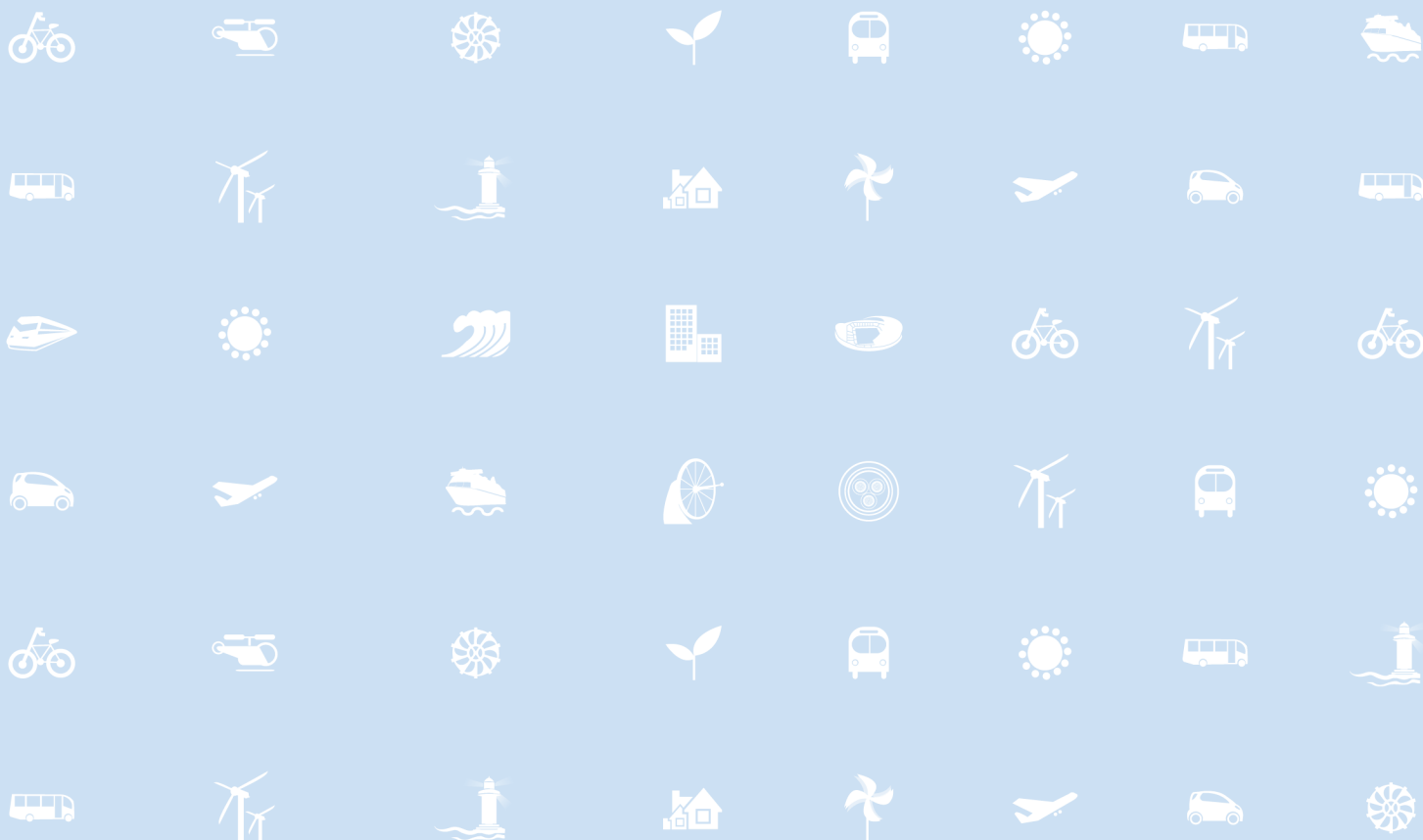




BEYOND EXPECTATION & BEYOND LIMITATION



**POLYOL**





## MESSAGE FROM CEO

Dear valuable customers,

First of all, I would like to express my deepest gratitude to our valuable customers in the world who have constantly supported Kukdo Chemical Co., Ltd. to become the global leader of Epoxy industry. Since Kukdo set foot in the world of epoxy for the first time in Seoul, Korea 42 years ago, we have overcome a lot of challenges successfully, thanks to the full support from our customers.

Kukdo currently operates 3 factories in Korea and 1 in China for produce 543,000mt of epoxy resins and 120,000mt of polyol annually. We also set up a logistics center in the heart of Europe where we are able to provide the most efficient and prompt delivery service. It is a huge benefit to our valuable customers that they are able to avoid the risk of time lag and reduce the burden of inventory. We are working hard to finalize our global supply networks in a few years to provide the same excellent service to our customers who are outside of our current network.

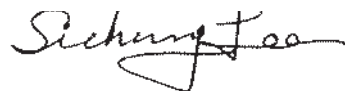
Furthermore, Kukdo continuously focuses on our well-organized quality control and environmental management system based on ISO-9000 and 14001 for our customer's confidence. We also increasingly put our efforts toward developing innovative products for our valuable customers who are engaged in a variety of applications including electric & electronic products, automobiles, wet & powder coatings, composites, adhesives and insulation. We are strongly confident that our continuous efforts on R&D benefit our valuable customers enormously, which eventually increase our customer's value.

As Kukdo's core value is "For customer value", we try to provide our valuable customers with a total solution; supplying trend-leading products, innovative materials, cost-efficient packaged delivery service, technology and market information in cooperation with our valuable customers. Our core value will be firmly alive in our daily life in Kukdo.

All members of Kukdo always appreciate the full support from our valuable customers and promise that we will continuously try our best for our customer's success.

Faithfully yours,

Si Chang Lee, President



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THE WORLD BEST EPOXY PRODUCER



**GLOBAL  
SALES  
NETWORKS**



## KUKDO HISTORY

### 1970~80's History

- Feb. 1972 Establishment of KUKDO CHEMICAL Industry CO., LTD.
- Jan. 1973 Completion of Seoul factory for Epoxy resin & Hardener (1st factory in Korea)
- Oct. 1983 Establishment of R&D Center.

### 1990's History

- Apr. 1994 Completion of Iksan factory for Epoxy resin & Hardener (2nd factory in Korea)
- Mar. 1996 Establishment of KUKDO Fine Chemical in Sihwa(3rd factory in Korea)
- May. 1997 Establishment of PU Business Division
- Apr. 1999 Change Company Name to KUKDO CHEMICAL CO., LTD.

### 2000's History

- Apr. 2002 Establishment of KUKDO CHEMICAL (KunShan) CO., LTD. in China
- Nov. 2003 Completion of KunShan factory for Polyol and Epoxy resin in China
- Jul. 2004 Completion of Busan factory for System Polyol and Epoxy resin in Busan
- Dec. 2004 1st expansion of 16KT of Polyol in China factory(Total 65KT)
- Mar. 2008 Acquisition of HAJIN CHEM TECH
- Nov. 2008 Completion of 40KT of Liquid Epoxy resin in Iksan
- Dec. 2008 Awarded 200 Million Dollar Export Tower Prize (45th Trade Anniversary)
- Nov. 2010 Awarded 2010 Global Excellent Management by JMAC
- Apr. 2011 Obtained Customs approved registered exporter Certificate by Customs
- Sep. 2011 Obtained AEO(Authorized Economic Operator) Certificate by Customs
- Dec. 2011 Awarded 300 Million Dollar Export Tower Prize (48th Trade Anniversary)
- Dec. 2011 Awarded Korean World-class Product Award 2011 by Knowledge Economy
- May. 2012 2nd expansion of 55KT of Polyol in China factory(Total 120KT)
- Feb. 2013 Establishment of SHINDO CHEMICAL CO., LTD.

With unceasing spirits of innovation and challenge

# KUKDO BRINGS CONVENIENT AND WEALTHY LIFE TO YOU.



Head Office



Iksan Factory



Busan Factory



**Kukdo** is certified to ISO-9001/ISO-14001 and complying with the most stringent requirements for manufacturing, sales and management under new regulations such as REACH, RoHS and GHS.

All of the relevant products have been registered under REACH.

**Kukdo** is also committed to developing new and novel products to follow the ever more stringent environmental requirements.





SIHWA Factory



CHINA Factory

## MANAGEMENT PHILOSOPHY OF KUKDO

1. CUSTOMER CENTERED
2. EMPLOYEE'S HAPPINESS
3. RESPONSIBILITIES TOWARD STOCK HOLDERS
4. MID & LONG TERM PREDICTION and PREPARATION
5. CEASELESS CHALLENGE and INNOVATION
6. LEGITIMACY and JUSTICE
7. SOCIAL RESPONSIBILITIES

# KUKDO POLYOL

## What is vision EGK 2015

### Achievement of customer's absolute satisfaction!

We provide top quality products and total solutions

### The world's best Quality Manufacturer

- The global standard company satisfying customer's needs
- Secure global network, human resources, marketing and products capacity to meet customer's demand all over the world
- Provide customers with comprehensive techniques and services

### Excellent and Great KUKDO

Respectable and transparent company as a global standard top-ranking company

### Human Resources Management

- Help employees to realize their ambitions
- Respect employee's creativity & competence
- Promote the most talented people

### Emphasis on R&D

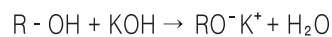
- Lead the advanced technology in the world wide chemical market



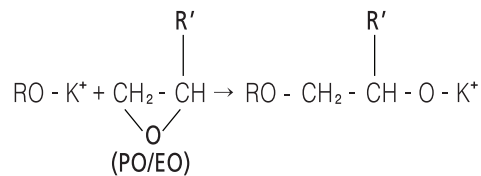
## WHAT IS POLYOL?

Polyol, abbreviation of polyhydric alcohol, is a kind of alcohol which has more than two hydroxyl groups. It is made of two components polymerization, one is **PO or PO/EO** and the other is **starting compound** which hydroxyl groups are two or more. It is a hydroxyl-group terminated compound which has a molecular weight from hundreds to thousands.

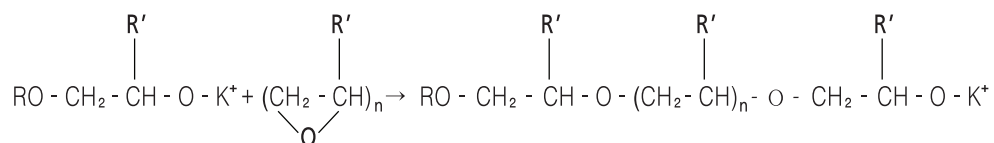
### Catalyst Addition



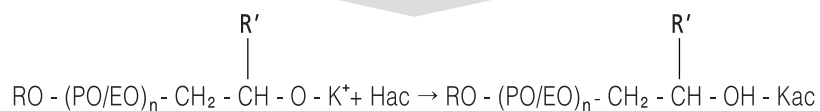
### Initiation Reaction



### Propagation Reaction

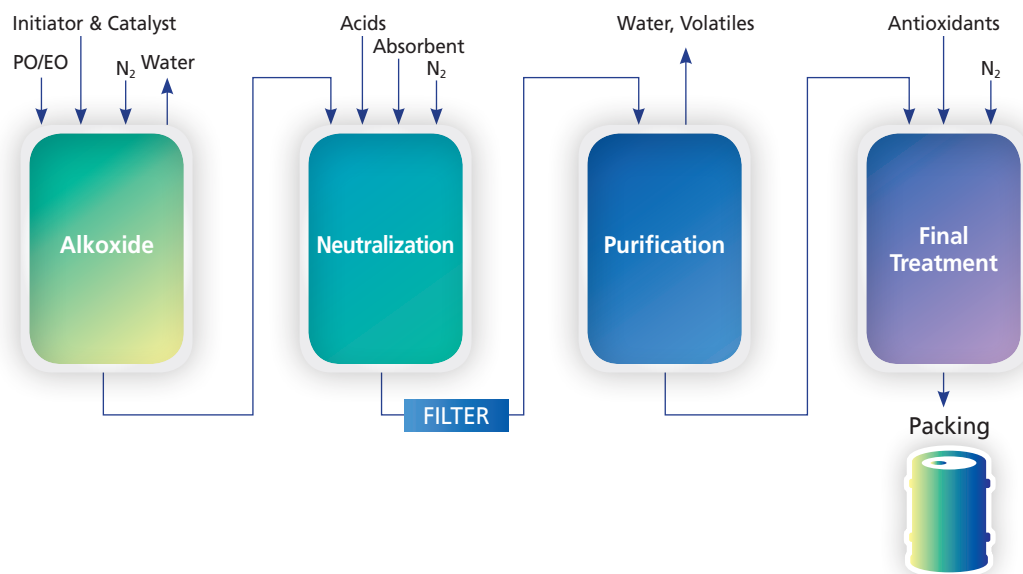


### Neutralization Reaction

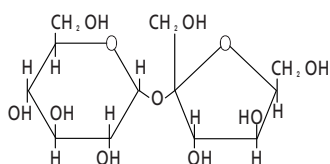


# KUKDO POLYOL

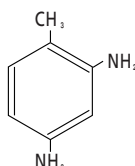
## Polyol Manufacturing Process



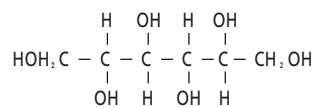
## Chemical Structure of Initiators



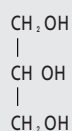
**Sucrose(SC)**



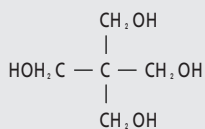
**Toluenediamine(TD)**



**Sorbitol(ST)**



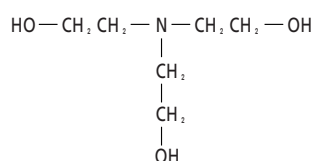
**Glycerine(GY)**



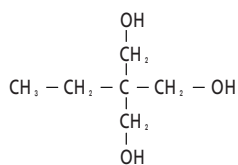
**Pentaerythritol(PN)**



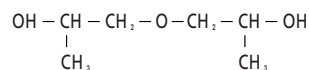
**Ethylene Diamine(ED)**



**Triethanol Amine(TE)**



**Trimethylol Propane(TP)**



**Dipropylene glycol(DP)**

## POLYETHER POLYOL

**POLYETHER POLYOL** enables users to synthesize various of polyurethane resins from flexible to rigid one and ensure their high quality to be applied at wide range of applications, such as Foam and CASE. Due to our up-to-date synthesizing and refining technology, the products show excellent mechanical and physical properties.

GRADE		FOAM										NON-FOAM			
		RIGID			SEMI-RIGID			FLEXIBLE			ISF				
		Insulation	MDF wood	Fire retardance	Mold foam	Slab foam	Chain extender	Mold foam	Slab foam	HR foam	Chain extender	Integral skin foam	Elastomer	Sealant	Coating
DP-400	DP-700N											●		●	●
DP-750	DP-750E											●		●	●
DP-1000												●	●	●	●
DP-2000	DP-2000P							●				●	●	●	●
DP-2000E	DP-2500E											●	●	●	●
DP-3000	DP-3500E											●	●	●	●
DP-4000	DP-4000E											●		●	
DP-6000E														●	●
GY-250		●	●			●									
GY-420	GY-440	●	●			●								●	●
GY-600E		●	●												
GY-700			●			●								●	●
GY-750P			●												
GY-1000													●	●	●
GY-3000	GY-3000M							●					●		
GY-3000E							●								●
GY-3010E	GY-3011E							●							
GY3350E							●								
GY-3500												●	●		
GY-4000												●	●		
GY-5000E	GY-5002E						●					●			
GY-5100													●	●	
GY-6000E	GY-6500E						●					●			
ST-480	ST-481	●	●												
SC-357	SC-370	●	●												
SC-381		●	●			●			●						
SC-400	SC-450	●	●												
SC-455	SC-456	●	●												
SC-490	SC-4508	●	●												
SC-510		●	●												
ED-500	ED-750	●	●			●			●	●					
PN-400	PN-560	●	●												
TD-400	TD-405	●	●	●											
TE-360		●	●												
TP-400			●			●			●					●	●
TR-390		●	●						●						

# KUKDO POLYOL

## Polyol for CASE / Non foam

For CASE(Coating, Adhesive, Sealant, Elastomer), two functional diol is conventionally used and KUKDO's products are designed to synthesize stable prepolymer.

Grade	Color (APHA)	OHV (mgKOH/g)	Viscosity (cps/25°C)	AV (mgKOH/g)	Water Content(%)	pH	Reference
DP-400	50 max	265-295	50-80	0.05 max	0.05 max	5-7	High purity  Narrow molecular weight distribution  Tensile strength, elongation, hardness, improvement  Good flowability
DP-700N	40 max	155-165	90-130	0.05 max	0.05 max	6-7	
DP-750	50 max	145-155	90-130	0.05 max	0.05 max	5-7	
DP-750E	50 max	145-155	100-160	0.05 max	0.05 max	5-7	
DP-750P	50 max	145-155	90-130	0.05 max	0.05 max	5-7	
DP-1000	50 max	108-116	125-175	0.05 max	0.05 max	5-7	
DP-2000	50 max	54-58	270-340	0.05 max	0.05 max	5-7	
DP-2000E	50 max	54-58	270-340	0.05 max	0.05 max	5-7	
DP-2000P	50 max	54-58	270-340	0.05 max	0.05 max	5-7	
DP-2500E	50 max	44-48	320-470	0.05 max	0.05 max	5-7	
DP-3000	50 max	33-37	560-640	0.05 max	0.05 max	5-7	
DP-3500E	50 max	31-35	700-1,000	0.05 max	0.05 max	5-7	
DP-4000	50 max	26-30	700-900	0.05 max	0.05 max	5-7	
DP-4000E	50 max	26-30	750-950	0.05 max	0.05 max	5-7	
DP-6000E	50 max	18-22	1,800-2,300	0.05 max	0.05 max	5-8	
DE-600	50 max	178-197	100-200 (@20°C)	0.1 max	0.1 max	5-7	Good flowability
DE-2500	80 max	43-47	-	0.1 max	0.2 max	5-7	
GY-700	50 max	225-255	250-350	0.05 max	0.05 max	5-7	
GY-1000	50 max	158-178	200-300	0.05 max	0.05 max	5-7	
GY-3000	50 max	54-58	460-520	0.05 max	0.05 max	5-7	
GY-3500	50 max	46-50	500-700	0.05 max	0.05 max	5-7	
GY-4000	50 max	41-45	600-800	0.05 max	0.05 max	5-7	
GY-5100	50 max	31-35	800-900	0.05 max	0.05 max	5-7	

## Polyol for Rigid Polyurethane

Comparing to adiabatic materials, the products have many advantages in adhesion, weight, buffer and simplicity, heat resistance. Especially, the excellent properties allow them to be applied at the various industries such as civil construction, home appliances and furniture.

Grade	Color	OHV (mgKOH/g)	Viscosity (cps/25°C)	AV (mgKOH/g)	Water Content(%)	pH	Reference
GY-250	70 max (APHA)	655-695	800-1,000	0.1 max	0.08 max	5-8	Low viscosity High density
GY-420	50 max (APHA)	385-415	300-400	0.1 max	0.08 max	5-8	
GY-440	50 max (APHA)	370-400	300-400	0.1 max	0.08 max	5-8	
GY-600E	50 max (APHA)	270-290	200-300	0.1 max	0.08 max	5-8	Low viscosity High reactivity
SC-357	4(G) max	327-387	1,500-3,000	0.1 max	0.1 max	5-8	General rigid foam Multi-functionality Excellent mechanical property
SC-370	5(G) max	355-380	3,000-4,000	0.1 max	0.1 max	5-8	
SC-381	4(G) max	365-395	6,000-8,000	0.1 max	0.1 max	4.5-7.5	
SC-400	5(G) max	380-420	4,500-6,500	0.1 max	0.1 max	5-8	
SC-450	5(G) max	430-470	14,000-19,000	0.1 max	0.1 max	4.5-7.5	
SC-4508	4(G) max	440-480	4,500-7,500	0.1 max	0.1 max	5-8	
SC-455	9(G) max	430-470	3,500-6,500	0.1 max	0.1 max	9-11	
SC-456	7(G) max	435-475	4,000-7,000	0.1 max	0.1 max	9-11	
SC-490	6(G) max	470-510	6,000-10,000	0.1 max	0.1 max	5-8	
SC-510	4(G) max	485-525	3,600-4,700	0.1 max	0.1 max	5-8	
ST-480	400 max (APHA)	460-500	35,000-50,000	0.1 max	0.1 max	6-9	Dimensional stability
ST-481	250 max (APHA)	460-500	15,000-22,000	0.1 max	0.1 max	6-9	
ED-500	100 max (APHA)	480-520	6,100-7,700	-	0.1 max	-	Aliphatic amine Crosslinking agent Spray system
ED-750	100 max (APHA)	730-770	35,000-55,000	-	0.1 max	-	
PN-400	100 max (APHA)	380-420	1,400-2,000	0.1 max	0.1 max	5-8	High density
PN-400E	100 max (APHA)	375-420	1,000-1,600	0.1 max	0.1 max	5-8	
PN-560	100 max (APHA)	540-580	1,900-2,800	0.1 max	0.1 max	5-8	
TD-400	-	380-420	6,900-10,111	-	0.1 max	9-11	Aromatic amine
TD-401	-	395-415	4,000-8,000	-	0.1 max	9-11	Good compatibility with isocyanate
TD-405	-	380-415	12,000-22,000	-	0.1 max	9-11	
TE-360	7(G) max	350-390	260-360	-	0.1 max	-	Low viscosity High reactivity
TP-400	100 max (APHA)	385-415	500-800	0.1 max	0.1 max	5-8	For synthesis material
TR-390	-	475-515	1,000-2500	-	0.1 max	-	Spray system

# KUKDO POLYOL

## Polyol for Flexible Polyurethane

The products are designed to perform the excellent properties to produce slabstock foam, which has good vent and cozy cushion, as well as ISF, which is soft sufficient to shock-absorbing car seat and soundproof materials.

Grade	Color (APHA)	OHV (mgKOH/g)	Viscosity (cps/25°C)	AV (mgKOH/g)	Water Content(%)	pH	Reference
GY-750P	50 max	214-234	220-320	0.1 max	0.08 max	5-8	Slow recovery foam
GY-3000M	50 max	54-58	450-650	0.1 max	0.08 max	5-8	Slabstock
GY-3000E	50 max	52-56	450-550	0.1 max	0.08 max	5-8	High reactivity, Mold foam
GY-3010E	50 max	54-58	400-700	0.1 max	0.08 max	5-8	Slabstock
GY-3011E	50 max	54-58	400-700	0.1 max	0.08 max	5-8	
GY-3350E	50 max	48-55	615-815	0.1 max	0.05 max	5-8	High reactivity, Cell opener
GY-3500M	50 max	46-50	600-800	0.1 max	0.08 max	5-8	Slabstock
GY-5000E	50 max	31-35	850-980	0.1 max	0.08 max	5-8	High elasticity
GY-5002E	50 max	31-35	860-980	0.05 max	0.08 max	5-8	
GY-6000E	50 max	26-30	1,000-1,300	0.1 max	0.08 max	5-8	
GY-6500E	50 max	24-28	1,000-1,400	0.1 max	0.1 max	5-8	



## Polymer Polyol

The products are an inactive polyether polyol modified with a styrene-acrylonitrile(SAN) polymer for slab and flexible polyurethane foam.

Grade	OHV (mgKOH/g)	Viscosity (cps/25°C)	AV (mgKOH/g)	Water Content(%)	pH	Reference
KPOP-3045	28-32	4,500-6,500	0.1 max	0.08 max	5-8	Slabstock
KPOP-3020	34-40	1,200-2,000	0.1 max	0.1 max	5-8	
KPOP-3022	37-41	1,000-1,400	0.1 max	0.1 max	5-8	
KPOP-3010	41-45	500-1,200	0.1 max	0.1 max	5-8	
KPOP-3013	39-44	700-1,300	0.1 max	0.2 max	5-8	
KPOP-3015	38-45	800-1,500	0.1 max	0.1 max	5-8	
KPOP-5040	20-24	6,000-9,000	0.1 max	0.1 max	5-8	HR Foam
KPOP-5041	20-24	6,000-9,000	0.1 max	0.1 max	5-8	
KPOP-5042	19-23	4,500-7,500	0.1 max	0.1 max	5-8	
KPOP-5030	23-27	3,000-5,000	0.1 max	0.1 max	5-8	
KPOP-3630	21-25	2,500-3,500	0.05 max	0.1 max	5-8	
KPOP-5020	24-29	2,500-4,500	0.2 max	0.1 max	7-9	
KPOP-5021	24-28	1,500-3,000	0.2 max	0.1 max	5-7.5	

# KUKDO POLYOL

## Mannich Polyol

The products are high reactivity and multifunctional aromatic amine phenolic polyol for general purpose rigid foam.

Grade	Color (Gardener)	OHV (mgKOH/g)	Viscosity (cps/25°C)	Water Content(%)	pH	Reference
KMP-420	6 max	400-440	8,000-15,000	0.1 max	10-12	Rigid Foam
KMP-425E	6 max	410-440	4,000-8,000	0.1 max	10-12	
KMP-470E	6 max	455-485	7,000-13,000	0.1 max	10-12	

## Bisphenol-A based Polyol

The products are polyether polyol Bisphenol A -based designed for the production of CASE/non-foam and rigid polyurethane foam.

Grade	Color (APHA)	OHV (mgKOH/g)	Viscosity (cps/25°C)	AV (mgKOH/g)	Water Content(%)	pH	Reference
BP-11	100 max	300-320	1,000-1,500 (@60°C)	0.06 max	0.05 max	6-8	Adhesive
BP-11S	100 max	265-295	5,000-10,000 (@40°C)	0.05 max	0.05 max	6-8	Chain extender for PU Elastomer
BP-33	100 max	180-210	3,500-5,500	0.06max	0.1 max	5-8	
BP-55	200 max	130-160	1,200-2,000	0.06 max	0.1 max	5-8	Rigid Foam



## POLYURETHANE SYSTEM

To meet the customer's satisfaction, KUKDO manufactures polyurethane system based on our own raw materials. We offer a wide selection from flexible to rigid system as well as guarantee the excellent mechanical and physical properties.

Series		Application
Rigid	KSF-1000	Spray
	KPF-2000	Panel, UBR
	KIF-3000	Appliance, Injection, High Density
Flexible	KFF-4000	Furniture, Cushion
	KFF-5000	Automobile (Seat, Head rest)
	KFF-6000	Automobile (Dash board)
Semi-Rigid	KMF-7000	Automobile (Steering wheel)
	KMF-8000	Furniture (Arm rest)
	KMF-9000	Integral skin foam (Cold cure)

- ▶ KSF : KUKDO Spray Foam
- ▶ KPF : KUKDO Panel Foam
- ▶ KIF : KUKDO Injection Foam
- ▶ KFF : KUKDO Flexible Foam
- ▶ KMF : KUKDO Semi-rigid Foam



# KUKDO POLYOL

## Rigid Polyurethane System

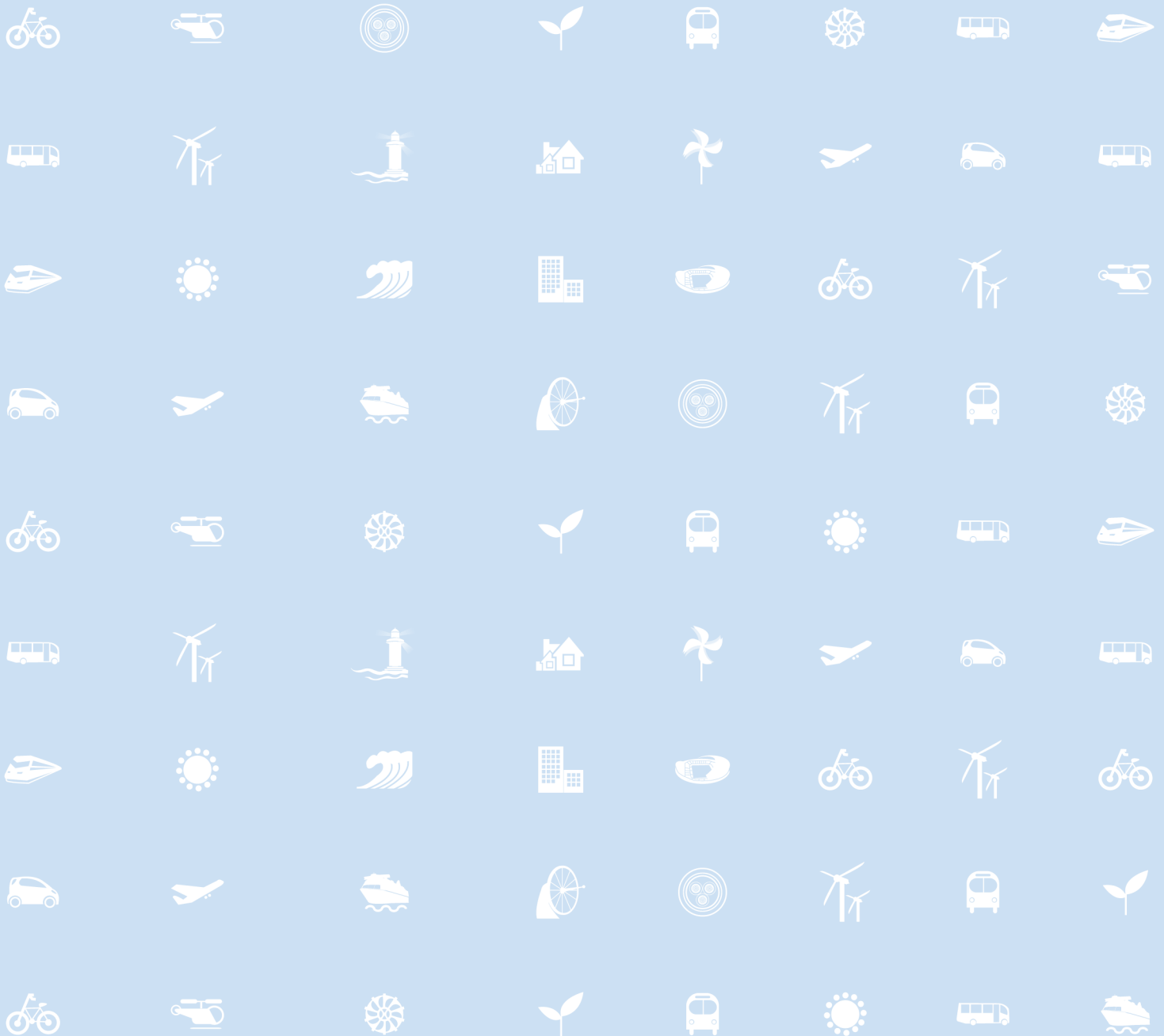
Based on its good adiabatic, hardness and adhesion, rigid system is used on interior and exterior structure of construction and refrigerating storage. Also it shows high performance in the specific application such as LNG vessel and pipe coating.

Application	Series	Density(kg/m³)	Usage	Reference
Spray	KSF-1000	8-10 25-30	Fire retardance water blown spray	All water blown system
	KSF-1200	24-26 26-28	Interior insulation material for livestock and building	HCFC-141b system
	KSF-1300	30-40	Exterior insulation and waterproof	
	KSF-1400	25-30	Fire retardance spray	
	KSF-1500	45-55	High density	
Discontinuous Panel	KPF-2100	52-56 56-60	UBR board	All water blown system
	KPF-2300	23-25 25-27	Panel (cold storage warehouse)	HCFC-141b system
	KPF-2350	50-55 55-60	For panel brim	HCFC-141b system
Continuous Panel	KPF-2400	35-38	Sandwich panel semi system	PUR HCFC-141b system
	KPF-2600	40-45	Glass wool panel siding system	HCFC-141b system
	KPF-2700	35-38	Sandwich panel system	PUR HCFC-141b system
	KPF-2800	41-45	Sandwich panel system	Fire retardance PIR system
Appliance	KIF-3000	23-25 26-29	Refrigerator	c-Pentane system
	KIF-3600	22-23 25-26	Showcase	HCFC-141b system
High Density	KIF-3100	100-130 150-180	Wood imitation	All water blown system
	KIF-3200	200-230	LNG pipe support	
	KIF-3900	1000-1200	Modeling board (Foam & Non-foam)	Shore D 65-70 Shore D 70-75
Injection	KIF-3300	40-55	Pre-insulated pipe	HCFC-141b system
	KIF-3400	40-45	LNG pipe cover	PIR block foam
	KIF-3500	35-40	Reefer container	HCFC-141b system
	KIF-3700	22-24 26-28 30-35	Water tank, boiler insulation	HCFC-141b system
Adhesive	KA-604F		Adhesive for EPS and glass wool	All water blown system

## Conventional Flexible and Car Application

Flexible system is open cell structure and suitable to manufacture various cushion materials by the slabstock or molding process. Car application has high elasticity, which shows good properties in shock absorbing and sound-proof.

Application	Series	Density(kg/m <sup>3</sup> )	Usage	Reference
Furniture	KFF-4000	30-40	Furniture and Cushion for automobile	High resilience foam
		40-50		
		50-60		
	KFF-4100	20-25	Medical and Cushion	Soft foam
		25-30		
	KFF-4200		Sofa and Cushion	High resilience foam
	KFF-4300	25-30	Sound-proof and Packing	High hardness foam
		30-35		
Automobile	KFF-5000	35-45	Seat cushion	High resilience back seat
		40-50		Dual hardness back seat
		40-50		Dual hardness cushion
		50-60		High density cushion
	KFF-5100	50-60	Head rest	High density foam
		60-70		
	KFF-6000	70-90	Dash board	Sound-proof
		100-120		
	KMF-7000	400-500	Steering wheel	Pentane system
		400-500		Water blown system
	KMF-9000	400-500	Handle	Integral skin foam



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