isocyanate can be monomer based, a prepolymer, a polymer or a blend. For the prepolymer, amine- and/or hydroxyl-terminated resins can be used. On the other hand, the resin blend should only contain amine-terminated resins and/or chain extenders and not any hydroxyl reactive polymer component.

POLYURETHANE



POLYUREA





3. Hybrid polyurethane/polyurea coatings

A polyurethane/polyurea hybrid coating has a composition which is a combination of the above-mentioned two coating systems. The isocyanate component can be the same as for the “pure” polyurea systems. The resin blend is a blend of amine-terminated and hydroxyl-terminated polymer resins and/or chain extenders. The resin blend may also contain additives, or non-primary components. To bring the reactivity of the hydroxyl-containing resins to the same level of reactivity as the amine-terminated resins, the addition of one or more catalysts is necessary.

SUPRASEC® products for polyurethane spray coatings

A-side	B-side
MDI-prepolymers - European product range: SUPRASEC® 2445, 2026, 2237 - For higher flexibility : SUPRASEC® 2445 - For higher hardness: SUPRASEC® 2237	Polyether polyols Daltoce® F 435, F 428
	Chain extenders: - help control cross linking and the rate of reaction - impact on heat stability of the cured film
	Additives: Catalysts: to control the reaction rate and end-cure Water scavengers: to capture residual water in raw materials.

Limitations:

- Cannot be applied in humid conditions
- Sagging at vertical substrates
- Substrate temperature dependent
- Investment in equipment is required
- Experienced applicators are needed

Product properties

Product	NCO value (%)	Viscosity at 25°C (mPa.s)
SUPRASEC® 2445	16.0	1000
SUPRASEC® 2026	21.4	450
SUPRASEC® 2237	22.5	850

Individual product and safety data sheets are available on request.

Typical properties of polyurethane and their test methods.

	Unit	Test method
Reactivity		
Gel time	sec.	Manual
Tack free time	sec.	Manual
Physical Properties		
Tensile @break	N/mm ²	DIN 53504
Elongation @break	%	DIN 53504
Angle tear	N/mm	DIN 53515
Trouser tear	N/mm	DIN 53507
Hardness	Shore A	DIN 53505
	Shore D	DIN 53505

Starting formulations

1. Standard base flexible formulation

Isocyanate	SUPRASEC® 2445	100	pbw
Resin blend	Balanced polyether polyol	70 - 80	pbw
	Glycol chain extender	5 - 10	pbw
	DETDA	2 - 5	pbw
	Gel catalyst	0.5	pbw
	End cure catalyst	0.1	pbw
	Molecular sieves	3 - 5	pbw
Properties	Gel time	6	sec.
	Tack free time	15	sec.
	Tensile @break	8	MPa
	Elongation @break	300	%
	Angle tear	25	N/mm
	Hardness	75	Shore A
		20	Shore D
Processing	Index	1.05	
	Ratio isocyanate/resin	1.00	v/v

2. Standard high hardness protective formulation

Isocyanate	SUPRASEC® 2237	100	pbw
Resin blend	Blended polyether polyol	70 - 80	pbw
	High fn polyol	15 - 20	pbw
	Glycol chain extender	0 - 5	pbw
	End cure catalyst	0.1	pbw
	Molecular sieves	3 - 5	pbw
Properties	Gel time	8	sec.
	Tack free time	16	sec.
	Tensile @break	20	MPa
	Elongation @break	55	%
	Angle tear	50	N/mm
	Hardness	96	Shore A
		55	Shore D
Processing	Index	1.05	
	Ratio isocyanate/resin	1.00	v/v



Spray conditions

The most important element of handling polyurethane coatings is the mixing. Good mixing will be obtained in a suitable mixing module by impingement with mechanical purge. Operational pressure and temperature of the products will also help to optimise the mixing efficiency. Because of the high cure speed of spray systems and the short mixing time, the products are mixed by impingement at high pressure. Certainly for field applications, it is preferable to formulate the products on a fixed 1:1 volume-mixing ratio. The pressure used in the field will vary between 110 and 150 bar. The viscosity of the products at application temperature ideally needs to be lower than 100 mPa.s and the viscosity of the two components needs to be of the same level. The viscosity of the resin blend at 25°C is of approximately 700 mPa.s, dropping well below 100 mPa.s at application temperature. Experiments have proven that polyurethane films produced at 45°C, 60°C and 80°C have different properties. Increasing temperature in general improves the properties but also the liquidity. As there are fewer or no amine groups available in these systems, the viscosity build-up is much slower. Therefore, applications on a vertical substrate are more challenging due to sagging and dripping. The new spray equipment allows different temperature settings for the two components, ensuring an optimum mixing in the spray head. The spraying equipment has improved significantly. New features are:

- separate temperature settings for both components;
- easier variable ratio settings;
- easy output control;
- easy monitoring of application parameters.

The index of a polyurethane system is typically kept at a slight over-index of the isocyanate in the range of 1.05-1.10. As the isocyanate group reacts to humidity, the excess isocyanate compensates for the 'loss' of isocyanate groups during storage and/or application. The film properties for 1:1 volume ratio sprayed system were measured for an index variation between 0.90

and 1.15. The test results indicated that the film performs best at an index of 1.05 and higher. Below an index of 1.05 the results can vary significantly and become unpredictable, even for an index shift of 0.2.

Surface Preparation

An important element in adhesion of coating is the type and condition of the surface. Clearly, good surface preparation can improve adhesion and either cleaning the surface to remove contamination, or priming or roughening to activate the surface, should provide a good surface for chemical or mechanical bonding. Specific preparation may depend on the exact substrate i.e. concrete, metal.

Huntsman innovation and customer-focused partnerships

As an acknowledged market leader, Huntsman Polyurethanes has been instrumental in advancing the use of MDI-based coating technologies. We offer a range of modified MDI specialties to address specific demands.

We have a deep understanding of the chemistry and, through a policy of continuous innovation, are able to offer a high level of proactive support to formulators. Such assistance encompasses not only the choice of chemical components but also advice on formulating, processing and handling.

By offering fast, responsive service through direct communication and feedback, our specialist teams are helping customers not only to meet a very wide variety of demands and to solve difficult technical problems quickly, but also to open new markets by providing innovative solutions for currently insoluble applications.

HUNTSMAN

Enriching lives through innovation

Huntsman Polyurethanes is committed to your business and can offer fast and flexible response to your needs

Believing in confidential dialogue, we offer direct links into the laboratories with full technical backup. Commercial support and dedicated customer service is available throughout Europe, Asia and the US.



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The Huntsman story

Global resources for local needs

Huntsman Polyurethanes is a business division of Huntsman Corporation. Huntsman is a global manufacturer and marketer of differentiated chemicals. Its operating companies manufacture products for a variety of global industries including chemicals, plastics, automotive, aviation, textiles, footwear, paints and coatings, construction, technology, agriculture, health care, detergent, personal care, furniture, appliances and packaging. Originally known for pioneering innovations in packaging, and later rapid and integrated growth in petrochemicals, Huntsman today has 14,000 employees and 78 operations in 24 countries. The company had 2006 revenues of over \$ 13 billion.

Huntsman Polyurethanes warrants only that its products meet the specifications agreed with the buyer. Typical properties, where stated, are to be considered as representative of current production and should not be treated as specifications.

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Products may be toxic and require special precautions in handling. The user should obtain Safety Data Sheets from Huntsman Polyurethanes and Huntsman Performance Products containing detailed information on toxicity, together with proper shipping, handling and storage procedures, and should comply with all applicable safety and environmental standards.

Hazards, toxicity and behaviour of the products may differ when used with other materials and are dependent on the manufacturing circumstances or other processes. Such hazards, toxicity and behaviour should be determined by the user and made known to handlers, processors and end users.

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