

# COMPOSITE EPOXY SYSTEMS

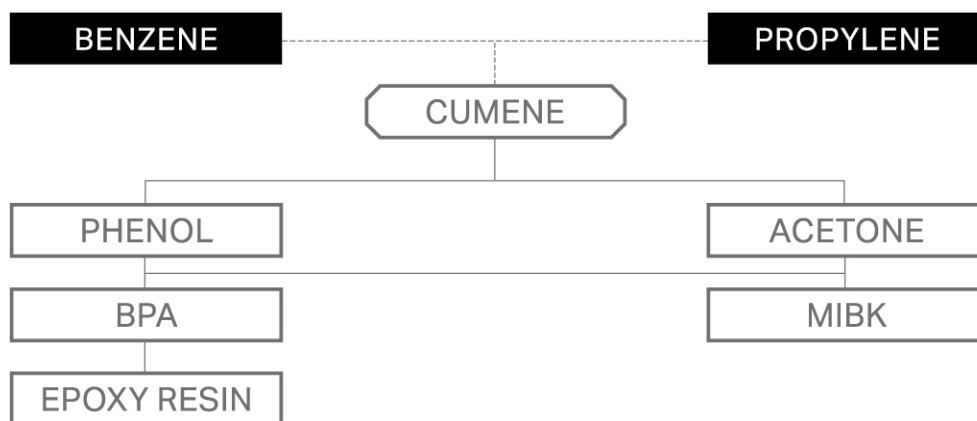
PRODUCT INFORMATION



# KUMHO P&B CHEMICALS

Kumho P&B(KPB), the nation's first Phenol manufacturer, has achieved a vertically integrated structure in manufacturing petrochemical products, which range from Phenol / Acetone to Bisphenol-A, MIBK and Epoxy Resins, and has contributed to the growth of the domestic petrochemical industry with state-of-the-art technologies.

As a reliable and trustworthy supplier of industrial basic intermediates, Kumho P&B has continuously focused on the development of new technologies to achieve customer satisfaction. We are growing to become a world-leading petrochemical company by building advanced systems of quality management, preventing pollution and ensuring industrial safety, while striving for low-carbon green growth to fight against global warming, one of the world's biggest challenges.



## HISTORY

**1976. 04**

Kumho Chemical Co., Ltd. Founded

**1980. 11**

Start-up of Cumene / Phenol / Acetone plants

**1987. 06**

Joint Investment Agreement with Shell (50:50, KSC)

**1990. 11**

Completion of Phenol Plant expansion to 100,000 MTA

**1991. 01**

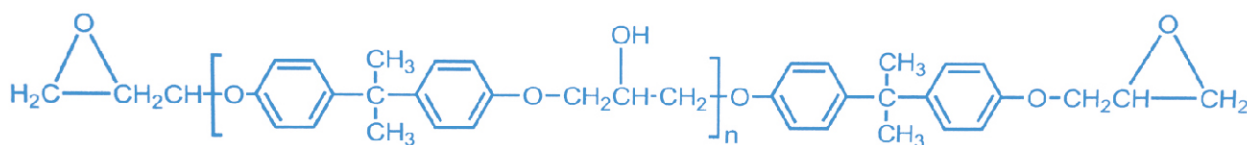
Completion of BPA, MIBK & Epoxy resin plants

# World Leading Technology & Eco-Friendly Management

Since Kumho P&B was designated an Environmentally-Friendly Company by the Korean government in 1999 for its recognition of the importance of eco-friendly management, the company has focused on investing in Research and Development related to green projects, such as energy-saving by minimizing process waste energy, the reduction of CO<sub>2</sub> emissions, and the introduction and development of new eco-friendly processes and products.

Kumho P&B efforts were recognized again in 2002, when the company won the Grand Prize in Environmentally-Friendly Management from the Ministry of Environment. What's more, Kumho P&B was selected as a quality-competitive excellent enterprise in successive years, recognition of its advanced technology and operational know-how in this field.

Kumho P&B is now ready to present a significant technological innovation with our windturbine blade manufacturing system. To provide greater support for blade manufacturers, our energetic and professional R&D will develop innovative new raw materials in order to improve customers' processes, and will continue expertise and knowledge to help customers and industries to achieve mutual benefits. In addition, our integrated product lines in the areas of Phenel, Acetone and Bisphenol-A will supply more competitive goods. Kumho P&B's KER & KCA systems for windturbine blade manufacturing will be the best solution to achieve your technology innovation.



## 1998. 03

Shell withdraw from KSC / Renamed to Kumho P&B Chemicals, Inc. (KPB)

## 2000. 06

Joint Investment Agreement with Nippon Steel Chemical Co., Ltd.

## 2009. 06

Epoxy systems for windturbine blade approved by Germanischer Lloyd

## 2010. 08

Epoxy adhesive systems for windturbine blade approved by Germanischer Lloyd

# 01 KER Liquid Epoxy Resins

Liquid "KER" Epoxy resins are used in several major industries, notably the paint industry (high-solid and solvent-free coatings), the electrical industry (casting, potting, encapsulation), the building industry (floorings, mortars, grouts, adhesives) and in many other applications e.g. structural laminates, high performance adhesives, etc. The KER range contains resins with different reactivities, viscosities and handling characteristics, which provide a wide choice to the user.

Grade	EGC (mmol/kg)	WPE (g/eq)	Viscosity@25°C (Pa.s)	Color (Pt/Co)	Hydro-Cl (mg/kg)	Remark
KER 215	4,800-5,200	192-208	0.7-1.1	Max. 100	-	Diluted with AGE, Low viscosity
KER 215HC	4,650-5,100	196-215	1.0-3.0	Max. 100	5,000-9000	Diluted with AGE, Non-crystallization
KER 8132	4,650-5,130	195-215	0.5-0.7	Max. 100	-	Diluted with AGE, Low viscosity
KER 815	5,100-5,600	178-196	0.7-1.1	Max. 100	-	Diluted with n-BGE, Low viscosity
KER 815HC	4,651-5,128	195-215	0.8-1.6	Max. 100	17,500-19,500	
KER 815J	5,128-5,714	175-195	0.15-0.5	Max. 100	6,000-9,000	-
KER 8240	4,545-5,000	200-220	0.7-1.1	Max. 100	< 400	Diluted with AGE, BA
KER 880	5,263-5,376	186-190	12-14	Max. 100	< 300	Standard, Low $\alpha$ -glycol
KER 827	5,400-5,550	180-185	8.0-10.5	Max. 100	< 400	Standard
KER 828K	5,290-5,346	187-189	11-14	Max. 100	180-250	
KER 828	5,260-5,420	184-190	12-14	Max. 100	< 400	
KER 828EL	5,260-5,420	184-190	12-14	Max. 100	< 200	
KER 828A	5,200-5,400	185-192	12-15	Max. 100	1,000-2,000	Standard, Non-crystallization
KER 828H	4,878-5,348	187-205	12-18	Max. 100	5,000-10,000	Non-crystallization, Low viscosity
KER 828S	4,444-4,878	205-225	19-24	Max. 100	18,500-22,000	
KER 828HC	4,000-5,000	200-250	20-30	Max. 100	18,000-28,000	
KER 828LV	5,340-5,500	182-187	10-12	Max. 100	< 500	Low viscosity
KER 828HLV	5,350-5,520	181-187	9-11	Max. 100	< 400	
KER 829	5,076-5,235	191-197	3.0-7.0	Max. 100	-	High reactivity
KER 834	3,800-4,250	235-263	2.1-2.3 *	Max. 100	< 300	Semi-solid, Available in Solution
KER 836	2,990-3,450	290-334	2.0-3.6 *	Max. 100	-	
KER 8828HB	4,390-4,813	208-228	1.5-2.0	Max. 100	5,400-9,000	Diluted with Benzyl alcohol, Low viscosity

• 1 Pa.s = 10 Poise

• Viscosity \* = 40wt.% Solid in MEK

## 02 KER Solid Epoxy Resins

Solid KER epoxy resins are mainly used in the manufacture of solvent-borne paints, air-drying epoxy esters, can coatings, PCM(coil) coatings, powder coatings, printing wiring board and moulding powders. The KER grade range contains resins of different molecular weight. All solid KER epoxy resin grades, manufactured by Kumho P&B Chemicals, Inc., are characterized by a low and consistent hydrolizable(or saponifiable) chlorine contents.

Grade	EGC (mmol/kg)	WPE (g/eq)	Viscosity@25°C (mPa.s)	Color (Pt/Co)	Remark
KER 1001MSQ	1,740-2,000	500-575	6.3-7.9	Max.100	Less sintering than 1-type resin
KER 3001	2,000-2,220	450-500	6.3-7.9	Max.100	Ambient cure, Marine & Heavy duty coatings
KER 3001N	2,040-2,170	461-490	5.3-6.8	Max.100	
KER 3022	1,429-1,667	600-700	5,000-15,000 <sup>*1</sup>	-	Powder coatings
KER 3002	1,420-1,600	625-704	10.5-13.5	Max.100	
KER 3002N	1,515-1,560	641-660	8.9-9.8	Max.100	
KER 3003	1,260-1,420	704-794	13-17	Max.100	
KER 3003-FCA-10	1,135-1,295	770-880	Flowing Agent 9.0-11.0(wt.%)	-	Contain Flow control Agent
KER 3003KFL	1,260-1,380	725-794	Flowing Agent 2.43-2.97(wt.%)	-	
KER 3004NFL	952-1,111	900-1,050	Flowing Agent add type	-	
KER 1004	1,053-1,177	850-950	15-25	Max.100	Powder coatings, Can coatings
KER 3004	1,020-1,180	847-980	20-25	Max.100	
KER 3005N	714-833	1,200-1,400	25-55	Max.100	
KER 3007	600-820	1,220-1,667	42-80	Max.100	Stoved coatings, Can coatings & primer coating for pre-coated Metal
KER 1009	260-440	2,273-3,846	100-280	Max.100	

- Viscosity : 40wt.% Solid in MEK
- Viscosity <sup>\*1</sup> : melt viscosity @ 120°C

## 03 Composite Epoxy Systems for Infusion / RTM / Hand Laminating

### • INFUSION / RTM

KER 9100 / KER 9200 / KFER 9400 epoxy systems, low viscosity resin, are appropriated for vacuum assisted resin infusion or RTM process. Due to the low viscosity and outstanding mechanical performance, the KER epoxy systems are particularly suitable for the production of large, fiber reinforced, composite parts.

Epoxy(A) Curing Agent(B)	Viscosity (mPa.s at 25°C)	Mixing Ratio (A:B)	Mixing Viscosity (mPa.s at 25°C)	Gel time at 25°C (min)	Tg (°C)	Remark
KER 9100	800-1,400					
KCA 9110	10-60	100:30	200-300	450-550	85-100	Standard
KCA 9120	10-50	100:30	200-300	350-450	85-100	Faster
KER 9200	400-800					
KCA 9210	30-100	100:31	200-500	300-400	100-140	Slower
KCA 9220	30-100	100:28	200-500	150-250	100-140	Standard
KFER 9400	4,000-6,500					
KFCA 9400	20-200	100:29	3,000-3,700	80-100	110-125	UL94 V0
KFCA 9410	20-200	100:82	500-800	250-300	110-125	UL94 V1
KER 93150	800-1,200					
KCA 93150	10-100	100:44	500-800	60-90 at 60°C	150-160	
KER 93180	1,000-2,500					
KCA 93180	10-100	100:47	500-800	60-90 at 60°C	180-190	
KER 93200	2,000-5,000					
KCA 93200	30-180	100:50	400-700	20-40 at 60°C	200-210	

## • HAND LAY-UP / LAMINATING

The hand lay-up epoxy systems are designed for hand laminating, repairing components for high static and dynamic loads. It consists of an epoxy resin with a variety of amine curing agents for different gel time. The viscosity of the system is optimized to offer the appropriate balance between application properties and fiber wetting.

Epoxy(A) Curing Agent(B)	Viscosity (mPa.s at 25°C)	Mixing Ratio (A:B)	Mixing Viscosity (mPa.s at 25°C)	Gel time at 25°C (min)	Tg (°C)	Remark
KER 9500	2,200-3,200					
KCA 9510	800-1,200	100:35	900-1,300	15-35	120-135	
KCA 9520	20-200	100:27	900-1,300	30-100	110-125	

## • STRUCTURAL ADHESIVES

Epoxy(A) Curing Agent(B)	Viscosity (mPa.s at 25°C)	Mixing Ratio (A:B)	Mixing Viscosity (mPa.s at 25°C)	Gel time at 25°C (min)	Tg (°C)	Remark
KER 9900	Thixotropic					
KCA 9910	Thixotropic	100:45	Thixotropic	80-120	90-110	
KCA 9920	Thixotropic	100:45	Thixotropic	150-250	80-100	

## • 1-PACK EPOXY RESIN

Epoxy	Viscosity (mPa.s at 25°C)	Gel time at 100°C (min)	Gel time at 120°C (min)	Tg (°C)	Remark
KER 9861	2,000-4,000	10-20	4-6	110-130	



## 04 Composite Epoxy Systems for Mass Production

### • HPRTM / WCM

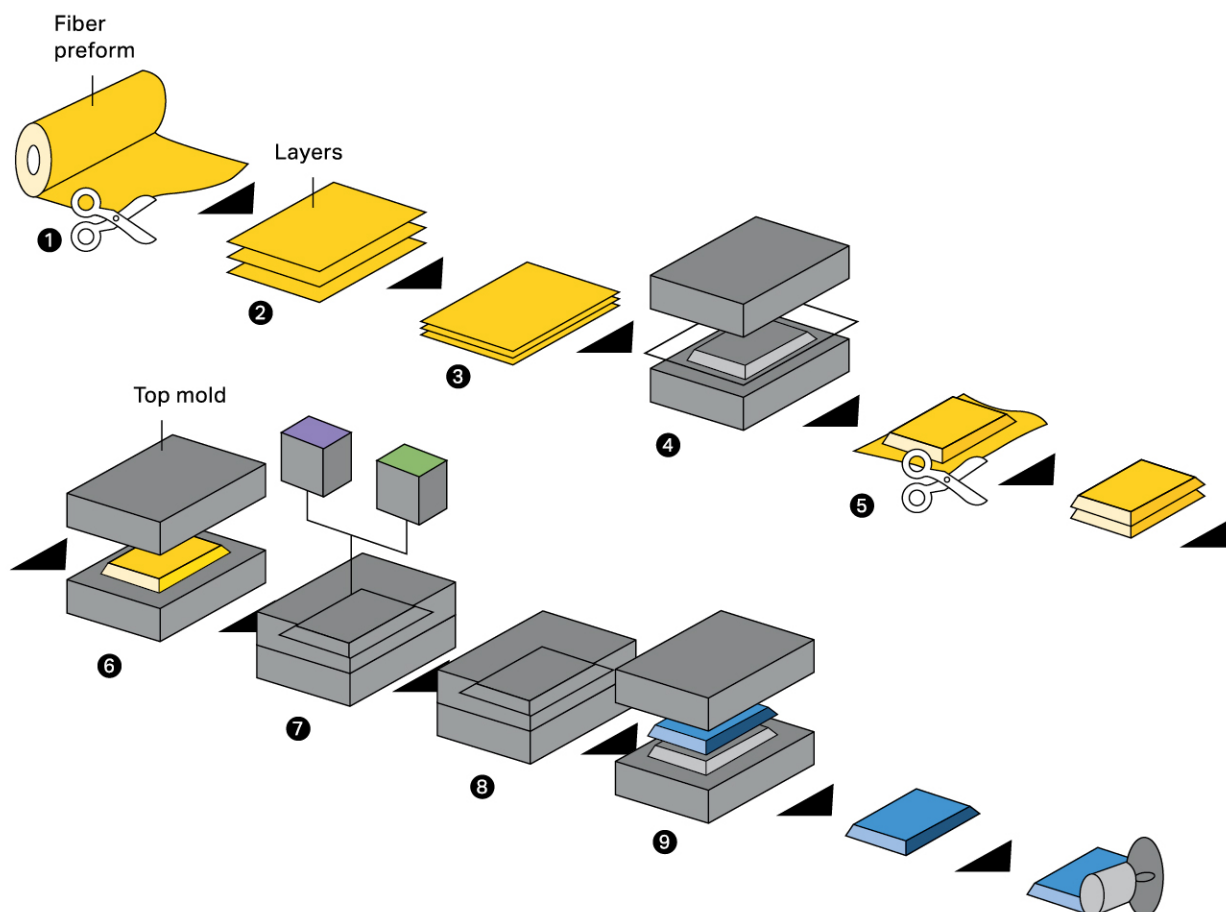
KER 9600 / KER 9610 epoxy systems, designed for fast curing rate, are good enough low viscosity for HPRTM and WCM process. It consists of an epoxy resin with a variety of amine curing agents for different gel time. In addition, KER 96XXX systems are designed for high temperature resistant epoxy system with fast curing for mass production.

Epoxy(A) Curing Agent(B)	Viscosity (mPa.s at 25°C)	Mixing Ratio (A:B)	Mixing Viscosity (mPa.s at 120°C)	Gel time	Tg (°C)	Remark
KER 9600	7,000-10,000					Standard
KCA 9610	10-50	100:20	30-100	< 1 min at 125°C	100-130	
KCA 9620	10-50	100:17	30-100	< 2 min at 115°C	100-130	
KCA 9630	10-50	100:20	30-100	< 5 min at 110°C	100-130	
KER 9610	2,000-4,000					Low Viscosity
KCA 9610	10-50	100:20	30-100	< 1 min at 125°C	100-130	
KCA 9620	10-50	100:17	30-100	< 2 min at 125°C	100-130	
KCA 9630	10-50	100:20	30-100	< 5 min at 125°C	100-130	
KER 96150	3,000-5,000					
KCA 96150	10-50	100:24	50-200	< 5 min at 120°C	150-160	
KER 96180	40,000-60,000					
KCA 96180	10-50	100:30	50-200	< 5 min at 120°C	180-190	
KER 96200	10,000-20,000					
KCA 96200	10-50	100:32	50-200	< 5 min at 120°C	200-210	

### • EPOXY BINDER

Epoxy	Aspects	Curing	Remark
KER B9803	Powder	Non-Curable	
KER B9807	Powder	Non-Curable	





## • SHORT CYCLE TIME

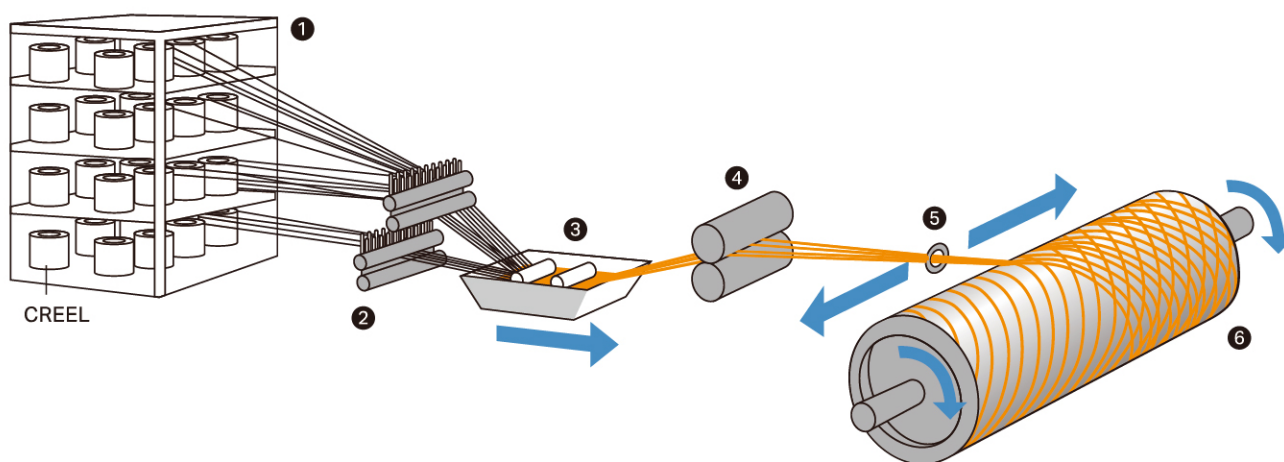
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|----------------------------|-----------------------------|----------------------------------|
| ① Binder Stabilized Fabric | ④ Heating and Some Pressure | ⑦ Mold Closing & Resin Injection |
| ② Fabric Lay-up            | ⑤ Stabilized Preform        | ⑧ Curing                         |
| ③ Preforming               | ⑥ Transfer to Mold          | ⑨ Demolding                      |

## 05 Composite Epoxy Systems for Filament winding / Pultrusion / Prepreg

### FILAMENT WINDING / PULTRUSION

KumhoP&B Chemicals supply various type of epoxy resin and curing agent for filament winding and pultrusion process. The systems are well customized for our customers, so our technical service will develop according to each requirements.

Epoxy(A) Curing Agent(B)	Viscosity (mPa.s at 25°C)	Mixing Ratio (A:B)	Mixing Viscosity (mPa.s at 25°C)	Gel time at 25°C (min)	Tg (°C)	Remark
KER 828	12,000-14,000					CNG Tanks
KCA 4089		100:90	10-100 at 120°C	5-7 min 120°C	110-130	
KER 827	500-2,000					Tanks
KCA 4089	10-200	100:90	50-200 at 120°C	> 10 min at 120°C	110-130	
KER 9300	8,000-10,000					Tanks
KCA 4510	10-100	100:32	1,000-3,000	3-4 min at 120°C	140-160	
KFER 9410	8,000-11,000					UL94 V0
KFER 9410	10-50	100:35	1,000-2,000	< 10 min at 120°C	120-140	



### FILAMENT WINDING PROCESS

① CONTINUOUS ROVINGS

② SEPARATOR COMBS

③ RESIN BATH

④ NIP ROLLERS

⑤ GUIDE

⑥ ROTATING MANDREL

- EPOXY RESIN FOR PREPREG**

<b>Epoxy(A) Curing Agent(B)</b>	<b>Accelerator(C)</b>	<b>Mixing Ratio</b>	<b>Drying time</b>	<b>Tg(°C)</b>	<b>Remark</b>
KER 9814					
KCA 9814	KCA 9814I	100:2-10:2-5	24h at Ambient Temp.	110-130	Ambient aging
KER 9815					
KCA 9815	-	100:5-15	1-3h at 80-100°C	110-130	Heat Aging

**SEOUL OFFICE**

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