

PRODUCT GUIDE

EPOXY RESINS, CURING AGENTS AND REACTIVE DILUENTS



**Energising possibilities...
Stimulating growth...**



First manufacturing site, Atul, India

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 inaugurated by its first Prime Minister, Pandit Jawaharlal Nehru. Atul is part of 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 greenest and largest 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.

Lapox® is a registered trademark of Atul Ltd.

Product range

Resins

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

Reactive diluents

Aliphatic and Aromatic (mono, di and trifunctional)

Curing agents

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

Accelerators and catalysts

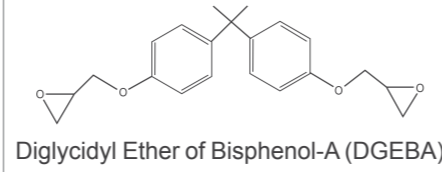
Industries served

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

RESINS

BISPHENOL-A BASED UNMODIFIED LIQUID RESINS

Atul offers unmodified liquid epoxy resins in various viscosities. Liquid epoxy resins are recommended for advancement reactions and various formulations. Formulated resins prepared from these resins are used for multiple applications including coatings, construction, adhesives, electrical and composites.



Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	Recommendations
	Gardner	Eq/kg	mPa s	
AR-101	Max 1	5.25 - 5.45	11,000 - 15,000	A standard viscosity, liquid epoxy resin for multiple applications. ED version also available for low ionic impurities.
ARL-141	Max 1	4.30 - 4.70	20,000 - 28,000	A high viscosity unmodified resin recommended to obtain high reactivity in coatings and adhesive formulations.
B-7	Max 2	3.57 - 4.45	450 - 800 ²	A semi-solid resin for adhesives and prepregs.
B-9	Max 50 ³ (APHA)	5.25 - 5.45	8,000 - 11,000	A low viscosity, unmodified liquid epoxy resin for multiple applications. ED version also available for low ionic impurities.
B-11	Max 1	5.25 - 5.45	11,000 - 15,000	A standard viscosity, unmodified liquid epoxy resin for multiple applications. ED version also available for low ionic impurities.

¹Brookfield viscosity

²70% solution in butyl carbitol by Brookfield viscometer

³ASTM D1209

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196

RESINS

BISPHENOL-A BASED MODIFIED LIQUID RESINS

Atul offers various modified resins for different applications including floorings, coatings, composites and adhesives.

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	Recommendations
	Gardner	Eq/kg	mPa s	
ARB-22 (XR-118)	Max 2	4.90 - 5.20	800 - 1,200	A modified epoxy resin recommended for primers, mortars and floor top coatings.
ARB-26	Milky white liquid	4.87 - 5.20	450 - 750	A modified epoxy resin recommended for self-leveling floorings and coatings with high gloss.
ARB-28	Max 1	5.00 - 5.50	1,500 - 2,000	A modified epoxy resin recommended for primers, mortars and floor top coatings.
ARB-30	Max 1	5.00 - 5.50	4,500 - 5,500	A modified epoxy resin recommended for primers, mortars and floor top coatings.
ARB-32	Max 150 ² (APHA)	4.65 - 5.12	500 - 700	A modified epoxy resin recommended for primers, mortars and floor top coatings, crack-filling and high solids coatings.
ARB-33	Max 75 ² (APHA)	5.12 - 5.55	500 - 700	A modified epoxy resin recommended for primers, mortars, grouts, maintenance coatings and castings.
ARL-135	Max 2	5.40 - 5.90	1,700 - 2,500	A modified epoxy resin recommended for FRP components and concrete structure strengthening.
ARL-135 LV	Max 2	5.40 - 5.90	1,000 - 1,500	A modified epoxy resin recommended for fast impregnation of reinforcement and concrete structure strengthening.
ARL-136	Max 4	5.30 - 5.70	2,500 - 4,500	A modified epoxy resin recommended for pultrusion, filament winding and coating applications.
ARL-143	Max 4	4.87 - 5.12	1,500 - 2,500	A low viscosity epoxy filler modified resin to achieve fire retardant properties for wet lamination.
ARPN-52 (L-552)	Max 4	6.65 - 6.85	1,000 - 1,500	A modified resin with high functionality. The product is recommended for FRP composites to be used in static and dynamic conditions at ambient and elevated temperatures.
B-47	Max 1	5.20 - 5.50	450 - 650	A modified epoxy resin recommended for high gloss, heavy duty floorings, high solids coatings, grouts and crack-filling applications.

¹Brookfield viscosity

²ASTM D1209 and ASTM D5386

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196

RESINS

BISPHENOL-A BASED SOLID RESINS

Atul offers Bisphenol-A based modified and unmodified resins from Type 1 to Type 9. Solid resins are recommended for protective coatings, powder coatings, functional coatings, rebars, can and coil coatings and wire enamels.

Lapox®	Epoxy value	Viscosity ¹ @ 25°C	Softening point	Recommendations
	Eq/kg	mPa s	°C	
ARP-12	1.42 - 1.53	375 - 475	80 - 90	A medium molecular weight epoxy resin recommended for powder coating formulations to enhance flow.
ARP-13 HT	1.25 - 1.35	4,500 - 6,500 @ 150°C	Tg = Min 55	A medium molecular weight epoxy resin recommended for powder coating formulations with improved storage stability.
ARP-13 LV	1.33 - 1.40	500 - 600	95 - 101	A medium molecular weight epoxy resin recommended for hybrid powder coatings.
ARP-14 HF	1.17 - 1.28	480 - 580	85 - 90	A medium molecular weight modified epoxy resin to achieve better flow properties in powder coating formulations.
P-3 (ARP-11)	2.15 - 2.22	160 - 190	65 - 75	A Type 1 epoxy resin recommended for solvent based protective coatings, zinc based primers and stoving enamels.
P-4 (ARP-14)	1.12 - 1.20	550 - 700	90 - 102	A Type 4 epoxy resin recommended for esterification with fatty acids for enamels and exterior coatings of cans and tubes, also suitable for functional powder coatings.
P-5 (ARP-17)	0.53 - 0.59	1,800 - 2,600	110 - 120	A Type 7 epoxy resin suitable for cross linking with amino and phenolic resins as stoving lacquers for internal coatings of cans and tubes.
P-6 (ARP-19)	0.34 - 0.42	5,000 - 10,000	125 - 140	A Type 9 high molecular weight epoxy resin recommended for tubes, can and coil coatings.
P-10 (ARP-14 E)	1.08 - 1.18	430 - 550	90 - 100	A solid epoxy resin recommended for esterification of water based systems for anodic electrodepositions.
P-62 (ARP-13)	1.25 - 1.40	600 - 700	95 - 101	A standard solid epoxy resin for powder coating formulations.
P-122 (ARP-14 A)	1.05 - 1.15	500 - 700	85 - 90	A solid epoxy resin recommended for functional powder coatings.

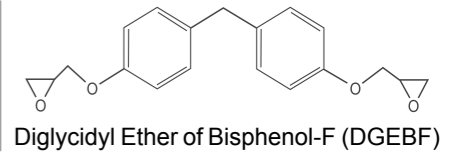
¹Brookfield viscosity of 40% solution in butyl carbitol

*Method: Epoxy value - ASTM D1652; Viscosity - ASTM D2196; Softening point - ASTM E28

RESINS

BISPHENOL-F AND BISPHENOL-A/F BLENDS

Bisphenol-F based resins are known for low viscosity, better chemical resistance and low crystallisation tendency in cold conditions. Atul offers Bisphenol-F based pure and Bisphenol-A/F blend resins in varying viscosities for several applications.



Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	Recommendations
	Gardner	Eq/kg	mPa s	
ARF-11 (XR-40)	Max 2	5.70 - 6.30	2,000 - 5,000	A standard Bis-F based epoxy resin recommended for construction, composite, electrical casting and coating applications.
ARF-15	Max 2	6.00 - 6.40	1,200 - 1,600	A distilled and pure Bis-F based epoxy resin for specific applications.
ARFM-12 (XR-123)	Max 2	5.55 - 5.80	6,500 - 8,500	A medium viscosity Bis-A/F blend recommended for coatings, composites, floor coatings and construction applications.
ARFM-13 (XR-60)	Max 2	5.50 - 5.75	4,500 - 6,500	A low viscosity Bis-A/F blend recommended for coatings, composites, floor coatings and construction applications.
ARFM-14 (XR-106)	Max 2	5.10 - 5.40	860 - 960	A reactive diluent modified Bis-A/F blend recommended for high solids coatings, construction and floor coatings.

¹Brookfield viscosity

*Method: ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196

RESINS

SOLVENT CUT RESINS

Atul offers solid resin solutions in various solvents. Major applications include industrial maintenance coatings, marine coatings, protective coatings, varnishes, stoving enamels and FRP composites.

Lapox®	Epoxy value	Viscosity ¹ @ 25°C	Non-volatile content ²	Recommendations
	Eq/kg	mPa s	°C	
ARL-148	–	50 - 350	48 - 52	A low viscosity epoxy resin recommended for polyester film coatings along with melamine formaldehyde curing agent (AH-343).
ARL-154	–	50 - 350	50 - 55	A low viscosity epoxy resin recommended for polyester film coatings to achieve high gloss and adhesion.
B-7 X 80	3.10 - 3.40	600 - 850	79 - 81 (150°C/1h)	A solvent cut epoxy resin recommended for high solids coatings to achieve excellent adhesion, gloss and flexibility.
L-68	2.00 - 2.22	2,200 - 3,000	79 - 81 (105°C/2h)	A brominated epoxy resin solution in Methyl Ethyl Ketone (MEK). The product is recommended for FR-4 laminates and fire retardant coatings.
P-101	1.90 - 2.20	9,000 - 13,000	74 - 76 (150°C/2h)	A Type 1 epoxy resin solution in xylene recommended for paint and coatings.
P-101 HV	1.80 - 2.20	14,000 - 20,000	74 - 76 (150°C/2h)	A Type 1 epoxy resin solution in xylene recommended for paint and coatings.
XR-128	Max 0.08	2,000 - 5,000	49 - 51 (160°C/2h)	A high molecular weight epoxy resin solution recommended for primers and enamels. The product improves flexibility in coating formulations.

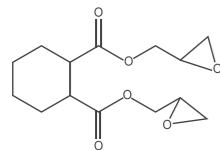
¹Brookfield viscosity

²120°C/2h

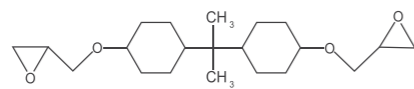
*Method: Epoxy value - ASTM D1652; Viscosity - ASTM D2196; Non-volatile content - Atul

CYCLOALIPHATIC RESINS

Cycloaliphatic resins offer UV resistance if cured with cycloaliphatic curing agents. Cycloaliphatic resins are recommended for outdoor coatings, electrical castings and floorings.



Diglycidylester of HHP acid



Diglycidylester of HBPA

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	Recommendations
	Gardner	Eq/kg	mPa s	
ARCH-11 (XR-34)	Max 1	5.50 - 6.30	500 - 1,100	A cycloaliphatic epoxy resin recommended for electrical component castings and potting, outdoor coatings and floorings.
ARCH-12	Max 1	5.00 - 5.55	350 - 750	A modified cycloaliphatic epoxy resin with low viscosity which offers good thermal shock resistance in electrical cast components.
ARCH-13	Max 100 ² (APHA)	4.16 - 4.54	2,000 - 4,000	A low viscosity cycloaliphatic resin based on hydrogenated Bis-A. The product is recommended for outdoor coatings, floorings, electrical castings and composite parts with high toughness.

¹Brookfield viscosity

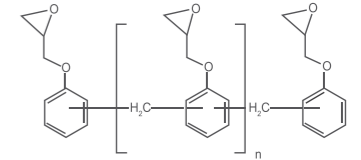
²ASTM D1209

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196

RESINS

EPOXY PHENOL NOVOLAC RESINS

Epoxy phenol novolac (EPN) resins are available in varying functionalities and are recommended to achieve higher chemical and thermal resistance in various applications including adhesives, coatings, floorings, composites and electrical.



Epoxy Phenol Novolac (EPN)

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	Non-volatile content ²	Recommendations
	Gardner	Eq/kg	mPa s	%	
ARPN-25	Max 3	5.59 - 5.81	1,100 - 1,700 @ 52°C	–	A low viscosity EPN resin with average 2.5 functionality recommended for composite, electrical and coating applications.
ARPN-36 (L-238)	Max 2	5.50 - 5.70	20,000 - 50,000 @ 52°C	–	A standard semi-solid EPN resin having average 3.6 functionality recommended for composites, electrical, chemical resistant coatings and floorings.
ARPN-36 M 80	Max 2	4.40 - 4.60	150 - 350	79 - 81	A solution of EPN resin ARPN-36 in MEK recommended for chemical resistant coatings, electrical and composite applications.
ARPN-36 X 80	Max 2	4.40 - 4.60	800 - 1,500	79 - 81 (150°C/1h)	A solution of EPN resin ARPN-36 in xylene recommended for chemical resistant coatings, electrical and composite applications.
ARPN-54	Max 3	5.50 - 6.00	25,000 - 35,000	–	A modified EPN resin recommended for composite, electrical and coating applications.

¹Brookfield viscosity

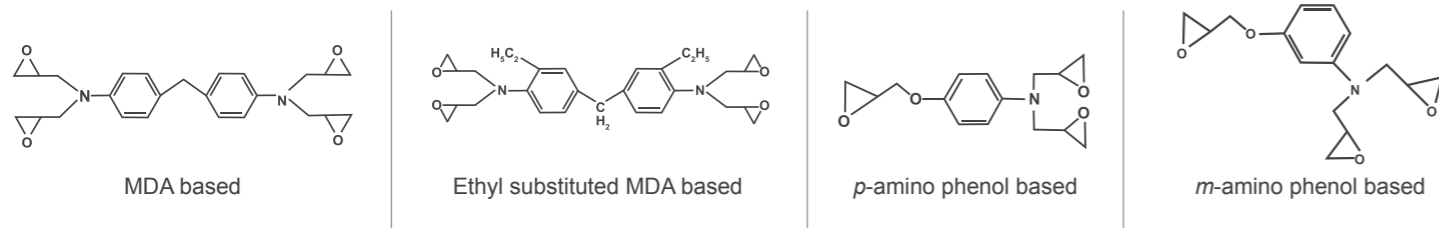
²105°C/2h

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196;

RESINS - SPECIALTY

GLYCIDYL AMINE BASED MULTIFUNCTIONAL RESINS

Atul offers various specialty resins with different functionalities and thermal stabilities. Specialty resins provide high Tg (glass transition temperature) along with mechanical and thermal resistance, and are extensively used for high performance structural adhesives, prepregs, FRP composites, electrical and electronic applications.

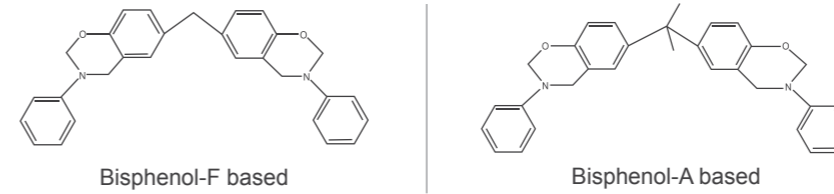


Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Recommendations
	Gardner	Eq/kg	mPa s	%	
ARTF-13	Max 12	7.46 - 8.55	7,000 - 11,000 ² @ 50°C	Max 0.10	Medium viscosity variants of tetrafunctional resin based on MDA for aerospace and high performance composites.
ARTF-14	Max 12	7.46 - 8.55	10,000 - 12,000 ² @ 50°C	Max 0.10	
ARTF-15	Max 12	7.46 - 8.55	11,000 - 13,000 ² @ 50°C	Max 0.10	
ARTF-16	Max 12	7.46 - 8.55	13,000 - 15,000 ² @ 50°C	Max 0.10	
ARTF-17	Max 12	7.46 - 8.55	17,000 - 19,000 ² @ 50°C	Max 0.10	A high viscosity, tetrafunctional resin based on MDA for aerospace and high performance composites.
ARTF-18	Max 12	7.46 - 8.55	7,000 - 19,000 ² @ 50°C	Max 0.10	A general purpose tetrafunctional resin based on MDA for aerospace and high performance composites.
ARTF-23 (XR-23)	Max 12	8.55 - 9.00	3,000 - 6,000 @ 50°C	Max 0.10	A low viscosity, tetrafunctional resin based on MDA for aerospace and high performance composites.
ARTF-33 (XR-93)	Max 7	7.52 - 8.47	7,000 - 12,000	Max 0.10	A tetrafunctional resin based on ethyl substituted MDA for aerospace and high performance applications. The product offers very low viscosity and reactivity.
ARTF-35	–	8.70 - 9.50	2,000 - 5,000	Max 0.30	A trifunctional unmodified resin based on <i>p</i> -amino phenol for aerospace and high performance applications.
ARTF-36	–	9.40 - 10.50	550 - 850	Max 0.20	A distilled trifunctional unmodified resin based on <i>p</i> -amino phenol for aerospace and high performance applications.
ARTF-37	–	9.10 - 9.80	7,000 - 13,000	Max 0.30	A trifunctional unmodified resin based on <i>m</i> -amino phenol for aerospace and high performance applications.
ARTF-38	–	9.80 - 10.6	1,500 - 4,800	Max 0.20	A distilled trifunctional unmodified resin based on <i>m</i> -amino phenol for aerospace and high performance applications.
ARTF-32	Max 18	7.40 - 8.50	2,000 - 4,000 @ 50°C	Max 0.10	A low viscosity, tetrafunctional resin based on substituted MDA for aerospace and high performance composites.
ARTF-39	Max 10	7.00 – 8.00	2,500 - 4,000 @ 50°C	Max 0.10	A modified low viscosity, multifunctional resin for aerospace and high performance composites.

¹Brookfield viscosity
²Viscosity by CAP 2000 (ASTM D4287)
 *Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196; HyCl - ASTM D1726

RESINS - SPECIALTY

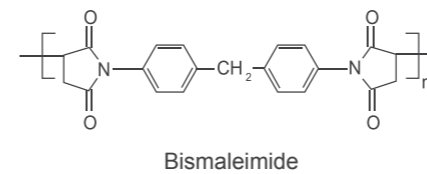
BENZOXAZINE RESINS



Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Recommendations
	Gardner	Eq/kg	mPa s	%	
ARBZ-10	Yellowish solid	60 - 80 (softening point, °C)	1,000 - 7,000 ² @ 100°C	200 - 450 sec @ 220°C (gel time)	A Bis-F based benzoxazine resin for high performance composites, electrical and electronics. The product offers excellent resistance to moisture, has low shrinkage and provides flame retardancy.
ARBZ-10 A 75	Yellowish liquid	74 - 76% (solid content)	100 - 400	380 - 420 sec @ 220°C (gel time)	A Bis-F based benzoxazine resin ARBZ-10 solution in acetone with 75% solids. The product offers excellent resistance to moisture, has low shrinkage and provides flame retardancy.
ARBZ-11	Yellowish solid	60 - 80 (softening point, °C)	50 - 500 ² @ 125°C	250 - 550 sec @ 220°C (gel time)	A Bis-A based benzoxazine resin for high performance composites, electrical and electronics. The product offers excellent resistance to moisture and low shrinkage.

¹Brookfield viscosity
²Viscosity by CAP 2000 (ASTM D4287)
 *Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196; HyCl - ASTM D1726

BISMALEIMIDE RESINS

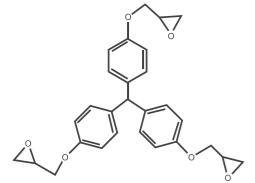


Lapox®	Colour	Melting point	Viscosity ¹ @ 25°C	HyCl	Recommendations
	Gardner	°C	mPa s	%	
ARBMI-11	Fine yellow powder	155 - 158	–	Acid value: <1	A bismaleimide resin for composites, electrical and electronic applications. The product offers excellent thermal stability.
ARD-63	Yellow to amber liquid	–	13,000 - 25,000	Purity (HPLC): Min 90%	A co-reactant to use along with ARBMI-11. The product offers excellent processability and achieves high mechanical properties.

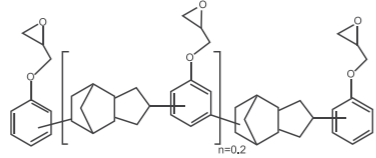
¹Brookfield viscosity
 *Method: Colour - ASTM D1544; Melting point - ASTM D1519; Viscosity - ASTM D2196; HyCl - ASTM D1726

RESINS - SPECIALTY

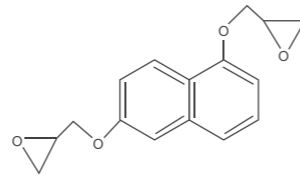
OTHER SPECIALTY RESINS



Triphenol methane based



Dicyclopentadiene based



Naphthalene based

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Recommendations
	Gardner	Eq/kg	mPa s	%	
ARC-28	Max 50 ² (APHA)	5.71 - 5.95	4,000 - 5,500	Max 0.03	A distilled and pure Bis-A based epoxy resin for aerospace, high performance composites and impregnation of electrical machines.
ARTF-34	Max 13	5.88 - 6.66	30 - 55 ³ @ 150°C	Max 0.05	A trifunctional resin based on triphenol methane for aerospace, high performance composites, electrical and electronic applications.
ARTF-50	Max 16	4.17 - 4.44	1,000 - 1,500 ³ @ 85°C	Max 0.05	A multifunctional resin based on Dicyclopentadiene (DCPD) for aerospace, composite, electrical and electronic applications. The product offers excellent resistance to moisture, provides high thermal stability and lowest dielectric constant.
ARN-16	Max 16	6.50 - 7.50	1,000 - 2,500 @ 50°C	Max 0.2	A bifunctional resin based on naphthalene for aerospace, structural adhesives and high performance composite components.

¹Brookfield viscosity

²ASTM D1209

³Viscosity by CAP 2000 (ASTM D4287)

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196; HyCl - ASTM D1726

DIMER ACID MODIFIED RESINS

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	Recommendations
	Gardner	Eq/kg	mPa s	
ARES-101	Max 8	2.12 - 2.60	300 - 800	A diglycidyl ester of dimer acid recommended to modify liquid epoxy resin to improve toughness and flexibility.
ARES-102	Max 12	2.50 - 3.50	20,000 - 30,000	A dimer acid modified liquid epoxy resin provides adhesion, toughness and flexibility. The product is recommended for coatings, adhesives, composite and laminating applications.

¹Brookfield viscosity

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196

ACCELERATORS AND CATALYSTS

Accelerators and catalysts are normally used along with curing agents to achieve faster production. They alter the properties of cured products and thus, their selection should be done carefully to suit the process and desired properties.

Lapox®	Appearance	Colour	Viscosity ¹ @ 25°C	Amine value	Recommendations
	-	Gardner	mPa s	mg KOH/g	
AC-13 (K-13)	Clear liquid	Max 2	Max 10	-	A liquid triamine accelerator recommended to accelerate anhydrides, polyamides and amines for composite, electrical and coating applications.
AC-14 (K-65)	Clear yellow brown liquid	Max 6	150 - 300	580 - 635	A liquid tertiary amine accelerator recommended to accelerate anhydrides, polyamides and amines for composite, electrical and coating applications.
AC-19	Clear liquid	Max 1	10 - 30	-	A low reactive liquid triamine accelerator recommended to accelerate anhydrides, polyamides and amines for composite, electrical and coating applications.
AC-20	Brown liquid or solid	-	Max 100	36 - 42 (melting point, °C)	An accelerator recommended to accelerate anhydrides, polyamides and amines for composite, electrical and coating applications.
K-86 (AC-15)	White crystalline powder	-	-	Min 75 (melting point, °C)	A solid polyamine complex recommended to accelerate aromatic amines.
K-112	Clear brown liquid	-	1,000 - 1,800	-	A modified viscous tertiary amine accelerator recommended to accelerate anhydrides, polyamides and amines for composite, electrical and coating applications.

¹Brookfield viscosity

*Method: Colour - ASTM D1544; Viscosity - ASTM D2196; Amine value - ASTM D2073

REACTIVE DILUENTS

Reactive diluents are used to reduce the viscosity of epoxy resins and to achieve the desired combination of properties. Atul offers a wide range of reactive diluents, including aromatic and aliphatic diluents that provide various functionalities.

ALIPHATIC - MONOFUNCTIONAL

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Structure	Recommendations
	Gardner	Eq/kg	mPa s	%		
ARD-13 (XR-80)	Max 1	3.35 - 3.70	4 - 12	Max 0.10		A reactive diluent based on C ₁₂ -C ₁₄ alcohol. The product provides excellent wetting and flexibility. It is recommended for epoxy flooring and coating applications.
ARD-14 (XR-83)	Max 1	6.20 - 7.30	Max 2	Max 0.10		A reactive diluent based on n-butanol. The product offers highest viscositycutting power due to extremely low viscosity. It is recommended for construction applications.

ALIPHATIC - DIFUNCTIONAL

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Structure	Recommendations
	Gardner	Eq/kg	mPa s	%		
ARD-51 (K-77)	Max 1	7.00 - 7.80	10 - 22	Max 0.15		A reactive diluent based on 1,4-butanediol recommended to modify resins used for construction and composite applications.
ARD-52 (XR-86)	Max 1	6.20 - 6.80	15 - 30	Max 0.15		A reactive diluent based on 1,6-hexanediol recommended to modify resins used for construction, coating and composite applications.
ARD-54 (XR-19)	Max 2	2.90 - 3.20	40 - 90	Max 0.15		A reactive diluent based on polypropylene glycol that imparts higher flexibility to epoxy resins.
ARD-56 (XR-87)	Max 1	6.90 - 8.00	12 - 18	Max 0.15		A reactive diluent based on neopentyl glycol recommended for coatings, construction and composite formulations.
ARD-59	Max 1	5.20 - 6.20	20 - 50	Max 0.20		A reactive diluent based on dipropylene glycol recommended for composite and construction formulations.
ARD-60	Max 1	8.00 - 9.00	15 - 22	Max 0.15		A high purity reactive diluent based on 1,4-butanediol recommended to modify resins used for composite applications.

¹Brookfield viscosity

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196; HyCl - ASTM D1726

REACTIVE DILUENTS

ALIPHATIC - TRIFUNCTIONAL

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Structure	Recommendations
	Gardner	Eq/kg	mPa s	%		
ARD-55 (XR-85)	Max 2	7.00 - 8.00	100 - 200	Max 0.15		A reactive diluent based on trimethylolpropane recommended for construction, composite and coating formulations.
ARD-65	Max 6	1.54 - 2.00	250 - 500	-		A reactive diluent based on castor oil recommended for concrete patching, floor coatings and thermal shock resistant potting.

AROMATIC - MONOFUNCTIONAL

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Structure	Recommendations
	Gardner	Eq/kg	mPa s	%		
ARD-10 (K-100)	Max 2	5.30 - 6.00	6 - 8	Max 0.20		A reactive diluent based on o-Cresol. Offers high gloss and mechanical strength recommended for floorings and electrical formulations.
ARD-11 (K-103)	Max 2	5.90 - 6.30	6 - 8	Max 0.20		A reactive diluent based on phenol recommended for floorings and electrical formulations.
ARD-12 (XR-59)	Max 2	4.10 - 4.50	20 - 35	Max 0.20		A reactive diluent based on p-tertiary butyl phenol recommended for crystallisation and chemical resistance.
ARD-15 (K-513)	Max 13	1.80 - 2.40	40 - 70	Max 1.00		A reactive diluent based on cardanol recommended to modify resins used for coatings, adhesives, construction and electrical applications.
ARD-58	Max 10	2.20 - 2.60	20 - 50	Max 1.00		A high purity reactive diluent based on cardanol recommended to modify resins used for coatings, adhesives, construction and electrical applications.

AROMATIC - DIFUNCTIONAL

Lapox®	Colour	Epoxy value	Viscosity ¹ @ 25°C	HyCl	Structure	Recommendations
	Gardner	Eq/kg	mPa s	%		
ARD-57 (XR-104)	Max 16	8.15 - 9.50	100 - 200	-		A reactive diluent based on aniline recommended for high performance composite formulations.

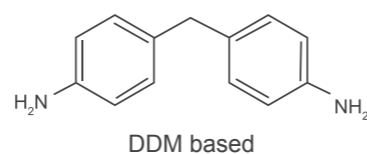
¹Brookfield viscosity

*Method: Colour - ASTM D1544; Epoxy value - ASTM D1652; Viscosity - ASTM D2196; HyCl - ASTM D1726

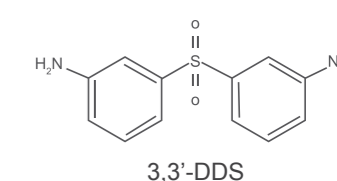
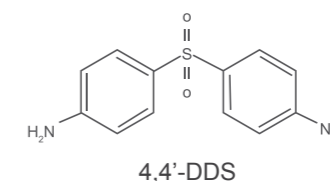
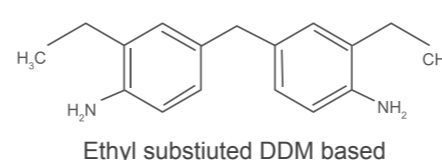
CURING AGENTS

AROMATIC AMINE CURING AGENTS

These are available in liquid and solid forms and are modified to cure epoxy resins at ambient conditions as well. Higher thermal stability and chemical resistance along with excellent mechanical properties are specific advantages of these curing agents. Atul offers a wide range of aromatic amine curing agents for various applications.



CURING AGENTS



Lapox®	Appearance	Colour	Viscosity ¹ @ 25°C	Amine value	Mixing ratio ²	Recommendations
	–	Gardner	mPa s	mg KOH/g	Parts by weight	
AH-657	Viscous brownish liquid	Max 18	9,000 - 14,000	555 - 625	25	A modified aromatic amine curing agent with low viscosity to achieve higher glass transition temperature. The product is recommended for filament winding and pultrusion processes for composite applications.
AH-667	Viscous brownish liquid	Max 15	1,400 - 2,000 @ 60°C	–	28	A semi-solid aromatic amine curing agent based on DDM recommended for composite applications.
K-5	White to tan pastilles	–	–	–	26	A pure aromatic amine curing agent-4,4'-Diaminodiphenyl methane recommended to cure epoxy resins at elevated temperatures.
K-41	Brown liquid	Max 13	3,800 - 5,800	4.70 - 5.10 (Eq/kg)	60	A low viscosity aromatic amine curing agent to be used along with curing agent K-42 for high chemical resistant industrial floorings and coatings. The product is recommended for chemical resistant tank linings along with glass fiber.
K-42	Dark brown liquid	Max 16	15,000 - 21,000	4.40 - 4.80 (Eq/kg)	60	An aromatic amine curing agent with high reactivity to be used along with curing agent K-41.
K-49	Brown liquid	Max 13	700 - 900	4.70 - 5.00 (Eq/kg)	60	A low viscosity aromatic amine curing agent with moderate reactivity recommended for solvent-free chemical resistant coatings, floorings and linings.
K-92	Brown liquid	Max 13	5,000 - 7,500	4.40 - 5.10 (Eq/kg)	60	An ambient curing modified aromatic amine curing agent recommended for high chemical resistant coatings, tank linings and floorings.

Lapox®	Appearance	Colour	Viscosity ¹ @ 25°C	Amine value	Mixing ratio ²	Recommendations
	–	Gardner	mPa s	mg KOH/g	Parts by weight	
AH-664	Dark brown liquid	Max 12	3,500 - 6,500	430 - 470	34	A liquid aromatic amine with high viscosity and low reactivity recommended to use along with accelerator for composite applications.
K-450	Dark brown liquid (solidifies upon storage)	–	250 - 400 @ 40°C	430 - 450	34	A liquid aromatic amine curing agent with very low reactivity recommended to use along with accelerator for composite applications.
ASH-10	Crystalline powder	White to off-white	176 - 185 (melting point, °C)	99% (purity)	35	An aromatic amine curing agent (sulfone) which is extremely slow reactive at ambient temperature suitable to manufacture prepregs for advanced composites, Printed Circuit Board (PCB), powder coating and Electronic Moulding Compounds (EMC).
ASH-10 FF	Crystalline powder	White to off-white	176 - 185 (melting point, °C)	99% (purity)	35	An aromatic amine curing agent (sulfone) - Free Flowing version of ASH-10 which is extremely slow reactive at ambient temperature suitable to manufacture prepregs for advanced composites, Printed Circuit Board (PCB), powder coating and Electronic Moulding Compounds (EMC).
ASH-10 MIC	Micronised powder	White to off-white	176 - 185 (melting point, °C)	99% (purity)	35	An aromatic amine curing agent (sulfone) - Micronised version of ASH-10 for uniform dispersion in solvent free resins. The product is extremely slow reactive at ambient temperature suitable to manufacture prepregs for advanced composites.
ASH-11	Crystalline powder	White to brownish	167 - 175 (melting point, °C)	99% (purity)	35	An aromatic amine curing agent (sulfone) which is more reactive than ASH-10. The product is suitable for fast curing and higher productivity.
ASH-11 MIC	Micronised powder	Off-white to yellowish brown	167 - 175 (melting point, °C)	99% (purity)	35	An aromatic amine curing agent (sulfone) - Micronised version of ASH-11 suitable for fast curing and higher productivity.
K-5200 (AH-618)	Yellow to brown liquid	Max 15	100 - 300	628 - 634	24	A hot curing aromatic amine curing agent recommended for achieving a long pot life and high glass transition temperature.

¹Brookfield viscosity

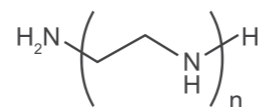
²With liquid epoxy resin of EEW:190

*Method: Colour - ASTM D1544; Viscosity - ASTM D2196; Amine value - ASTM D2073

CURING AGENTS

ALIPHATIC AMINES AND THEIR ADDUCTS

Aliphatic amines are low in viscosity and are preferred curing agents at ambient conditions for general applications. They offer excellent combinations of properties and are used in composites, coatings, adhesives and construction applications. Atul offers several grades of aliphatic amine curing agents with varying viscosity, reactivity and performance properties after optimum curing.



Aliphatic polyamine

Lapox®	Colour	Viscosity ¹ @ 25°C	Amine value	Pot life ² @ 25°C	Mixing ratio ³	Recommendations
	Gardner	mPa s	mg KOH/g	minutes	Parts by weight	
AH-313	Max 4	50 - 60	–	35 - 50	15	An unmodified aliphatic polyamine recommended for adhesives, castings, coatings and composite applications.
AH-315	Max 1	5 - 15	–	7 - 9 hr	32	An unmodified polyether amine recommended for adhesives, composites, coatings and casting applications.
AH-319 (K-48)	Max 4	200 - 300	17.00 - 17.80 (Eq/kg)	20 - 30	18	A modified polyamine curing agent with low vapour pressure and high reactivity recommended for adhesives, composites, castings and coating applications.
AH-332 to AH-338	Max 4	10 - 150	–	10 min - 10 hr	32	A comprehensive range of 7 aliphatic amine curing agents with varying pot life and viscosity recommended for composites, adhesives, construction and coating applications.
AH-341	Max 2	30 - 100	290 - 320	100 - 125	40	A modified aliphatic polyamine curing agent recommended for high solids coatings with a long pot life.
AH-342	Yellow brown	19,000 - 31,000	500 - 640	15 - 25 ⁴	80	A modified polyamine adduct with high reactivity recommended for adhesives and sealants.
AH-348	Max 1	5 - 10	680 - 720	40 - 50	21	An unmodified aliphatic polyamine curing agent recommended for mortar mastics and coatings.
AH-350	Max 8	500 - 1,000	650 - 750	3 - 4 ⁵	40	A modified polyamine adduct with high reactivity recommended for adhesives and sealants.
AH-351	Max 4	500 - 1,000	650 - 750	30 - 40	25	A light coloured modified polyamine curing agent recommended to use along with resin ARPN-54 to achieve 98% sulphuric acid resistance.

CURING AGENTS

Lapox®	Colour	Viscosity ¹ @ 25°C	Amine value	Pot life ² @ 25°C	Mixing ratio ³	Recommendations
	Gardner	mPa s	mg KOH/g	minutes	Parts by weight	
AH-354	Max 8	60,000 - 1,00,000	340 - 375	5 - 10 ⁶	100	A high viscosity aliphatic amine curing agent with extremely fast reactivity recommended as a co-curing agent for slow curing agents. The product can be used for making very fast setting adhesives and putties.
AH-371 to AH-373	Max 5	100 - 550	500 - 1,000	5 - 30	18 - 25	A comprehensive range of 3 modified aliphatic amine curing agents with varying pot life recommended for crack-filling, coating on natural stones, mortars and adhesives.
K-6 (AH-312)	Max 3	–	–	30 - 40	10 - 12	An unmodified aliphatic polyamine recommended for adhesives, castings, coatings, construction and composite applications.
K-7	Max 5	Max 10	–	20 - 25	10 - 12	An unmodified aliphatic polyamine recommended for adhesives, castings, coatings and composite applications.
K-54 (AH-356)	Max 2	2,900 - 3,600	398 - 415	15 - 30	35	A modified polyamine adduct recommended for high solids coatings, mortars and adhesives.
K-105	Black	3,000 - 6,000	–	Min 20	100 (with resin ARB-28)	A coal tar modified polyamine adduct recommended for construction and high build coatings.
K-306	Clear liquid	850 - 1,200	–	–	100 (with resin ARL-148)	A butylated melamine formaldehyde curing agent recommended for backing enamel with resin ARL-148 for polyester film coatings.
XH-61 (AH-321)	Max 2	1,500 - 2,000	165 - 210	4 - 6 hr	30 (with resin P-101)	A modified polyamine adduct solution in xylene and butanol recommended for clear coatings.

¹Brookfield viscosity

²100 g mix mass in plastic cup with liquid epoxy resin of EEW:190

³With liquid epoxy resin of EEW:190

⁴With liquid epoxy resin of EEW:190 of 25 g mix mass at 27°C

⁵With liquid epoxy resin of EEW:190 of 14 g mix mass at 27°C

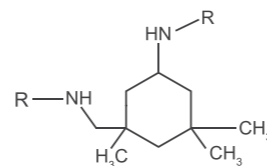
⁶With liquid epoxy resin of EEW:190 of 20 g mix mass at 27°C

*Method: Colour - ASTM D1544; Viscosity - ASTM D2196; Amine value - ASTM D2073; Pot life - ASTM D2471

CURING AGENTS

CYCLOALIPHATIC AMINE CURING AGENTS AND ADDUCTS

Cycloaliphatic amine curing agents offer low colour and viscosity. They are widely used in floorings, coatings, adhesives, self-leveling flooring and composite applications.



Cycloaliphatic polyamine

Lapox®	Colour	Viscosity ¹ @ 25°C	Amine value	Pot life ² @ 25°C	Mixing ratio ³	Recommendations
	Gardner	mPa s	mg KOH/g	minutes	Parts by weight	
AH-411	Max 1	10 - 20	–	90 - 120	23	An unmodified low viscosity cycloaliphatic amine curing agent for coatings, floorings and composite applications.
AH-412 (K-552)	Max 4	50 - 150	–	110 - 160 ⁴	38	A low viscosity cycloaliphatic amine curing agent for composite applications. The product offers excellent mechanical properties in static and dynamic working conditions.
AH-416	Max 1	400 - 600	250 - 300	30 - 45	60	A moderate viscosity, modified cycloaliphatic amine curing agent recommended for coatings and self-leveling flooring with high gloss.
AH-420 (K-964)	Max 3	40 - 60	320 - 340	25 - 40	48	A very low viscosity cycloaliphatic amine curing agent with moderate pot life for protective coatings and floorings with better chemical resistance.
AH-422	Max 1	100 - 140	–	200 - 250	32	An unmodified low viscosity cycloaliphatic amine curing agent for achieving a long pot life and higher glass transition temperature.
AH-424	Max 2	20 - 50	330 - 360	25 - 35	45	A low viscosity, modified cycloaliphatic amine curing agent to facilitate higher filler loading recommended for self-leveling floorings and coatings.
AH-428	Max 1	50 - 150	340 - 390	30 - 40	45	A low viscosity cycloaliphatic amine curing agent with fast reactivity recommended for coatings, self-leveling flooring with high gloss and colour stability.
AH-440	Max 2	150 - 300	335 - 375	25 - 40	40	A low viscosity, accelerated cycloaliphatic amine curing agent suitable for solvent-free coatings and floorings.
K-302	Max 2	300 - 600	260 - 310	40 - 50	50	A transparent, modified cycloaliphatic amine curing agent suitable for self-leveling flooring, solvent-free coating and clear casting applications.

¹Brookfield viscosity

²100 g mix mass in plastic cup with liquid epoxy resin of EEW:190

³With liquid epoxy resin of EEW:190

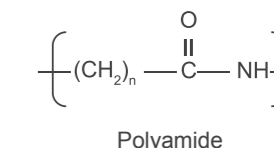
⁴100 g mix mass in plastic cup with ARPN-52 (L-552) resin

*Method: Colour - ASTM D1544; Viscosity - ASTM D2196; Amine value - ASTM D2073; Pot life - ASTM D2471

CURING AGENTS

POLYAMIDE CURING AGENTS

A polyamide curing agent is a reaction product of dimer acid and polyamine. These curing agents can be blended with epoxy resins in a variety of mixing ratios. Good chemical resistance, film forming character, high gloss and excellent adhesion of these curing agents make them suitable for coating and adhesive applications. Atul offers various curing agents under this category with varying viscosity and reactivity.



Polyamide

Lapox®	Colour	Viscosity ¹ @ 25°C	Amine value	Pot life ² @ 25°C	Mixing ratio ³	Recommendations
	Gardner	mPa s	mg KOH/g	minutes	Parts by weight	
AH-711	Max 9	50,000 - 75,000 @ 40°C	210 - 230	–	100 - 125	A high viscosity polyamide curing agent recommended for adhesives, sealants and anti-corrosive coatings.
AH-712	Max 9	45,000 - 60,000	290 - 320	110 - 130	55 - 65	A high viscosity polyamide curing agent recommended for protective coatings, adhesives, floorings, marine coatings and industrial paints.
AH-713 (K-46)	Max 9	12,000 - 18,000	350 - 400	60 - 80	50 - 55	A moderate viscosity polyamide curing agent recommended for high solids coatings, primers, grouts, mortars, adhesives, marine and industrial paints.
AH-714	Max 8	500 - 1,000	425 - 450	120 - 130	50	A low viscosity polyamide curing agent recommended for grouts, crack injection, primers, protective coatings, tile gap filling, mortars and adhesives.
AH-716 (K-29)	Max 10	2,500 - 5,500	202 - 225	80 - 100	100	A low viscosity modified polyamide curing agent recommended for high solids coatings, primers and floor coatings.
AH-725	Max 8	7,000 - 11,000	400 - 450	40 - 50	50	A moderate viscosity polyamide curing agent recommended for adhesives, mortars and protective coating applications. The product provides faster reactivity and early development of mechanical properties.
AH-727	Max 12	1,000 - 2,000	280 - 320	45 - 65	60 (with resin B-47)	A modified polyamide curing agent suitable for curing under wet/damp conditions. The product provides excellent adhesion to metal and concrete surfaces. It is recommended as a primer for floorings and coating applications.

¹Brookfield viscosity

²100 g mix mass in plastic cup with liquid epoxy resin of EEW:190

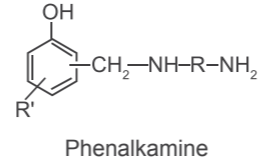
³With liquid epoxy resin of EEW:190

*Method: Colour - ASTM D1544; Viscosity - ASTM D2196; Amine value - ASTM D2073; Pot life - ASTM D2471

CURING AGENTS

PHENALKAMINE CURING AGENTS

A phenalkamine is a reaction product of cardanol and polyamine. They cure epoxy resins at low temperatures, even in moist conditions. They are preferred for protective and marine coatings in cold conditions.



Lapox®	Colour	Viscosity ¹ @ 25°C	Amine value	Pot life ² @ 25°C	Thin film set time (8 mils)	Mixing ratio ³	Recommendations
	Gardner	mPa s	mg KOH/g	minutes	hours	Parts by weight	
AH-543 (XH-80)	Max 15	2,000 - 5,000	300 - 350	50 - 65	4 - 5	67	A light colour and low viscosity phenalkamine curing agent useful for heavy duty anti-corrosive coatings for marine applications.

¹Brookfield viscosity
²100 g mix mass in plastic cup with liquid epoxy resin of EEW:190
³With liquid epoxy resin of EEW:190
 *Method: Colour - ASTM D1544; Viscosity - ASTM D2196; Amine value - ASTM D2073; Pot life - ASTM D2471

ANNEXURE

Calculating the mixing ratio of epoxy resin with curing agent:

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

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

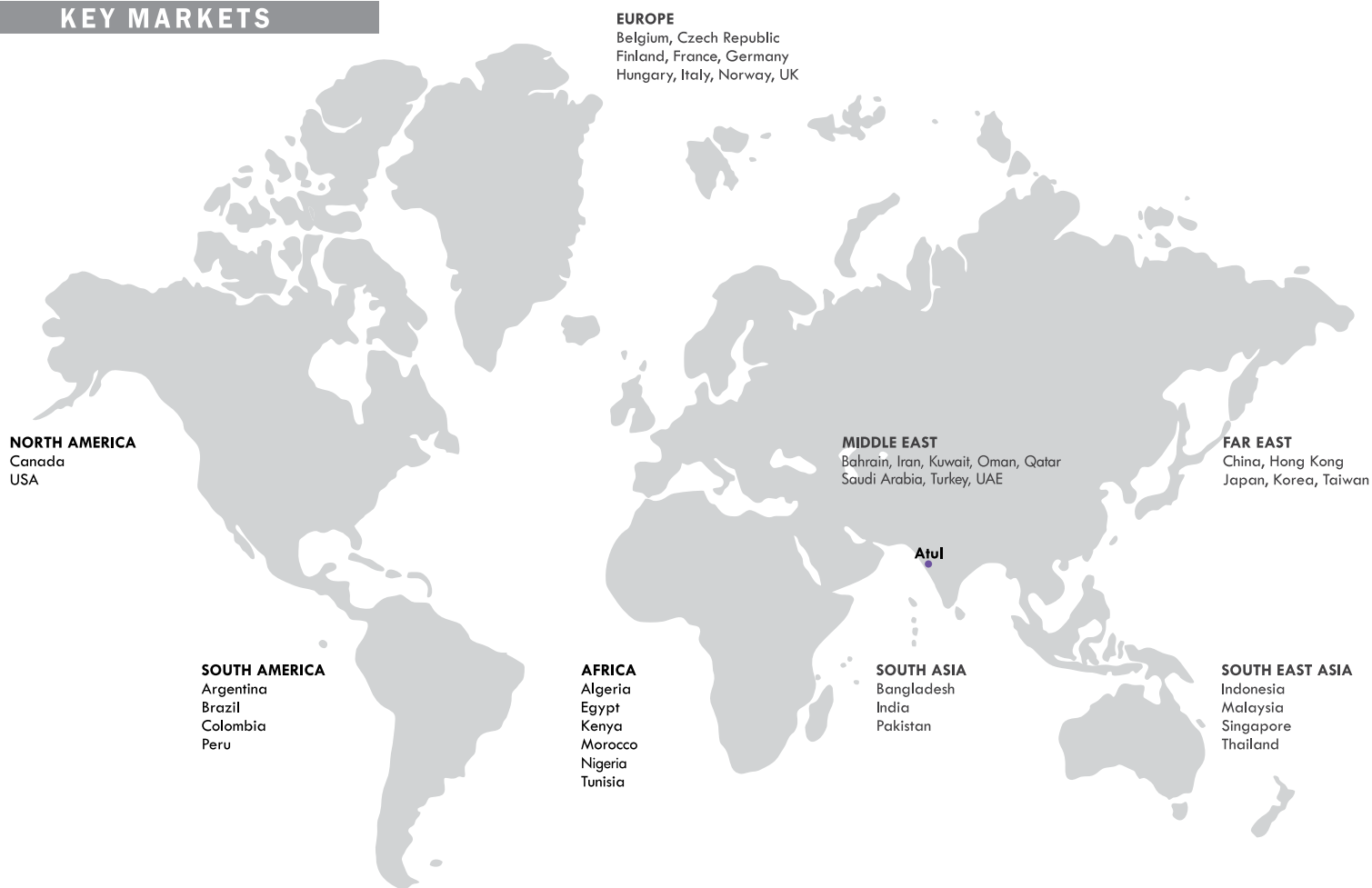
To calculate the stoichiometric ratio of curing agent with resin, use the following equation:

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

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

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

KEY MARKETS



NORTH AMERICA
Canada
USA

SOUTH AMERICA
Argentina
Brazil
Colombia
Peru

EUROPE
Belgium, Czech Republic
Finland, France, Germany
Hungary, Italy, Norway, UK

AFRICA
Algeria
Egypt
Kenya
Morocco
Nigeria
Tunisia

MIDDLE EAST
Bahrain, Iran, Kuwait, Oman, Qatar
Saudi Arabia, Turkey, UAE

SOUTH ASIA
Bangladesh
India
Pakistan

FAR EAST
China, Hong Kong
Japan, Korea, Taiwan

SOUTH EAST ASIA
Indonesia
Malaysia
Singapore
Thailand

INDIA

Head office

Atul 396 020, Gujarat
India
Telephone: (+91 2632) 230000
E-mail: contact@atul.co.in

Registered Office

Atul House
G I Patel Marg
Ahmedabad 380 014, Gujarat
India
Telephone: (+91 79) 26461294 | 3706

www.atul.co.in

Polymers Business - Mumbai (Goregaon)

Floor 15, C wing, Lotus Corporate Park
Western Express Highway, Goregaon (East)
Mumbai 400 063, Maharashtra
India
Telephone: (+91 22) 39877700
E-mail: polymers@atul.co.in

Polymers Business - Mumbai (Dadar)

310-B, Veer Savarkar Marg
Dadar (West)
Mumbai 400 028, Maharashtra
India
Telephone: (+91 22) 39876000

OUTSIDE INDIA

Atul Brasil Quimicos Ltda

Avenida Ipiranga, 318
Conjunto 1.001
Bloco A - Bairro República
São Paulo (SP), CEP 01046-010
Brazil
Telephone: (+55 19) 999442500

Atul China Ltd

Room number 806
Building 2E
686 Wuzhong Road
Shanghai 201103
China
Telephone: (+86 21) 64753255

Atul Europe Ltd

1|B Dean Row Court
Summerfields Village Centre
Dean Row Road
Wilmslow SK9 2TB, Cheshire
United Kingdom
Telephone: (+44 1625) 539209

Atul Middle East FZ-LLC

Office number 43, Floor 3
Nucleotide Complex
Dubai Science Park, Emirates Road
Al Barsha South
Dubai PO Box 500767
United Arab Emirates

Atul USA Inc

Building number 400
6917 Shannon Willow Road
Charlotte
NC 28226
United States of America
Telephone: (+1 704) 540 8460



POLYMERS



AROMATICS



BULK CHEMICALS
AND INTERMEDIATES



COLORS



CROP PROTECTION



FLORAS



PHARMACEUTICALS
AND INTERMEDIATES



Lalbhai Group

Mar 2018