LAPOX®

Atul

CONSTRUCTION

EPOXY RESINS, CURING AGENTS AND REACTIVE DILUENTS

Energising possibilities...
Stimulating growth...

LEGACY

Founded in 1947 by a legendary Indian, Kasturbhai Lalbhai, Atul Ltd (Atul), is amongst the first companies of independent India. It has the distinction of being the first private sector company of India to be inaugurated by the first Prime Minister of the country, Pandit Jawaharlal Nehru. It is part of the Lalbhai Group, one of the oldest diversified business houses of the country engaged in manufacturing since 1896. Ever since its inception, Atul has been committed to serving society, particularly in the areas of education, empowerment, health, relief, infrastructure and conservation.

PROFILE

The first site of Atul, spread over 1,250 acres of land, houses one of the largest and the greenest chemical complexes of its kind in the world. Starting with just a few textile dyes, the Company now manufactures 900 products and 450 formulations, managing complex chemical processes in a responsible way. It has also established fruitful and time-tested collaborations with leading multinational companies of the world.

Atul serves customers belonging to diverse industries including Adhesives, Agriculture, Animal Feed, Automobile, Composites, Construction, Cosmetic, Defence, Dyestuff, Electrical and Electronics, Flavour, Food, Footwear, Fragrance, Glass, Home Care, Horticulture, Hospitality, Paint and Coatings, Paper, Personal Care, Pharmaceutical, Plastic, Polymer, Rubber, Soap and Detergent, Sports and Leisure, Textile, Tyre and Wind Energy. In order to enhance customer focus, the Company has divided its product portfolio into seven businesses - Aromatics, Bulk Chemicals and Intermediates, Colors, Crop Protection, Floras, Pharmaceuticals and Intermediates and Polymers, and has established subsidiary companies in the USA, the UK, China, Brazil and the UAE.

PURPOSE

We are committed to significantly enhancing value for our Stakeholders by:

- fostering a spirit of continuous learning and innovation
- adopting developments in science and technology
- providing high quality products and services, thus becoming the most preferred partner
- having people who practice values and exemplify a high standard of behaviour
- seeking sustained, dynamic growth and securing long-term success
- taking responsible care of the surrounding environment
- improving the quality of life of the communities we operate in

POLYMERS BUSINESS

Epoxy resins, reactive diluents and curing agents are manufactured and marketed under the trade name 'Lapox®' by the Polymers Business of Atul. The manufacture of epoxy systems began in 1960 in Cibatul Ltd, a joint venture between the erstwhile Ciba-Geigy (Switzerland) and Atul. Following the disintegration of Ciba-Geigy, Cibatul was merged into Atul in 1999.

The state-of-the-art manufacturing facilities for these products are located in Atul complex, 200 km north of Mumbai. In addition to its leadership position within India, Polymers also sells to discerning customers outside the country. The Business has been awarded ISO 9001:2008 and ISO 14001.

Epoxy product range

Resins

Bisphenol-A and Bisphenol-F based resins
Cycloaliphatic resins
Epoxy phenol novolac resins
Modified and formulated resins
Multifunctional resins

Curing agents

Aliphatic amines and their adducts
Aromatic amines and their adducts
Cycloaliphatic amines and their adducts
Phenalkamines
Polyamides and Polyamidoamines

Reactive diluents

Aliphatic and Aromatic (mono, di and trifunctional)

Accelerators and catalysts

Tertiary amines

Industries served

Adhesives
Aerospace and Defence
Automotive
Composites
Construction
Electrical and Electronics
Food and Beverage packaging
Marine
Paint and Coatings
Sports and Leisure
Transport
Wind Energy

Lapox® range of products for construction

Atul's epoxy systems are designed to achieve high performance in the construction industry for various applications including:

Chemical resistance floorings and coatings
Crack-filling
Grouting
Repair and rehabilitation
Waterproofing

LAPOX® PRIMER SYSTEMS

Epoxy primers are applied before the screed and top coat. Epoxy systems must be carefully selected as the primer acts as an interface between the concrete and epoxy screed. Atul offers several primer systems with varying mix viscosity, pot life and curing time along with excellent substrate wetting and moisture resistance.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Colour (Max)	Recommendations
	Parts by weight	mPa s	minutes	Gardner	
B-11 / AH-543	100 : 66	4,500 - 5,500	40 - 50	Resin : 1 Curing agent : 10	This system cures at very low temperatures in high humidity, including moist surfaces.
B-47 / AH-546	100 : 50	3,000 - 4,500	60 - 80	Resin : 1 Curing agent : 10	Standard system suitable to perform in extreme conditions, including moist surfaces.
B-47 / AH-713	100 : 50	3,500 - 4,500	110 - 130	Resin : 1 Curing agent : 10	Recommended for all substrates. Faster curing can be achieved after addition of 3 - 5% of AC-14.
B-47 / AH-714	100 : 50	600 - 1,000	130 - 150	Resin : 1 Curing agent : 10	Low viscosity primer system for general applications.

[1]Brookfield viscosity
[2]Pot life of 100 g mix mass

LAPOX® MORTAR AND SCREED SYSTEMS

A thick layer of about 3 - 6 mm of mortar is laid on top of partially cured primer. Mortar is used to achieve load bearing properties on floorings. High filler loading and appropriate curing are major properties to be considered before selection of epoxy systems. Atul offers a wide range of epoxy systems for general purpose and heavy duty floorings to achieve an excellent combination of properties.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Colour (Max)	Recommendations
	Parts by weight	mPa s	minutes	Gardner	
ARPN-54 / AH-351	100 : 30	5,000 - 7,000	25 - 35	Resin : 3 Curing agent: 3	Fast reactive system for excellent chemical resistance to concentrated acids and alkalis.
ARPN-54 / K-41 / K-42	100 : 65	8,000 - 10,000	15 - 330	Resin : 3 Curing agent: 13	Available with two varying pot life curing agents. Recommended for achieving excellent chemical resistance.
B-47 / AH-546	100 : 50	3,000 - 4,500	60 - 80	Resin : 1 Curing agent: 10	Standard system suitable to perform in extreme conditions, including moist surfaces.
B-47 / AH-713	100 : 50	3,500 - 4,500	110 - 130	Resin : 1 Curing agent: 9	Standard system recommended for general purpose screed linings.
B-47 / K-41 / K-42	100 : 60	3,000 - 6,000	35 - 330	Resin : 3 Curing agent: 13	Available with two varying pot life curing agents. Suitable to achieve excellent chemical resistance.

[1]Brookfield viscosity
[2]Pot life of 100 g mix mass

LAPOX® SELF-LEVELING SYSTEMS

A self-leveling layer of epoxy system remains in contact with the environment. The self-leveling surface bears the mechanical load and protects the floor from a chemical attack. This layer of epoxy flooring must be aesthetically appealing. Low viscosity, light colour, compatibility with additives and appropriate cure time must be considered for an ideal selection of epoxy systems.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Colour (Max)	Recommendations
	Parts by weight	mPa s	minutes	Gardner	
ARB-22 / AH-416	100 : 55	500 - 700	45 - 60	Resin : 2 Curing agent : 1	This system allows a long pot life and provides excellent mechanical properties.
ARB-22 / AH-428	100 : 43	300 - 500	30 - 35	Resin : 2 Curing agent : 1	This system allows a long pot life and provides excellent mechanical properties.
ARB-26 / AH-416	100 : 60	300 - 500	40 - 50	Resin : Milky white liquid Curing agent : 1	Low viscosity system suitable to achieve a high gloss finish.
B-11 / AH-428	100 : 45	800 - 1,200	30 - 40	Resin : 1 Curing agent : 1	A moderate viscosity system with a cycloaliphatic curing agent that helps achieve excellent gloss and good chemical resistance.
B-47 / AH-416	100 : 60	300 - 500	40 - 50	Resin : 1 Curing agent : 1	Low viscosity system recommended for achieving high gloss and hardness with moderate chemical resistance.

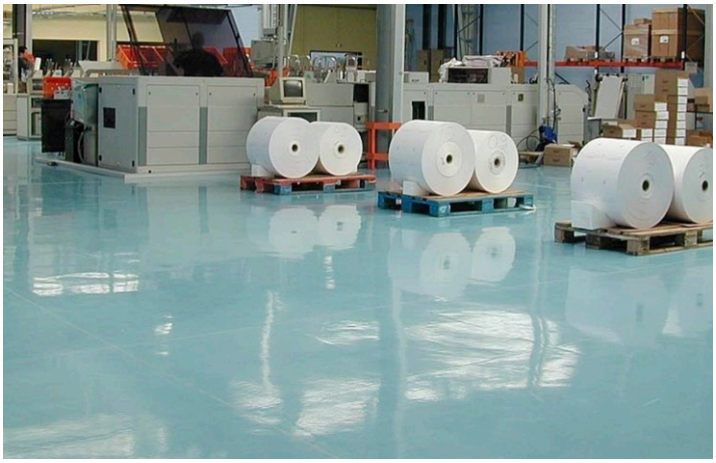
[1]Brookfield viscosity
[2]Pot life of 100 g mix mass

LAPOX® CHEMICAL RESISTANT FLOORING SYSTEMS

Atul offers standard solvent-free coating systems used for protection against corrosive chemicals for metal and concrete surfaces. Such coatings protect floor/substrate from chemicals including acids, alkalis and solvents. Atul's epoxy systems can be used for floor coatings, acid resistant linings, tile joining and gap filling in tank farms.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Colour (Max)	Recommendations
	Parts by weight	mPa s	minutes	Gardner	
ARPN-42 / AH-105	100 : 100	2,000 - 4,000	30 - 40	Resin : 2 Curing agent : Black	Coal tar modified system recommended for coating drain pipes, protection of concrete structures and vehicle chassis.
ARPN-54 / AH-351	100 : 30	5,000 - 7,000	25 - 35	Resin : 3 Curing agent : 3	A high viscosity system ideal to achieve excellent chemical resistance to strong acids and alkalis in industrial floorings.
ARPN-54 / K-41 / K-42	100 : 65	8,000 - 10,000	15 - 360	Resin : 1 Curing agent : 13	A high viscosity, variable pot life system for chemical resistant industrial floorings and coatings.
B-11 / K-41 / K-42	100 : 60	6,000 - 8,000	15 - 300	Resin : 1 Curing agent : 13	A variable pot life can be achieved by using a suitable proportion of two curing agents. These systems offers excellent resistance to mineral acids, alkalis and solvents.
B-11 / K-49	100 : 60	3,000 - 4,000	100 - 110	Resin : 1 Curing agent : 13	Recommended for protecting metal structures from corrosive chemicals such as mineral acids, alkalis and solvents.

[1]Brookfield viscosity
[2]Pot life of 100 g mix mass



LAPOX® SYSTEMS FOR REPAIR AND CRACK-FILLING

Atul offers epoxy systems for injection grouting and crack-filling. To achieve thixotropic properties, epoxy resins can be suitably formulated by the addition of silica to prevent sagging on vertical surfaces.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Colour (Max)	Recommendations
	Parts by weight	mPa s	minutes	Gardner	
B-11 / K-48	100 : 18	5,000 - 7,000	15 - 25	Resin : 1 Curing agent: 8	Recommended for horizontal and vertical cracks. The high reactivity of this system permits faster setting and quick return to service. Filler like chalk powder or silica flour can be blended to achieve thixotropic properties.
B-47 / AH-713	100 : 50	3,500 - 4,500	110 - 130	Resin : 1 Curing agent: 9	This is a universal system for construction applications. Its long pot life is suitable for large working areas. Injection grouting is possible with this system for horizontal and vertical cracks.
B-47 / K-48	100 : 18	600 - 700	15 - 25	Resin : 1 Curing agent: 8	This system has low mix viscosity compared to B-11 / K-48 and is suitable for thin cracks.

[1]Brookfield viscosity
[2]Pot life of 100 g mix mass

LAPOX® CONCRETE STRUCTURE STRENGTHENING SYSTEMS

Atul offers several resin systems with variable pot life, cure time, glass transition temperatures and physical properties. Variable pot life makes these systems ideal for small to very large jobs. Excellent mechanical properties such as tensile, flexural, shear strength and compression can be achieved if the epoxy is applied along with glass or carbon fiber reinforcement on concrete surfaces.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Colour (Max)	Recommendations
	Parts by weight	mPa s	minutes	Gardner	
ARL-135 / AH-334	100 : 32	700 - 1,200	25 - 35	Resin : 2 Curing agent : 1	Ambient cure, low viscosity, fast reactive system. Ideal to achieve quick impregnation of glass and carbon fiber with high mechanical strength.
ARL-135 / AH-335	100 : 32	500 - 700	50 - 60	Resin : 2 Curing agent : 1	Ambient cure, low viscosity, moderately reactive system.
ARL-135 / AH-336	100 : 32	500 - 700	80 - 100	Resin : 2 Curing agent : 1	This system is ideal for large structures; its long pot life permits adequate working time.

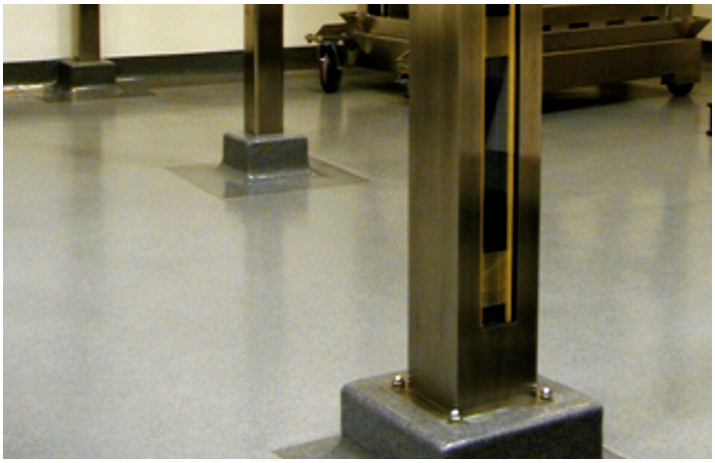
[1]Brookfield viscosity
[2]Pot life of 100 g mix mass

LAPOX® GROUTING SYSTEMS

Grouting provides an efficient and economical means of installing heavy machinery. High compression strength and resistance to vibrations are important properties to be considered before selecting epoxy grouting systems.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Colour (Max)	Recommendations
	Parts by weight	mPa s	minutes	Gardner	
B-47 / AH-713	100 : 50	3,500 - 4,500	110 - 130	Resin : 1 Curing agent : 9	Suitable for a long pot life, low exothermic and low shrinkage with good shock absorbance.
B-47 / K-48	100 : 18	600 - 700	15 - 25	Resin : 1 Curing agent : 8	Ideal grouting system for quick setting, excellent adhesion to foundation and fast strength build up.

[1]Brookfield viscosity
[2]Pot life of 100 g mix mass



LAPOX® ADHESIVE SYSTEMS

Lapox adhesives are available in variable viscosities and pot life to suit a variety of processes and applications. They provide excellent mechanical, electrical, water and chemical resistance, high thermal stability and exceptionally high bond strength with most substrates. The epoxy adhesives mentioned below are best suited for high performance applications.

Lapox® systems	Mixing ratio (resin : curing agent)	Mix viscosity[1] @ 25°C	Pot life[2] @ 25°C	Recommendations
	Parts by weight	mPa s	minutes	
A-16 / AH-717	100 : 80	15,000 - 20,000	150 - 200	This system helps to effectively bond marble, ceramic, metal and concrete with excellent resistance to shock and vibration.
A-16 / AH-800	100 : 100	Thixotropic	3 - 7	Rapid cure adhesive suitable to bond similar or dissimilar substrates quickly (in 5 - 7 minutes).
A-16 / K-5	100 : 27	–	170 - 190	A hot curing adhesive system designed for joints capable of withstanding operating temperatures upto165°C.
A-16 / K-6	100 : 10	4,000 - 6,000	20 - 30	Recommended for marble applications such as crack sealing, bonding, backing compositions and frame fittings.
A-31 / AH-717	100 : 80	25,000 - 40,000	40 - 80	Used in bonds where high shear strength (120 kgf/cm²) is required.
A-35 / K-35	100 : 30	400 - 500	> 60	This solvent-based system offers very low viscosity. Outstanding mechanical properties can be achieved if curing is performed at 120°C.
A-38 / K-99	100 : 40	50,000 - 1,00,000	20 - 25	Joints bonded with this system provide high adhesion strength and resistance to moisture and mild chemicals.
A-53 / K-6	100 : 10	600 - 800	30 - 60	This system binds substrates such as marble, steel and non-ferrous metals.
A-83 / K-83	100 : 40	Thixotropic	35 - 45	Standard adhesive system with thixotropic properties to fill gaps up to 5 mm thick.
A-555 / K-555	100 : 80	75,000 - 1,25,000	8 - 10	Adhesive that provides effective toughness and quick mechanical strength.
ARA-12 / AH-718	100 : 80	32,000 - 37,000	90 - 105	This system is suitable for multi-purpose bonding applications such as zari, electronic speakers, marble and ceramic.
XR-110 / XH-68	100 : 100	3,000 - 4,000	25 - 35	Adhesive system used for flexible cable joints.

[1]Brookfield viscosity
[2]Pot life of 100 g mix mass

GENERAL DEFINITIONS

Cross-linking
Reactive sites of the resin and curing agent make chemical bonds and form a three-dimensional network. Cross-linking starts as soon as the resin and curing agent come into physical contact. The speed of the reaction (i.e. of cross-linking) depends on the type of resin, curing agent and the temperature.

Cure time
Cure time is the amount of time required for a liquid resin-curing agent mix to convert into a completely cross-linked solid mass. It depends on various factors including the type of resin, curing agent and the temperature.

Epoxide Equivalent Weight (EEW)
EEW is the weight of the resin in grams that contains one gram-equivalent of epoxy. An interchangeable term, Epoxy Value (EV) may also be used. EV represents the fractional number of epoxy groups contained by 1,000 grams of resin. EEW can be obtained if 1,000 is divided by EV.

Gel time
Gel time is the amount of time required for a resin-curing agent mix to convert into a jelly-like mass. It depends on the type of resin and curing agent, the quantity of the mix and the temperature.

Glass Transition Temperature (Tg)
This is the critical temperature at which the polymer transitions from a hard, glassy material to a soft, rubbery material.

Post curing
When resin and curing agent react, cross-linking takes place and a solid, cured mass is obtained. In certain epoxy systems, even though the material appears cured and hard, optimum mechanical properties are not achieved. This happens due to the presence of free reactive sites of the resin and curing agent that can be completely cross-linked by heating (post curing) at appropriate temperatures.

Pot life
The amount of time taken to retain processable (i.e. usable) viscosity of a resin-curing agent mix. Mix viscosity increases with time. Pot life is dependent on the type of resin and curing agent, quantity of mix and the temperature.

Viscosity
The internal resistance of a liquid to flow, viscosity can also be defined as 'fluid friction'.

BASICS FOR COATINGS AND FLOORINGS

Substrate preparation
Epoxies bond well to most substrates. Adhesion may be enhanced by suitable surface preparation. There are several techniques to treat a substrate's surface, including:
- Sand blasting | mineral blasting
- Wet scouring
- Water scouring
- Concrete scarifying
- Rotary powder tool cleaning
- Chemical pre-treatment of concrete

Flooring installation
• Primer coat
The resin and curing agent is thoroughly mixed with the suitable mixture as per the mixing ratio. The mixing time should ideally be 3 - 4 minutes. An additional induction time of 3 - 4 minutes must be given in case of a polyamide curing agent. The primer coat may be suitably applied using a brush or roller.

• Screed | mortar
The resin and curing agent is slowly mixed in a paddle mixture for 3 - 5 minutes until the system is homogenised. Silica flour can be blended in to achieve thixotropic properties. The screed layer may be 2 mm to 8 mm, depending upon the requirement. The mortar must be spread rapidly during the summer in order to avoid premature gelation of the mixture.

• Self-leveling flooring
A self-leveling layer of the epoxy system remains in contact with the environment. Generally, a top coat can be formulated for different requirements such as anti-skid, glossy, chemical resistant, matte finish or a decorative finish in a variety of colours.

Coverage
Coverage of the system depends on surface porosity, roughness, the application technique, viscosity and the density of the system.

Re-coat time
This should be between 2 hours and 24 hours after the initial coat. For self-leveling flooring systems, it is recommended to apply the second coat while the primer coat still has some residual tack. This will improve adhesion between the two coats.

Colouring
Coatings and flooring systems can be given different shades using epoxy compatible pigments.

Spillage and clean-up tools
It is advisable to soak spilled material into sawdust or cotton waste and collect the spillage in specially identified waste drums. Use warm water and a detergent to clean up small spillage. Avoid contact with the skin and use hand gloves to clean spilled material. Tools and machines must be cleaned immediately before the epoxy cures. Any residue of epoxy on tools can be cleaned with solvents, cotton waste or a cloth, followed by warm water and a detergent.

Calculating the mixing ratio of epoxy resin with curing agent:

To calculate Amine Hydrogen Equivalent Weight (AHEW), use the following equation:

$$\text{AHEW} = \frac{\text{Molecular weight of amine}}{\text{Number of active hydrogen atoms}}$$

To calculate the stoichiometric ratio of curing agent with resin, use the following equation:

$$\text{PHR of amine} = \frac{\text{AHEW X 100}}{\text{Epoxy Equivalent Weight}}$$

To calculate Epoxy Equivalent Weight (EEW) of the mixture that contains reactive and non-reactive additives, diluents and fillers, use the following equation:

$$\text{EEW of mixture} = \frac{\text{Total weight}}{\frac{\text{Weight of component A}}{\text{EEW of component A}} + \frac{\text{Weight of component B}}{\text{EEW of component B}} + \frac{\text{Weight of component C}}{\text{EEW of component C}}}$$

MAJOR RESINS, CURING AGENTS AND THEIR SPECIAL FEATURES

Types of resins	Special features
Bisphenol-A based resins	General purpose basic resin in liquid and solid forms to achieve a combination of physical, electrical, mechanical, thermal and electrical properties
Bisphenol-F based resins	Relatively low viscosity, high chemical resistance and low crystallisation at lower temperatures
Brominated epoxy resins	Available in semi-solid and solid forms; used for flame retardancy
Carboxyl-terminated butadiene-acrylonitrile (CTBN) rubber modified resins	Higher viscosity, fracture toughness and impact resistance
Cycloaliphatic epoxy resins	Low viscosity and UV resistance
Epoxy acrylates	Quick curing by UV light for faster production
Fatty acid modified resins	High flexibility, low shrinkage and good adhesion properties
Phenol and cresol novolac epoxy resins	Relatively high viscosity, reactivity, thermal stability and chemical resistance
Polyurethane modified resins	High flexibility, low shrinkage and excellent adhesion properties
Reactive diluent modified resins	Low viscosity, high elongation and easy processibility
Silicone modified resins	High heat and thermal shock resistance
Tetrafunctional epoxy resins	High heat resistance, glass transition temperature and stiffness
Types of curing agents	**Special features**
Aliphatic and cycloaliphatic amine curing agents and adducts	Enables fast curing in the presence of accelerators
Anhydrides	Available in liquid and solid forms with elevated temperature curing and high electrical resistant properties
Aromatic amines	Available in liquid and solid forms with slow reactivity, elevated temperature curing and high performance properties
Mercaptans	Ambient curing, quick setting, high elongation
Phenalkamines	Low temperature curing, sea (saline) water resistant with good film forming character
Phenolics	Available in liquid and solid forms with elevated temperature curing, high heat and chemical resistant properties
Polyamides	Ambient curing, good adhesion and high flexibility

FIRST AID MEASURES

Skin

If skin contact should occur, flush contaminated skin with plenty of tepid running water. Any contaminated clothing, including shoes, should be removed and should not be reused until the articles are thoroughly laundered and entirely free of resin. Any injuries or irritation that may occur should receive prompt medical attention. Contact with liquid or solid epoxy resins may cause skin irritation. Some may also cause skin sensitisation. All skin contact with uncured resins should be avoided.

Eyes

If the eyes are contaminated, they should be flushed immediately with a large amount of water for at least 15 minutes holding eyelids open. Medical attention should be sought. Epoxy resins and curing agents are irritating to the eyes and can cause corneal injury.

Inhalation

If a person should experience any ill effects while working with these materials, he or she should be moved to fresh air and medical attention should be sought immediately. If breathing stops, administer artificial respiration at once. In certain processes, respiratory protection may be required; approved air-purifying or positive-pressure supplied air respirators should be used. The latter is preferable in areas where a high concentration of fumes is present to ensure that clean air is available to the operator.

Clean up and disposal

Contain large spills using an inert absorbent material such as clay or sand. Small spills may be scraped. Make sure to collect as much of the spill as possible. Unmixed and uncontaminated resin and curing agent may be saved for reuse. Do not use fine cellulose materials like sawdust to collect curing agents and do not dispose of material in trash containing any of these materials as spontaneous combustion may occur.

Spilled resin or mix (resin and curing agents) can be cleaned with any kind of thinner including acetone, alcohol, toluene and xylene. Remember to follow instructions on solvent containers. You can clean any leftover curing agent spills with warm, soapy water.

Dispose of absorbed spills, resin, curing agent and containers in accordance with federal, state or municipal regulations. Mix and cure waste resin and curing agent to an inert solid before disposal. Do not dispose of mixture until it has cooled. This reduces the risk of flash fires caused by the heat-producing cure process.

KEY MARKETS

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POLYMERS | AROMATICS | BULK CHEMICALS AND INTERMEDIATES | COLORS | CROP PROTECTION | FLORAS | PHARMACEUTICALS AND INTERMEDIATES

Lalbhai Group