

# POKETONE<sup>TM</sup>

## HYOSUNG POLYKETONE



### Non Toxic High Efficiency

Acrylate Free  
Melamine Free  
Bisphenol A Free  
Formaldehyde Free  
Lead/ Chrome/ Free  
Phthalate Free

### Global Warming Potential

PA6	6.7
PA66	6.4
mPPE	6.0
PBT	4.9
PC	3.4
POM	3.2
PK	3.1
Bio PK	2.8

(kg CO<sub>2</sub> eq)

\* mPPE data is based on the thesis "A Comparative Life Cycle Assessment of Alternative Polymers to Poly(vinyl-chloride) for Use in Flooring Applications by Lund University.

\* Other ETP data is based upon the Eco-profiles data from [www.plasticseurope.org](http://www.plasticseurope.org)

\* PK data are based upon Ecovincent database according to ISO Standard 14040 and 14044.

**Bio PK** data are based on 46% bio-ethylene content.

- Biomass uptake: 1.445kg CO<sub>2</sub> eq

A new thermoplastic polymer HYOSUNG POKETONE is a family of semi-crystalline aliphatic polyketone, made of carbon monoxide(CO) and olefins. POKETONE Terpolymer of CO, ethylene and propylene are used as engineering plastics in a broad range of applications with eco-friendly and non-toxic characteristics, such as low TVOCs(Total volatile organic compounds), free of formaldehyde and acrylonitrile, making it perfect not only for automotive parts but also toys, cosmetic cases and food contact applications.

## Abrasion/ Wear Resistance

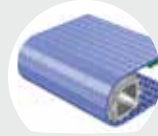
14 times higher wear properties than POM,  
reducing noise issues in variable wear applications



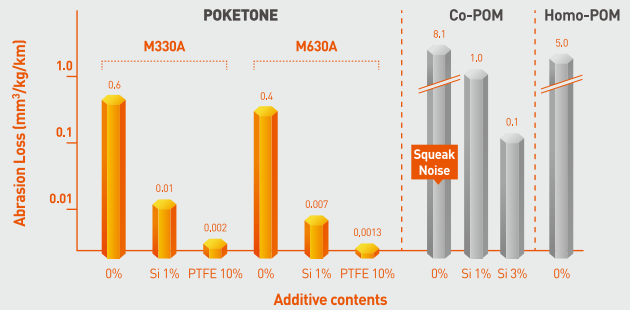
Gear



Monofilament



Conveyor Belt



## Chemical Resistance

Highly resistant to automotive fluids,  
hydrocarbon solvents, salts and weak acids/bases



Radiator End Tank



Cosmetic Parts



Oil Seal

	Semi-Crystalline						
	PK	PA66	PA12	POM	PBT	PPS	PVDF
Hydrocarbons							
Aliphatic	○	○	○	○	○	○	○
Aromatic	○	○	○	○	○	○	○
Halogenated	○	○	○	○	○	○	○
Ketones	○	○	○	○	○	○	○
Esters/Ethers	○	○	○	○	○	○	○
Aldehydes	○	●	●	○	○	○	○
Aqueous							
Water	○	●	○	○	●	○	○
Weak Acids	○	●	●	●	●	○	○
Weak Bases	○	●	●	○	○	○	●
Strong Acids	●	●	●	●	●	●	○
Strong Bases	●	●	●	○	●	●	●

○ : Resistant ● : Not Resistant

## Impact Strength

More than 2.3 times higher impact strength  
compared to Nylon, PBT



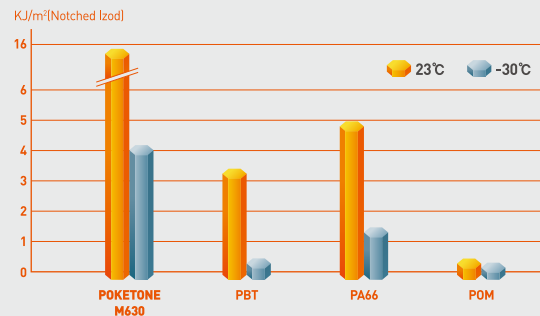
Connector



Handcart Wheel



Folding Chair Bracket



## Barrier Properties

Excellent barrier properties against hydrocarbon, fuel  
and acid gas for industrial uses



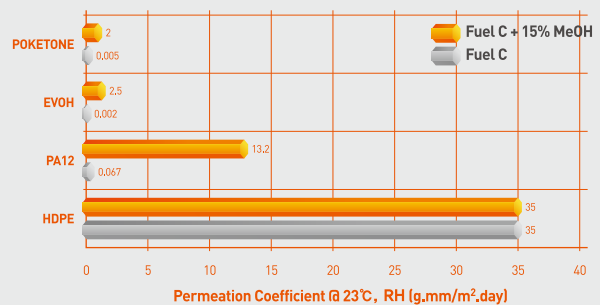
Film



Pipe



Fuel Tank



## Hydrolysis Resistance

Stable property retention to moisture, moisture  
absorption is approximately 1/4, compared to PA



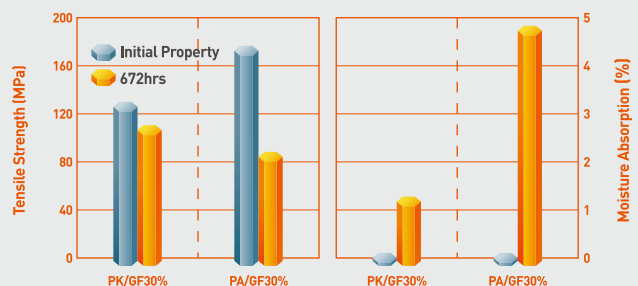
Water Meter



Water Purifier Tank



Boiler Heat Exchanger



## POKETONE Base Properties

Properties	Test Method	Unit	M130	M330	M630	M730	M640	M410	M710
<b>Physical Property</b>									
Density	ASTM D792	g/cm <sup>3</sup>	1.24	1.24	1.24	1.24	1.24	1.22	1.22
Mould Shrinkage (3mm thick.)	ASTM D955	%	1.8~2.0	1.8~2.0	1.8~2.0	1.8~2.0	1.8~2.0	1.6~1.8	1.6~1.8
<b>Thermal Property</b>									
Melting Temperature	ASTM D3418	°C	222	222	222	222	235	197	197
Melt Flow Index (240°C, 2.16kg) 220°C for M710 & M410, 255°C for M640	ASTM D1238	g/10min	200	60	6	3	6	35	3
HDT (18.6 kgf/cm <sup>2</sup> ) HDT (4.6 kgf/cm <sup>2</sup> )	ASTM D648	°C	105 200	105 200	102 195	90 190	130 215	72 155	75 155
<b>Mechanical Property</b>									
Tensile Strength at Yield	ASTM D638	MPa	63	60	58	56	67	45	43
Elongation at Break		%	≥ 100	≥ 200	≥ 200	≥ 200	≥ 200	≥ 200	≥ 200
Flexural Strength	ASTM D790	MPa	61	57	53	50	54	45	40
Flexural Modulus		MPa	1,550	1,500	1,350	1,250	1,500	1,000	900
Notched Izod Impact Strength	ASTM D256	J/m	60	95	220	240	300	110	200
		J/m	30	40	52	52	70	40	50
Surface Resistivity	ASTM D256	J/m	N.B.	N.B.	N.B.	N.B.	N.B.	N.B.	N.B.
Flammability	UL 94	Class	HB	HB	HB	HB	HB	HB	HB

\* Moisture Absorption (23°C, 50%RH) : 0.5% / Flammability : HB (0.8, 1.5, 3.0mm thick.)

\* The data listed here is not for specification warranty, but typical value.



## Certification



## POKETONE Compound Properties

Properties	Test Method	Unit	GF reinforced					
			General			Food & Drinking Water		
			M13FG6A	M13FG9A	M43AG6A	M33FG6A	M33FG9A	M33FG9A
			GF 30%	GF 50%	GF 30%	GF 30%	GF 50%	GF 30%
Density	ASTM D792	g/cm <sup>3</sup>	1.46	1.68	1.48	1.46	1.69	1.46
Melt Flow Index (240°C, 2.16kg)	ASTM D1238	g/10min	46	25	4.4	14	3	14
HDT(18.6kgf/cm <sup>2</sup> )	ASTM D648	°C	210	210	210	210	210	210
Tensile Strength at Yield	ASTM D638	MPa	145	165	130	140	155	140
Elongation at Break	ASTM D638	%	3	2	3	4	2.9	4
Flexural Strength	ASTM D790	MPa	190	214	191	190	210	190
Flexural Modulus	ASTM D790	MPa	7,100	11,800	6,800	6,600	10,000	6,600
Notched Charpy Impact Strength	ISO 179/1eA	kJ/m <sup>2</sup>	11	11	13	12	13	12

Melting Temperature: 222°C(ASTM D3418)

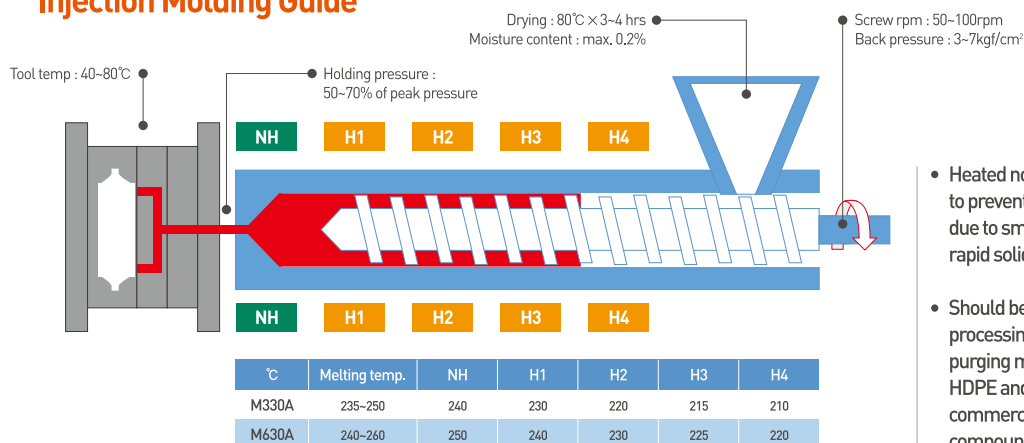
Properties	Test Method	Unit	Flame Retardant					
			M33AF1Y	M33AF2Y	M33AG2Y	M33AA2Y	M13FB5Y	M13FA7Y
			-	-	GF 5%	GF 30%	GF 30%	GF 30%
Flammability (t=0.8mm)	UL 94	Class	0.4T V-0	0.8T V-0	0.8T V-0	0.8T V-0	1.6T V-0	1.6T V-1
Density	ASTM D792	g/cm <sup>3</sup>	1.25	1.26	1.29	1.48	1.48	1.46
Melt Flow Index (240°C, 2.16kg)	ASTM D1238	g/10min	35	34	25	8	33	40
HDT(4.6kgf/cm <sup>2</sup> )	ASTM D648	°C	190	190	212	220	220	220
Tensile Strength at Yield	ASTM D638	MPa	46	50	53	112	115	135
Elongation at Break	ASTM D638	%	35	40	18	4.3	3.5	3
Flexural Strength	ASTM D790	MPa	65	58	79	176	180	192
Flexural Modulus	ASTM D790	MPa	1,900	1,700	2,550	7,300	7,700	7,800
Notched Izod Impact Strength	ASTM D256	J/m	45	70	70	127	95	120
Arc Resistance (AR)	ASTM D495	PLC	PLC 5	PLC 5	PLC 5	PLC 4	PLC 5	PLC 5
Hot Wire Ignition (HWI)	ASTM D3874	PLC	PLC 1	PLC 1	PLC 1	PLC 0	PLC 1	PLC 1
Comparative Tracking Index (CTI)	ASTM D3638	PLC	PLC 0	PLC 0	PLC 0	PLC 0	PLC 0	PLC 0

Melting Temperature: 222°C(ASTM D3418)

Properties	Test Method	Unit	Wear resistance					
			Mating Plastic / Low Load			Mating Steel/Low-Medium Load		
			+Rubber	+Si	+Si	+GF	+PTFE&Si	+MF
			M33R3A000	M33AS1A	M63AS1B	M33AG2T	M33AT2E	M63AM2A
Density	ASTM D792	g/cm <sup>3</sup>	1.23	1.24	1.24	1.35	1.29	1.31
Melt Flow Index (240°C, 2.16kg)	ASTM D1238	g/10min	68	49	5.7	17	20	0.2
Tensile Strength at Yield	ASTM D638	MPa	48	60	55	68	50	59
Elongation at Break	ASTM D638	%	300	200	200	8	40	77
Flexural Strength	ASTM D790	MPa	45	57	55	102	52	71
Flexural Modulus	ASTM D790	MPa	1,250	1,500	1,300	3,150	1,530	2,400
Notched Charpy Impact Strength	ASTM D256	J/m	380	76	122	132	87	132

Melting Temperature: 222°C(ASTM D3418)

## Injection Molding Guide



## Hot Runner Processing Guide

### Manifold



Externally heated systems are best. Internally heated manifolds are not suitable for POKETONE – these systems typically have hot spots and stagnation zones that cause partially solidified material to cling to the cooler manifold walls. All passages should be highly polished circular cross sections with gentle bends to minimize the possibility of stagnation zones.

### Nozzle



Nozzle and gate(for both valve gate and hot tip) elements need to be insulated from the mold plates to maintain proper temperature control. Small gate size is not recommended to prevent freeze-off issue at nozzle due to rapid solidification of POKETONE. All passages within the nozzle should be highly polished and streamlined to minimize stagnation and degradation zones. Each gate should use an individual temperature controller.

### Temperature



A typical hot runner temperature profile would range from 230°C (446°F) to 240°C(464°F) given the shear heating during processing. If the temperature at the gate is too low, melt at the gate will be too cold, which will make valve needle difficult to close and open.

### Purging



After processing, clean the hot runners by high density polyethylene or polypropylene immediately. POKETONE resin should be purged thoroughly and immediately to prevent risk of contamination like black specks and degradation.

## Solutions to Approach PK's Limitations

### Black Specks



#### ► Purging :

Purge thoroughly before and after processing to remove containinants.

#### ► Operating condition :

Keep the melt temperature as low as possible, aiming for 20°C above its T<sub>m</sub> and the maintain the residence time less than 5 min.

#### ► M/B Carrier and Pigment :

Use PK or LLDPE carriers and appropriate pigments in master batches.

#### ► Nozzle orifice size : min, Ø2,0

### UV Degradation



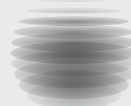
#### ► Indoor use :

Keep PK products indoor

#### ► Outdoor use :

Add UV 1164(0.5%), TiO<sub>2</sub>(2-3%), Carbon Black(1%) or Glass fiber as extra protective agents against UV degradation. Painting and vacuum coating also can significantly improve resistance to UV degradation.

### Discoloration



#### ► Storage Conditions :

Keep PK products indoor avoiding direct contact with light, heat, and humidity.

#### ► Color Choice :

Consider using black, brown and green color in the PK formulation to minimize visible color changes over time.

**[Note]** Even if color shifts PK's mechanical properties rarely changes

# New Wave of Innovation in Materials

**HYOSUNG** CHEMICAL  
CORPORATION

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RECYCLED  
MATERIAL

This eco-friendly paper contains 30%  
regenerated pulp made from recycled paper.



ELEMENTAL  
CHLORINE FREE

This eco-friendly paper is made from pulp bleached by chlorinated compounds like  $\text{ClO}_2$   
rather than elemental chlorine, so less dioxin is generated to reduce environmental impact.