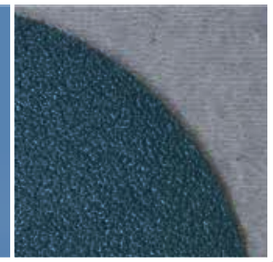
HUNTSMAN

Enriching lives through innovation

VITROX® ABR

Adhesives for abrasive applications



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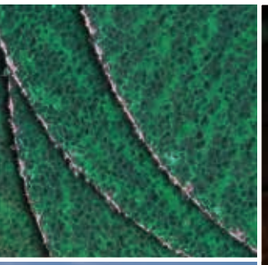
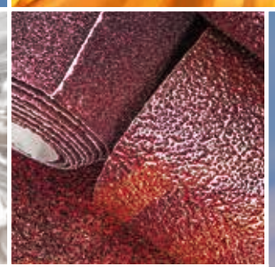
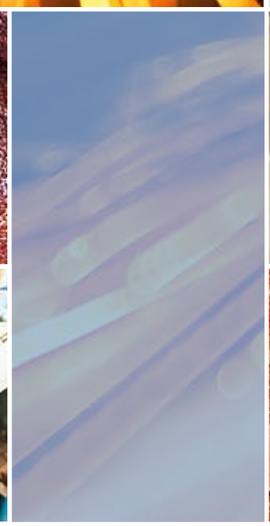
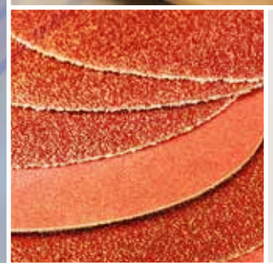
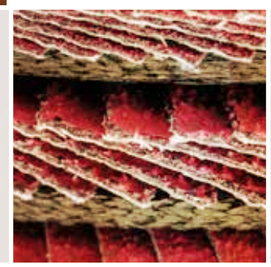










About us

Huntsman Polyurethanes is a division of Huntsman Corporation, a global manufacturer of differentiated chemicals that are used every day, in an array of industrial and consumer applications.

Helping to solve major design, manufacturing and sustainability challenges, our polyurethane chemistries are utilized in many different markets worldwide.

In the adhesives industry we apply our expertise in methylene diphenyl diisocyanate (MDI) chemistry to the development of polyurethane components, products and systems that can improve the production and performance of a range of bonding agents.

This know-how extends to the abrasives industry via our family of VITROX® ABR adhesives. Utilized as the main binding ingredient in abrasives, VITROX ABR adhesives can help make the manufacturing process more flexible, time efficient and cost effective – without compromising quality, performance or longevity.

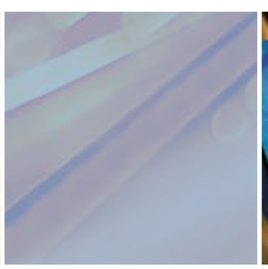
MEMBER OF FEPA
FEDERATION • OF • EUROPEAN PRODUCERS • OF • ABRASIVES

Actively engaged in the abrasives industry

Our commitment to the abrasives industry is reflected in our membership of the Federation of European Producers of Abrasives (FEPA). As an active participant in this professional body we are dedicated to engaging with decision makers throughout the abrasives value chain to develop a cohesive approach to standardization issues as well as environment, health and safety matters.

FEPA welcomes organizations and groups of manufacturers that have as their object the encouragement of technical or scientific research in the field of the manufacture or conversion of abrasive products. These organizations and companies, whose collaboration can be beneficial to the aims of the Federation and of its members, can join as Associated Members of FEPA.

Frank Verguet, General Secretary



VITROX ABR adhesives

VITROX ABR adhesives are a family of specialty, two-component resins. Free from hazardous classified solvents they can radically simplify the production of abrasive products.

Used to firmly bind mineral and synthetic grains to backing materials and webs, VITROX ABR adhesives can give manufacturers greater control over resin-related steps in the abrasive production process.

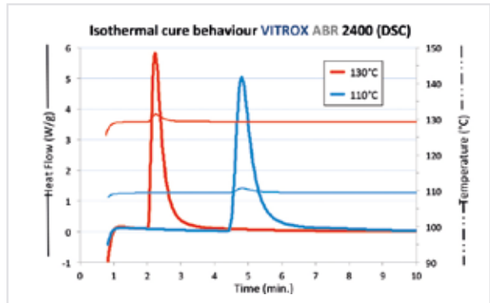
Characterized by a tunable set of mechanical properties, VITROX ABR adhesives can be adapted to meet a wide range of production parameters. With the ability to fine-tune resin reactivity, abrasive products manufacturers can optimise productivity and ensure a consistent, quality finish.

Key features include:

- **An adjustable open time:** The pot life of VITROX ABR adhesives can be tuned from just a few minutes to several hours depending on requirements. The result is a more precise production process and less wastage in the event of line stoppages.

- **Variations in viscosity and hardness:** With low to high viscosity, and rigid to flexible options available, VITROX ABR adhesives can be optimized to suit different materials, application techniques and processing conditions.

- **A fast fix:** VITROX ABR adhesives have snap cure capabilities that can save abrasive manufacturers time and money. The snap cure of VITROX ABR adhesives is triggered at 110°C to 130°C. This can help increase production throughput and reduce or even eliminate the amount of time that abrasives have to spend in energy intensive ovens – helping to cut costs further.

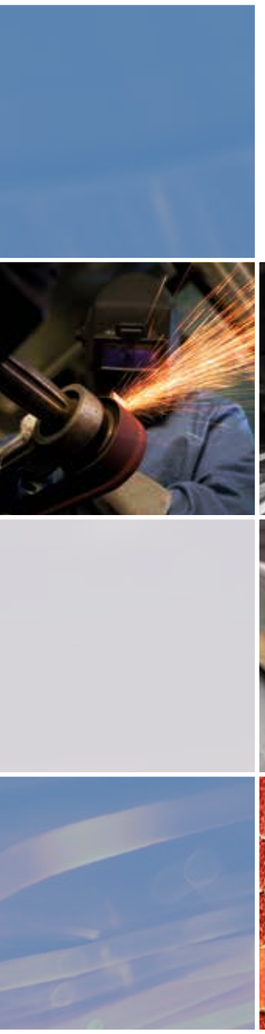


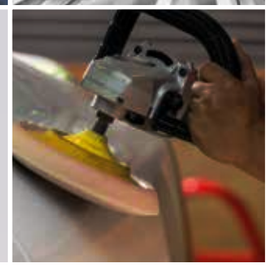
This graph, measured with differential scanning calorimetry (DSC), shows exothermic curing peaks – demonstrating the reactivity of the two-component system, VITROX ABR 2400, upon exposure to a constant curing temperature of 110°C to 130°C. The sharp profile of the peaks shows fast curing and excellent conversion of the VITROX ABR system.

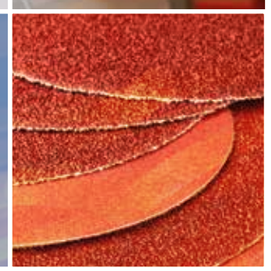
DSC is a thermo-analytical technique in which the difference in the amount of heat required to increase the temperature of a sample and a reference is measured as a function of temperature. Both the sample and the reference are maintained at nearly the same temperature throughout the experiment. The basic principle underlying this technique is that when the sample undergoes a physical transformation, such as a phase transition from liquid to solid state upon curing, more or less heat will need to flow to it than the reference to maintain both at the same temperature.

Benefits

VITROX ABR adhesives are easy to work with and offer a number of processing, performance and cost benefits.







Processing

- Excellent wetting and bonding to various substrates and grits
- Tunable open-time and fast cure
- Tunable viscosity (low, medium, high)
- Excellent tackiness
- Ease of process and production flexibility
- Increased throughput
- Robust technology
- Processable on existing lines
- Long shelf life of components.

Performance

- Excellent durability
- High temperature stability, no smearing
- Hardness and toughness combined
- Water resistance
- Easy coloring.

Cost

- Energy savings
- Reduction in working capital and storage costs
- Waste reduction
- No solvent recycling required
- Capex minimization (cost & time).

EHS

- Free of hazardous classified solvents
- REACh compliant.

Applications

VITROX ABR adhesives can be used to create abrasive products in a range of formats; from coarse materials for portable or stationary equipment for heavy-duty projects; to lightweight abrasives for polishing the surface of delicate substrates. Examples include:

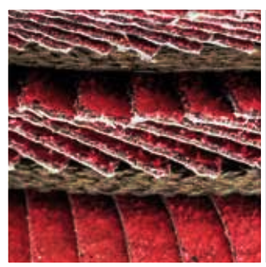
- Metal
- Wood
- Leather
- Glass
- Ceramic
- ...

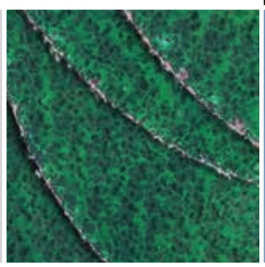
Adhesives based on our VITROX ABR technology can be used to bind different grits and grains to assorted backing materials using a variety of standard techniques. Compatible materials include:

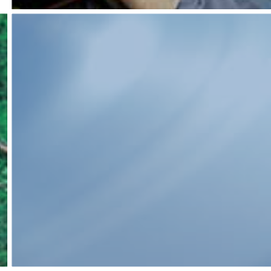
- Paper
- Fabric
- Non-woven
- Film
- ...

All kinds of grits and grains will adhere to VITROX ABR adhesives including:

- Aluminium oxide
- Silicon carbide
- Diamond
- Cubic boron nitride (CBN)
- ...







Systems

Characteristics

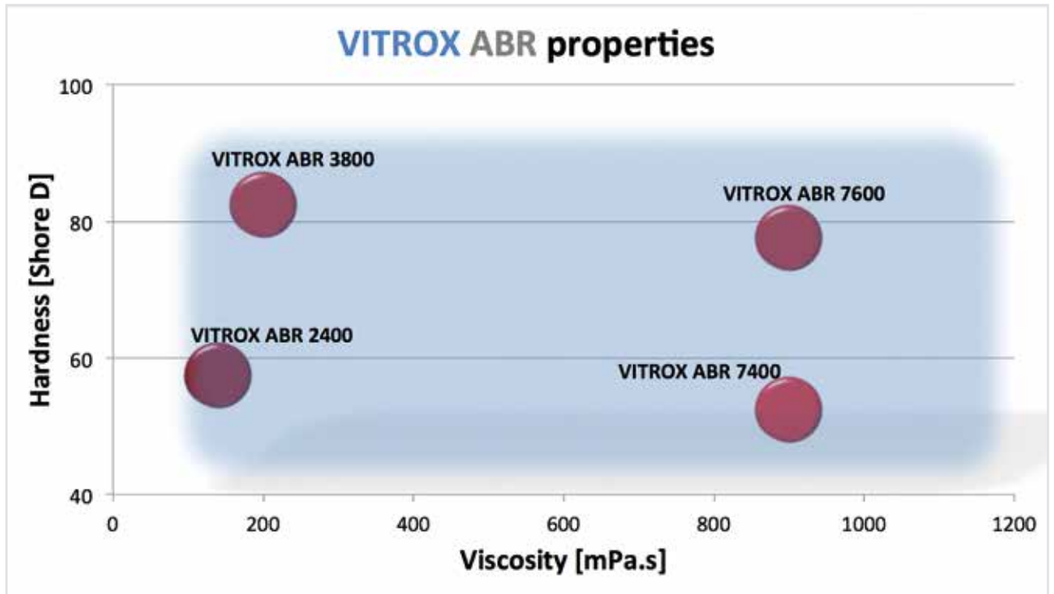
- Two component systems
- Mixing ratio: 1/1 up to 4/1
- Tunable from low to high viscous, rigid to flexible
- Pot life tunable from a few minutes to several hours
- Heat curing mechanism triggered at 110°C to 130°C
- No need for long post-cure cycles.

Product range

Currently, there are four systems available in the VITROX ABR range:

- VITROX ABR 2400 – low viscosity, flexible
- VITROX ABR 3800 – low viscosity, rigid
- VITROX ABR 7400 – high viscosity, flexible
- VITROX ABR 7600 – high viscosity, rigid.

Properties



Customized grades can be developed on request.

VITROX ABR - System properties: overview*

	Curing time neat resins @ 130°C (mins)	Viscosity @ 25°C (mPa.s)	Hardness (Shore D)
VITROX ABR 2400	< 10	140	55-60
VITROX ABR 3800	< 10	200	80-85
VITROX ABR 7400	< 10	900	50-55
VITROX ABR 7600	< 10	900	75-80

*Typical values

VITROX ABR - System processing: overview*

Comp A	Comp B	Mix ratio A/B pbw**	Pot life @ 25°C 100gr (hr)	Viscosity A @ 25°C (mPa.s)	Viscosity B @ 25°C (mPa.s)
VITROX ABR 2400 A	VITROX ABR 2400 B	50/50	> 4	25	100
VITROX ABR 3800 A	VITROX ABR 3800 B	80/20	> 4	25	1150
VITROX ABR 7400 A	VITROX ABR 7400 B	40/60	> 4	25	500
VITROX ABR 7600 A	VITROX ABR 7600 B	60/40	> 4	25	1100

*Typical values ** pbw = part by weight

Research & development

At Huntsman we are committed to investing in research and development to ensure that the products we develop meet the needs of our customers and can be processed extremely efficiently. At our Everberg R&D center we have installed a brand new pilot line. Our highly skilled technical teams are also available to collaborate with customers who have a specific request to fulfill or a complicated manufacturing challenge to overcome.

- **Supporting customers with tailor-made solutions**
- **Committed to long-term partnerships**
- **Offering in-house customer prototyping**
- **Supporting customers with dedicated training.**

About VITROX chemistry

Huntsman's VITROX technology is an award-winning, polyurethane chemistry with snap-cure capabilities and an adjustable pot life. Proven to deliver resins with an adaptable handling window, a fast curing time and high temperature resistance properties, VITROX products have the potential to disrupt the status quo in a variety of applications where new levels of innovation and functionality are required. As well as offering abrasive products manufacturers the chance to achieve new production, processing and cost efficiencies, different variants of our VITROX chemistry have been used to great success in various industries. For example, this novel chemistry has found application in the trenchless technology sector, where it has been used to repair cracked water and sewage pipes from the inside out – removing the need to dig up roads and pavements, which can prove both costly and disruptive in busy towns and city centers.

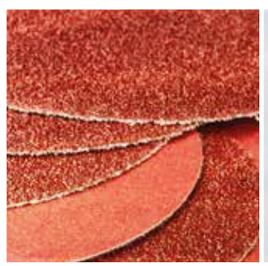
Sustainability

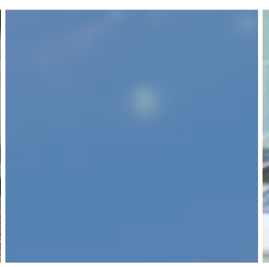
Sustainability is a fundamental part of Huntsman's corporate and business strategies. At corporate level we have a sustainability office and a sustainability leadership council to coordinate work across our five business divisions, and develop and distribute an annual corporate sustainability report. We are also a signatory to the United Nations Global Compact and have committed to making ten principles in the areas of human rights, labor, environment and anti-corruption an integral part of our strategy, culture and day-to-day operations.

At an individual business level, our Huntsman Polyurethanes team is focused on the research and development of new products to help tackle society's sustainability challenges. Together with our customers we focus on creating MDI-based solutions that can help conserve energy, cut the consumption of precious natural resources, and improve overall comfort and well-being – contributing to a more sustainable society.

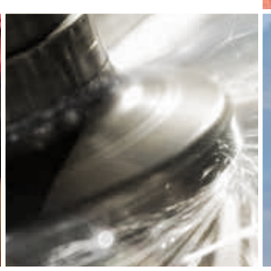
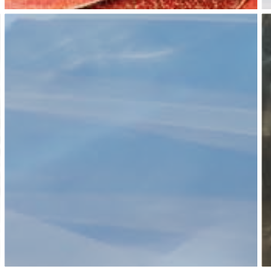
This work runs in parallel to implementing operational eco-efficiency initiatives at each of our office and manufacturing locations worldwide. We use the United Nations 2030 Sustainability Goals as an inspiring framework and apply life cycle thinking to improve the environmental performance of our products.

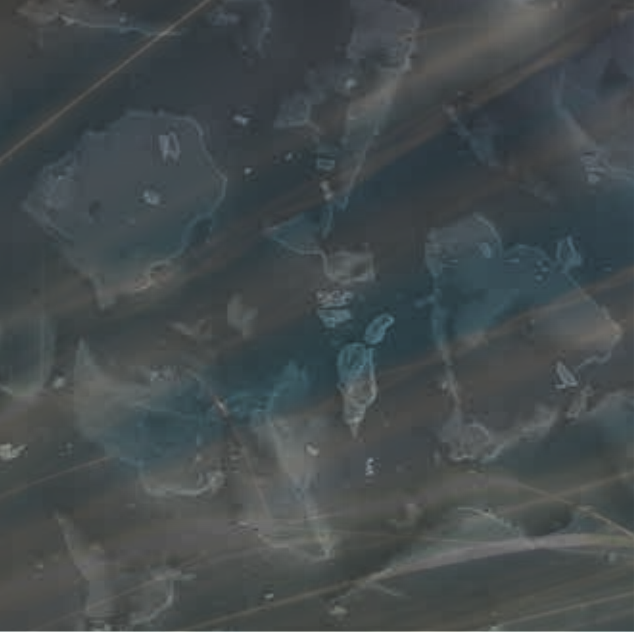
Integrated within our polyurethanes business we also have a group of issue management experts who monitor and analyze emerging environmental, health and safety issues. Their job is to understand the opportunities and risks in our industry and in the markets that we operate in. This helps ensure that our long-term business strategies are aligned with the legislative needs of our customers and the wider ambitions of the polyurethanes industry at large.

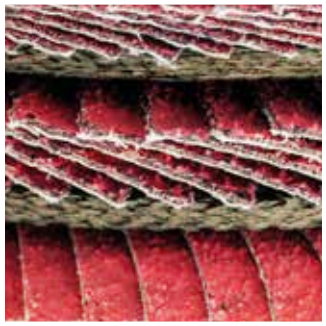


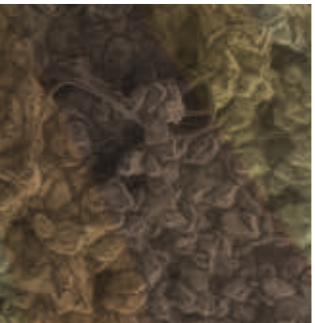









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About Huntsman:
Huntsman Corporation is a publicly traded global manufacturer and marketer of differentiated chemicals with 2015 revenues of approximately $10 billion. Our chemical products number in the thousands and are sold worldwide to manufacturers serving a broad and diverse range of consumer and industrial end markets. We operate more than 100 manufacturing and R&D facilities in approximately 30 countries and employ approximately 15,000 associates within our 5 distinct business divisions. For more information about Huntsman, please visit the company's website at www.huntsman.com.

www.huntsman.com/polyurethanes