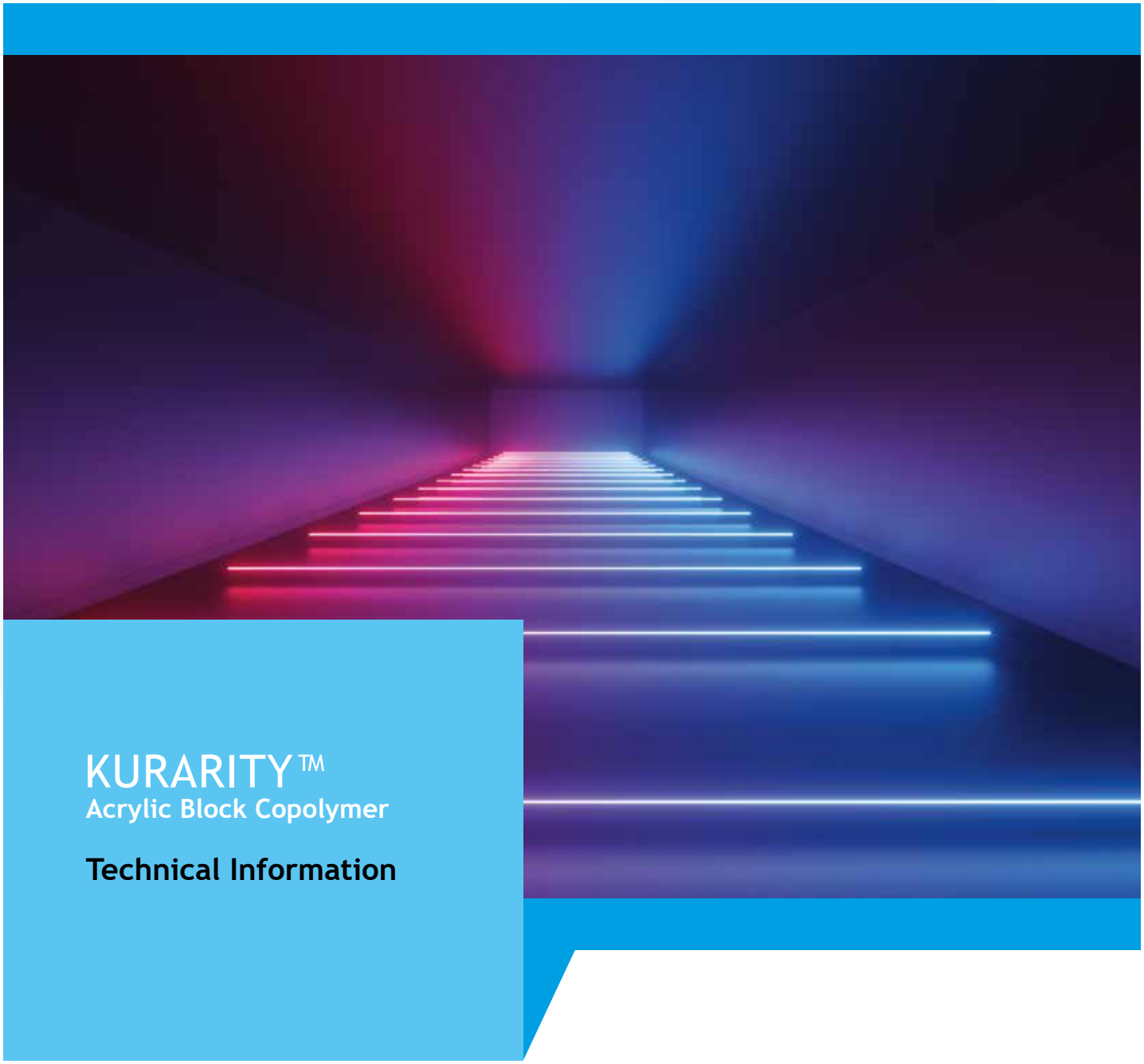
kuraray

KURARITY™



KURARITY™
Acrylic Block Copolymer

Technical Information

2 Kuraray & its elastomer business

Kuraray's development

1926 - Established in Okayama, Japan

1950 - KURALON™ (PVA fiber)/PVA production started
1958 - KURARAY POVAL™(PVA) for market sales

1964 - Polyester staple fiber
• CLARINO™ (man-made leather)

1972 - EVAL™ (EVOH resin)
1978 - Dental materials

1990 - VECTRAN™ (High strength polyarylate fiber)
1998 - KURALON K-II™ (PVA fiber)
1999 - GENESTAR™ (heat resistant polyamide)

Elastomers Business

1972 - Isoprene rubber (now terminated)
1974 - KURARAY LIQUID RUBBER

1990 SEPTON™ (HSBC)
1994 HYBRAR™ (HSBC)

2001 - SEPTON™ V series (Hard block cross-linkable HSBC)
2003 - SEPTON™ Q series (special HSBC)

KURARITY™'s development

1999 - AL based catalyst invented

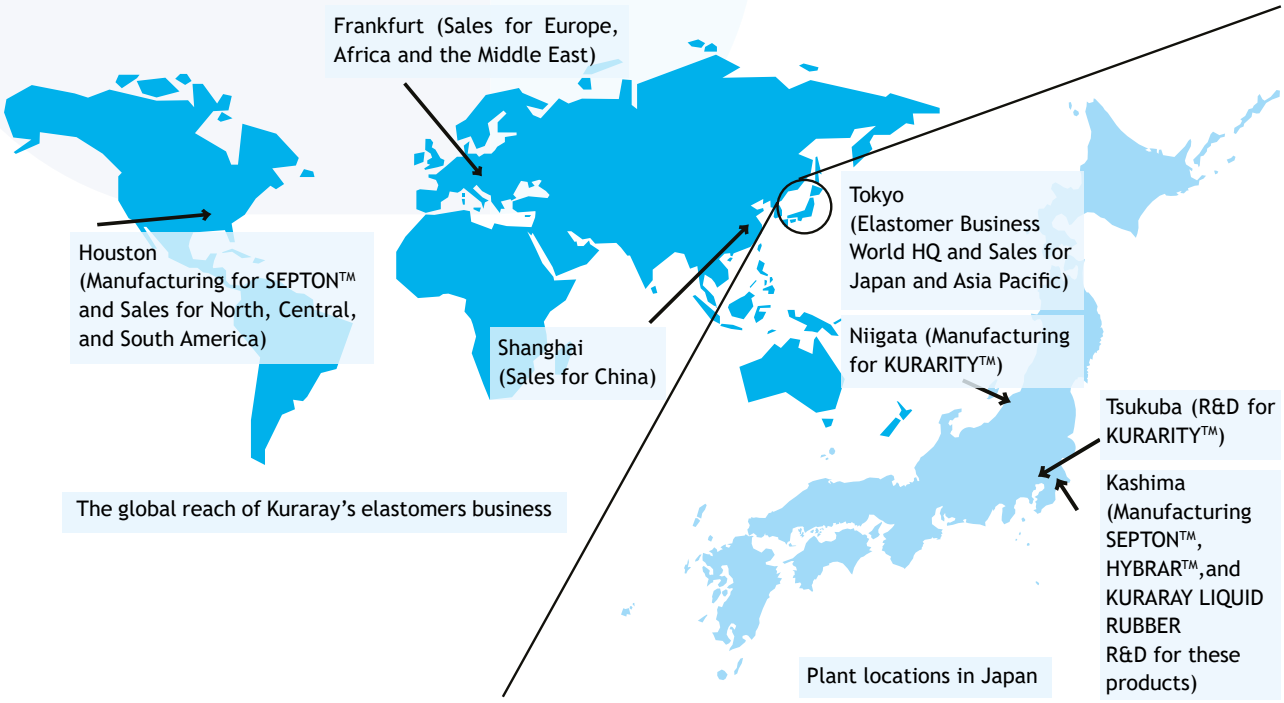
2003 - Pilot plant for KURARITY™ established

2011 - KURARITY™ commercialized

Methaclyrate Business

1959 - MMA monomer
1960 - PMMA Cast sheets

1972 PMMA Extruded sheets
1973 - PARAPET™ (PMMA resin)

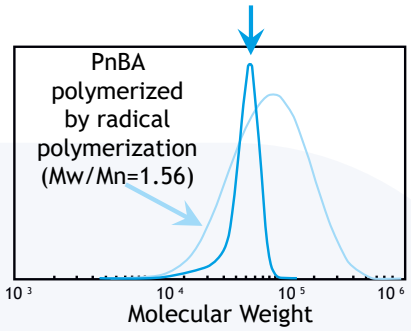


The global reach of Kuraray's elastomers business

3 Evolution of Kuraray's elastomers

KURARITY™ is a novel acrylic copolymer based on Kuraray's two main stream technologies.

KURARITY™
Mw distribution(Mw/Mn=1.13)



2003-

KURARITY™

Anionic living polymerization by an unique catalyst system
[Features]
- Extremely low residual monomer or oligomer
- Extremely low odor
- Low hardness without plasticizer

1990-

3rd Generation

"Hydrogenated Styrenic Block Copolymer" (HSBC)
- SEPTON™
- HYBRAR™

Advanced anionic living polymerization + Hydrogenation

1974-1990

2nd Generation

"Isoprene based Rubbers"
- Trans- Polyisoprene (TP)
- KURARAY LIQUID RUBBER

Anionic living polymerization

1972-1974

1st Generation

- Isoprene Rubber for Natural rubber substitution (*now terminated)

Ziegler-Natta

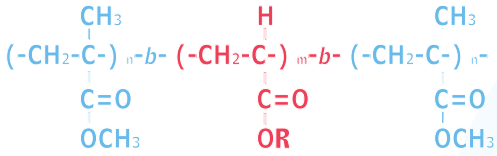
4

Contents

5 Structure and Characteristics of KURARITY™

MAM: All Acrylic Block Copolymer

Methyl-methacrylate **A**crylate **M**ethyl-methacrylate

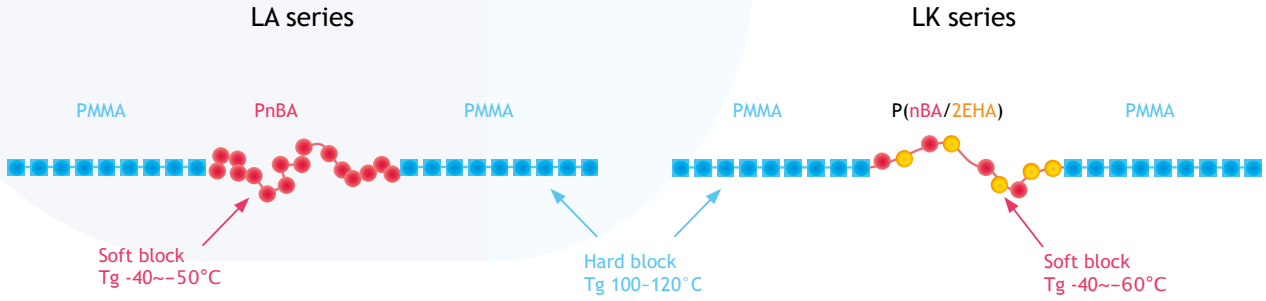


Kuraray leads the world in producing this novel acrylic block copolymer using its unique living anionic polymerization technology. Various type acrylates can be co-polymerized as A-B-A type or A-B type block co-polymer.

This unique technology provides the following advantages:

- √ **Excellent clarity**
- √ **Excellent weatherability with no concerns about hydrolytic degradation**
- √ **Extremely low residual monomer or oligomer**
- √ **Ultimately less odor**
- √ **Self-adhesive without tackifier and plasticizer**
- √ **Good compatibility with high polar materials**

Kuraray developed two families of KURARITY™ called LA series and LK series. LA series utilizes a poly (n-butyl acrylate) mid-block while the LK series utilizes a poly (n-butyl acrylate/2-ethylhexyl acrylate) mid-block.



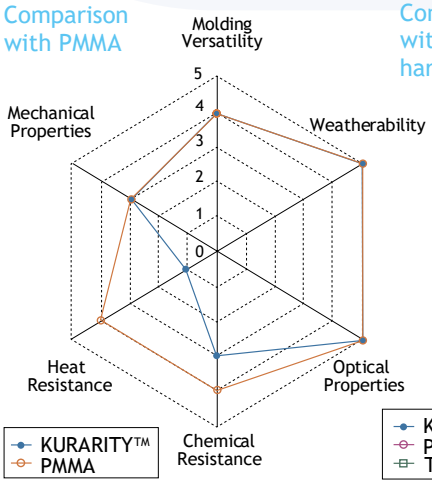
By forming PMMA as the hard block(s) and poly (n-butyl acrylate) or a poly (n-butyl acrylate/2-ethylhexyl acrylate) as the soft block, KURARITY™ exhibits elastomer properties at temperatures lower the than Tg of PMMA.

6 Comparison of KURARITY™ with Other Transparent Materials

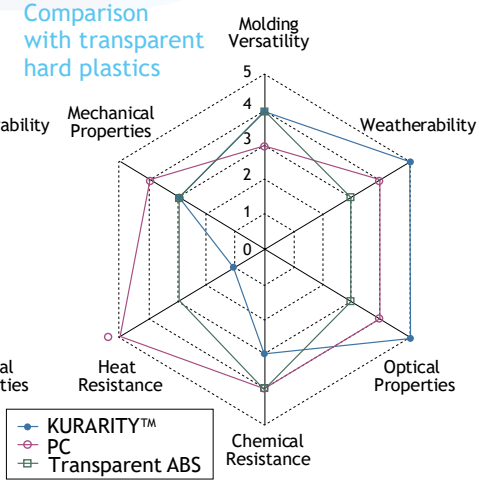
	Method	Condition (Unit)	KURARITY™ LA4285	PMMA	PC	Transparent ABS	Aliphatic TPU
Transmittance	ISO 13468-1	3mm/D65 (%)	91<	92<	89	88.5	88.7
Haze	ISO 14782	3mm (%)	<2	<0.3	1.0	9.9	9.8
Tensile Strength at break	ISO 527-2	(MPa)	19	60-80	60	42	32
Tensile Strain at break	ISO 527-2	(%)	90	2-7	90	50	800
Flexural Modulus	ISO 178	(MPa)	650	3300	2300	2000	60
Charpy Impact Strength unnotched	ISO 179	1eU(kJ/m^2)	NB	19-23	NB	NB	NB
Charpy Impact Strength notched	ISO 179	1eA(kJ/m^2)	28	1.3-1.4	50	15	NB
DTUL	ISO 75-1.-2	1.82MPa (°C)	58	86-101	124	73	-
Vicat Softening Point	ISO 306	B50Annealed (°C)	50	92-100	150-155	87	75-130
Surface Resistivity	IEC 60093	(Ω)	0.6*10^{16}	10^{16}<	10^{15}<	10^{16}<	10^{13}-10^{15}
Volume Resistivity	IEC 60093	(Ωcm)	1.1*10^{15}	2.7*10^{16}	2.0*10^{17}	5.5*10^{16}	10^{13}-10^{17}
Specific Gravity	ISO 1183	(-)	1.11	1.19	1.20	1.10	1.15
Rockwell Hardness	ISO 2039-2	R scale	47	(124)	(122)	108	70
		M scale	(18)	94-103	55	46	(48)
Durometer Hardness	ISO 7619-1	Type D	46	85-90	75-85	70-80	43
		Type A	95	95<	95<	95<	85
Linear Thermal Expansion	ISO 11359-2	ave.20-50deg (*10^-5K^{-1})	10	6	7	9-11	10-20
Flammability	UL 94	(-)	(HB)	HB	V-2	HB	(HB)
Water Absorption at 23°C	ISO 62	24hr (%)	0.9	0.3	0.2	0.8	0.8
Mold Shrinkage	ISO 8328	(%)	1.0-1.5	0.2-0.6	0.5-0.7	0.5	1.2-2.0
Refractive Index	ISO 489	nd	1.48	1.49	1.585	1.52	1.49-1.55
Abbe's Number	ISO 489	(-)	58	58	30	-	-
Pencil Hardness	ISO 15184	(-)	6B	2H-3H	2B	B	6B-H

Tested by Kuraray

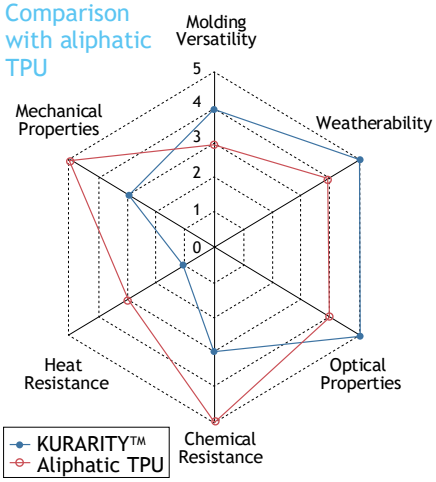
Comparison with PMMA



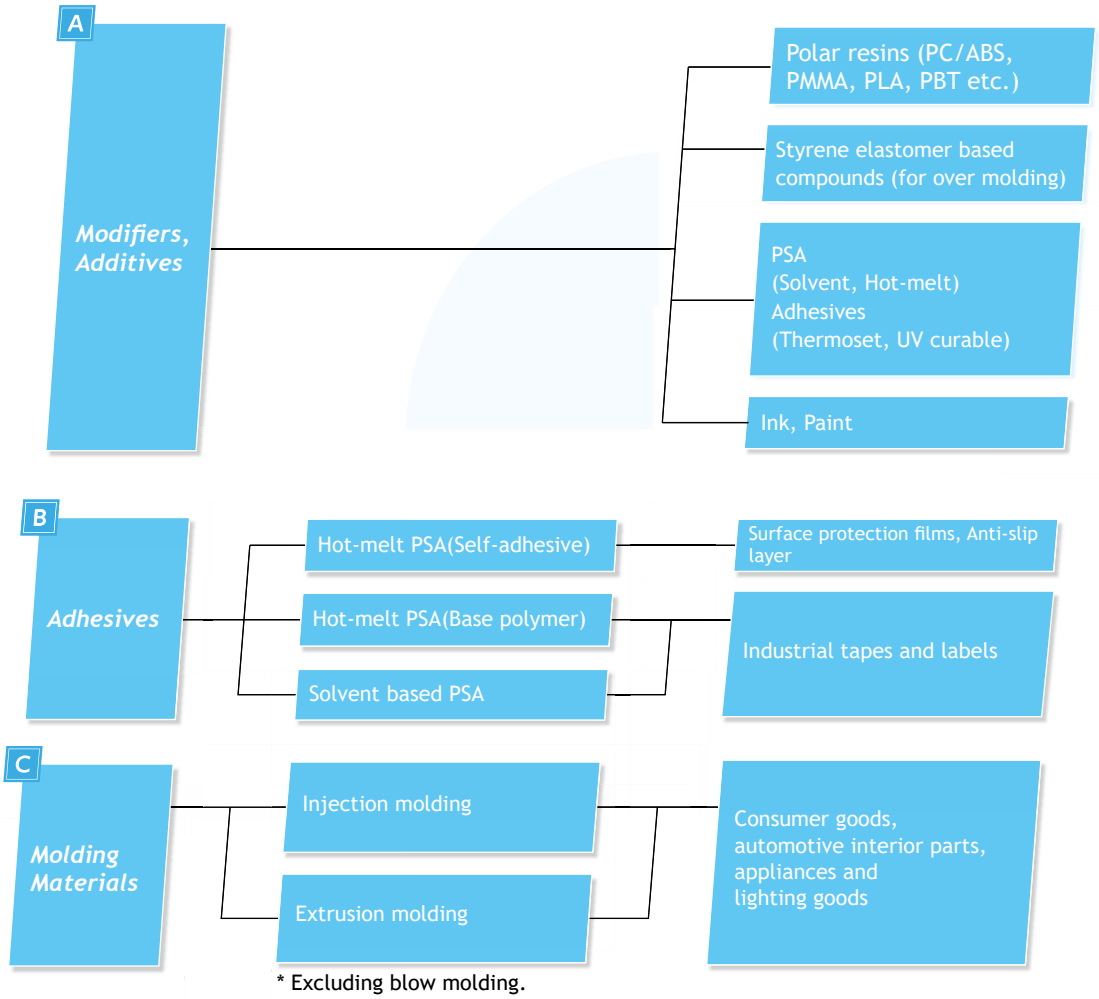
Comparison with transparent hard plastics



Comparison with aliphatic TPU



7 Potential Applications for KURARITY™

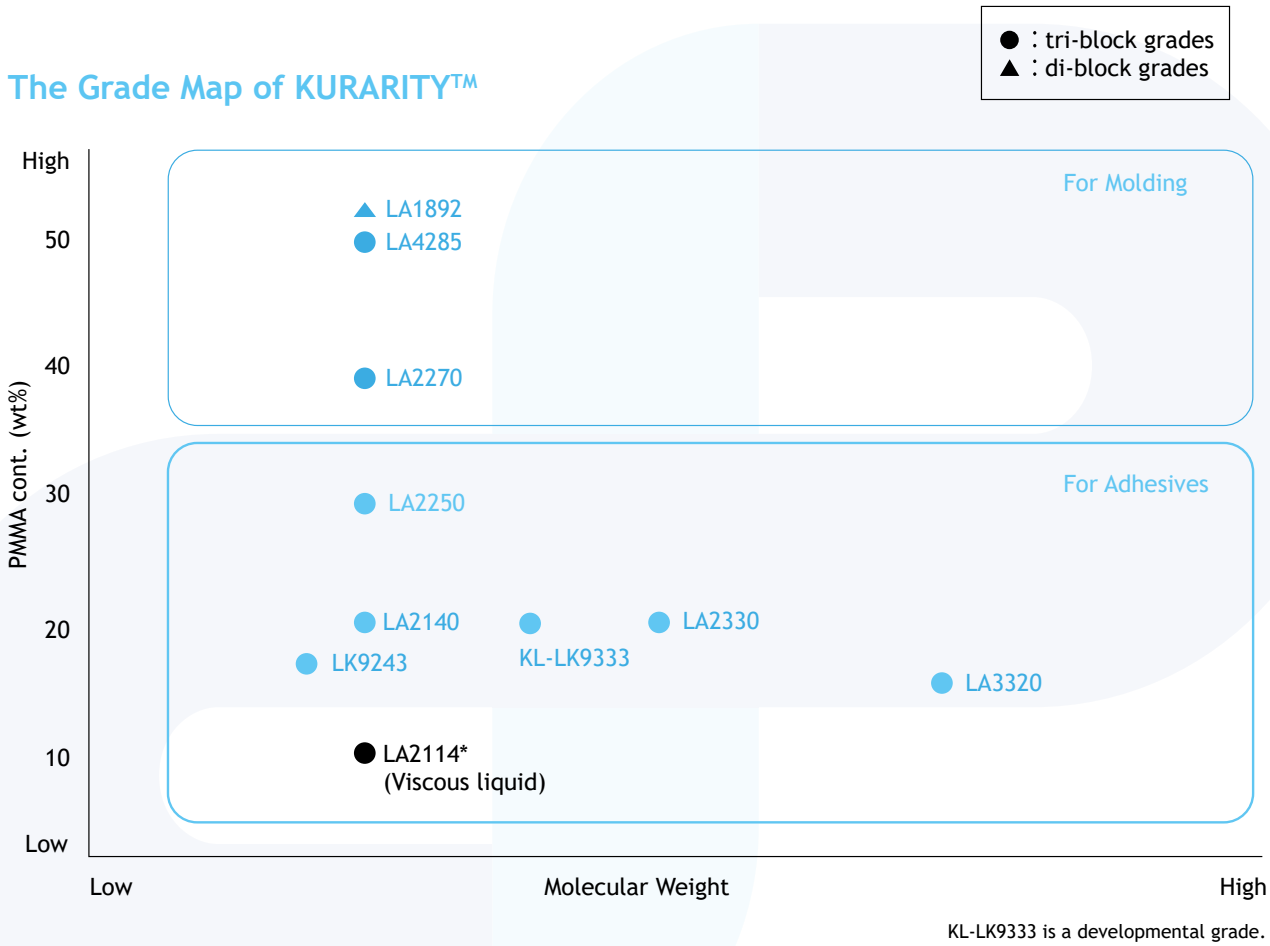


* Excluding blow molding.

8 Grades of KURARITY™

LA series : n-butyl acrylate based block copolymers
LK series : n-butyl acrylate/2-ethylhexyl acrylate based block copolymers

The Grade Map of KURARITY™

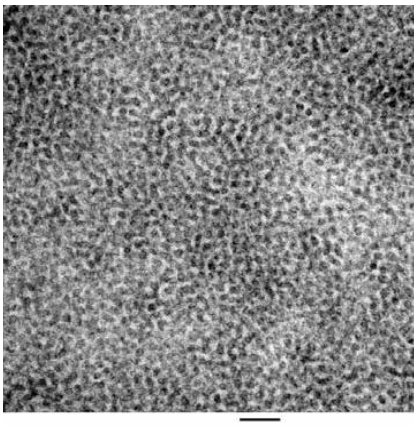


KL-LK9333 is a developmental grade.

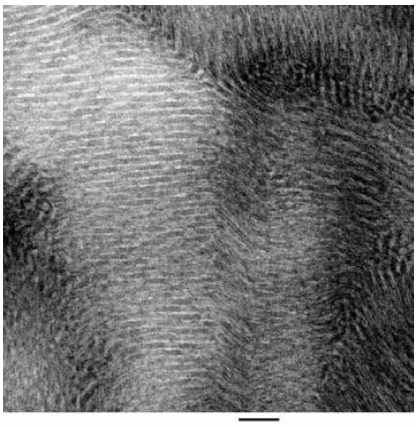
Microphase Separation Structure of LA series

Black: PMMA, White: PnBA

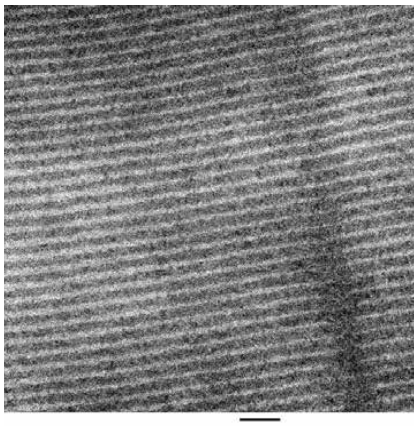
LA2140



LA2250



LA4285



9 Physical and Mechanical Properties of KURARITY™

Standard Grades

The figures are typical values and not the guaranteed value.

	Test Method	Units	LA3320	LA2330	LA2250	LA2270	LA4285
Hardness	ISO 7619-1 (Type A)	(-)	13	32	65	71	95
	ISO 7619-1 (Type D)	(-)	<5	<5	18	23	46
Specific Gravity	ISO 1183	(-)	1.06	1.08	1.08	1.10	1.11
MFR	ISO 1133 [190°C 2.16 kg]	(g/10min)	6.2	3.7	25	4.4	1.5
	ISO 1133 [230°C 2.16 kg]	(g/10min)	63	42	330	80	31
Modulus at 100%	ISO 37	(MPa)	0.4	0.3	3.7	9.0	19
Tensile Strength	ISO 37	(MPa)	3.6	7.0	9.0	12	19
	ISO 527-2	(MPa)	-	-	-	-	19
Tensile Elongation	ISO 37	(%)	540	490	380	149	140
	ISO 527-2	(%)	-	-	-	-	90
Flexural Modulus	ISO 178	(MPa)	-	-	-	-	650
Charpy Impact	ISO 179-1 (notched : 1eA)	(kJ/m^2)	NB	NB	NB	NB	28
Transmittance	ISO 13468-1 [3mm]	(%)	92	91<	91<	93	91<
Haze	ISO 14782 [3mm]	(%)	2.0-6.0 *	2.0-6.0 *	2.0-6.0 *	<1.0	<2.0
Suitable Applications	For PSA		+	+	+		
	For Molding				+**	+**	+
	For Compound, Additives		+**	+**	+**	+**	+

Specialty Grades

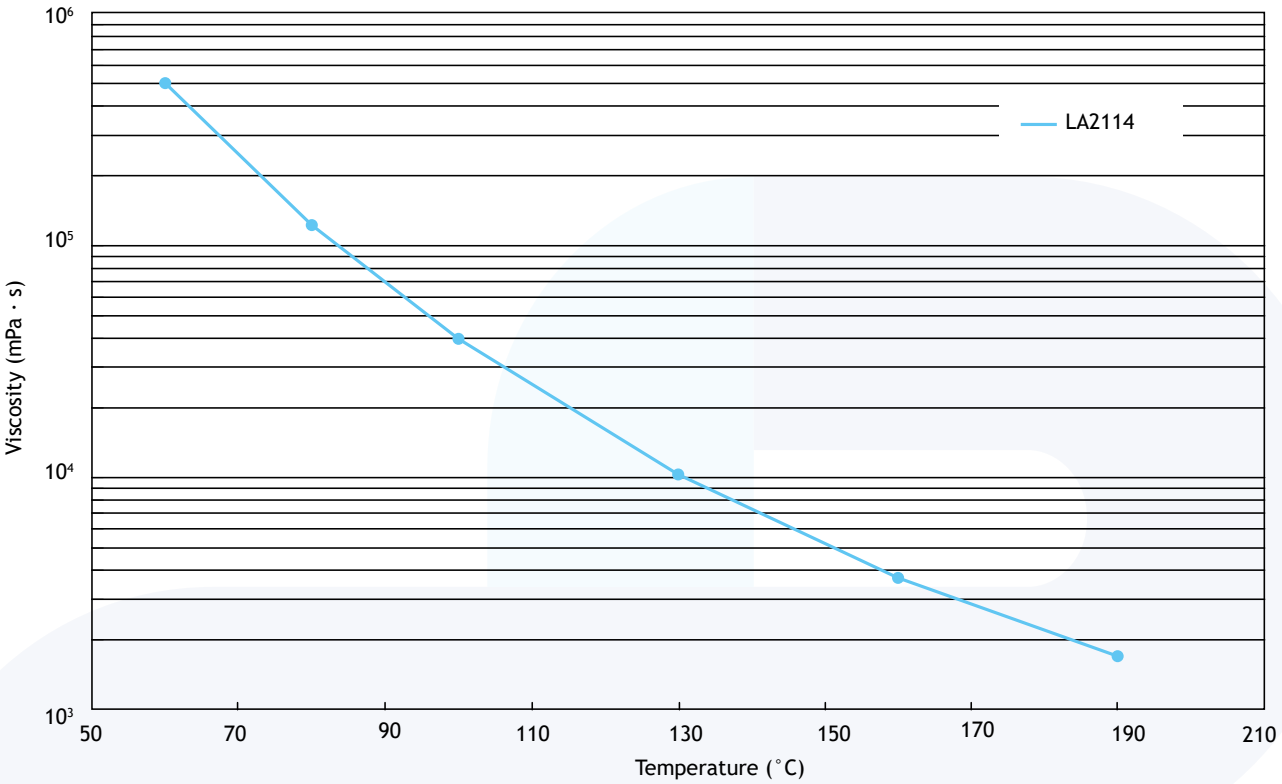
	Test Method	Units	LA2140	LA1892	LK9243	KL-LK9333
Hardness	ISO 7619-1 (Type A)	(-)	32	83	17	17
	ISO 7619-1 (Type D)	(-)	<5	41	<5	<5
Specific Gravity	ISO 1183	(-)	1.08	1.10	1.05	1.05
MFR	ISO 1133 [190°C 2.16 kg]	(g/10min)	31	11.4	93	3.8
	ISO 1133 [230°C 2.16 kg]	(g/10min)	>350	180	>350	85
Modulus at 100%	ISO 37	(MPa)	0.3	-	0.7	1.2
Tensile Strength	ISO 37	(MPa)	8.0	8.9	5.2	6.1
	ISO 527-2	(MPa)	-	-	-	-
Tensile Elongation	ISO 37	(%)	570	2.4	370	300
	ISO 527-2	(%)	-	-	-	-
Flexural Modulus	ISO 178	(MPa)	-	190	-	-
Charpy Impact	ISO 179-1 (notched : 1eA)	(kJ/m^2)	NB	17	NB	NB
Transmittance	ISO 13468-1 [3mm]	(%)	91<	92	92	92
Haze	ISO 14782 [3mm]	(%)	2.0-6.0 *	1.0	2.0-6.0 *	2.0-6.0 *
Suitable Applications	For PSA		+	+	+	+
	For Molding					
	For Compound, Additives		+**	+	+**	+**

* The HAZE value is normally worse due to the anti-blocking agent dusted onto the material.
** These grades can block or bridge while feeding into the extruder.
Some solutions to break it should be implemented.

Tested by Kuraray

KL-LK9333 is a developmental grade.

10 Temperature Dependency of Viscosity (Viscous Liquid Grade)



		LA2114	
Specific Gravity(-)	ISO1183	1.04	
(mPa*s)	ISO2555	60˚C	503,000
		80˚C	123,000
		100˚C	39,500
		130˚C	10,350
		160˚C	3,700
		190˚C	1,700
Tg (˚C)		-40 ~ -50	

ISO 2555, BROOKFIELD PRO GRAMMABLE DV-II +
VISCOMETER, Spindle: No.29
Tested by Kuraray

11 Adhesive Properties of KURARITY™

KURARITY™ itself exhibits self-adhesive properties as the following data show.
KURARITY™ could be used as an adhesive without tackifier or plasticizer.
Using KURARITY™ as an adhesive enables to get the following two properties:
- Super clean (no remaining adhesive on the surface after removal)
- Good tack even at very low temperatures

		LA2140	LA2330	LA3320	LK9243	KL-LK9333
Creep Test at 60°C (mm)	to Stainless steel	<0.1	<0.1	<0.1	0.8	0.1
SAFT (°C)	to Stainless steel	145	170	163	137	159
	to Glass	148	171	159	-	-
Ball Tack		5	7	9	8	8
Loop Tack Test (N/10mm)	to PMMA	4.2	10.8	14.0	10.8	8.2
180° Peel Adhesion (N/25mm)	to Stainless steel	15.0	16.6	14.0	7.4	10.4
	to Glass	11.1	16.5	14.4	16.0	3.2
	to Polyethylene	0.4	0.7	1.0	0.6	0.6
	to PMMA	16.8	16.2	15.4	15.4	10.6

Tested by Kuraray
KL-LK9333 is a developmental grade.

Test Specimens - PET(50μm)/KURARITY™(25μm), toluene solution
Test Conditions
Creep Test - 1.0kgf, Sample size 25mm×25mm, 1000min
SAFT - 0.5kgf, Sample size 25mm×25mm, 0.5°C/min
Ball Tack - JIS Z0237
Loop Tack - PSTC-16
180° Peel Adhesion - 300mm/min, Room Temperature

12 Solubility Parameters of KURARITY™

Low Polarity **High Polarity**

Solubility Parameter (SP)

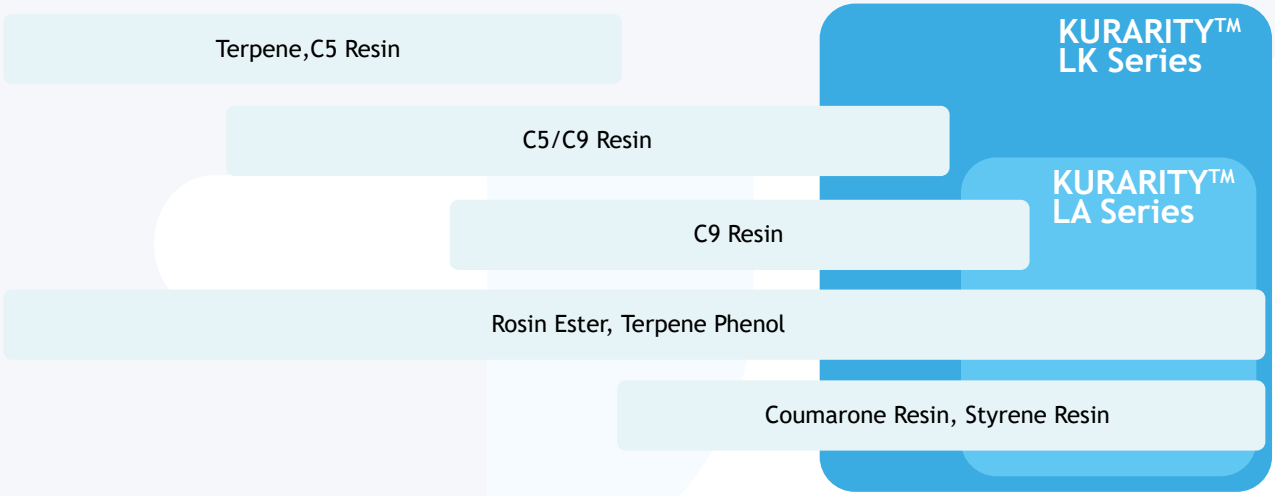
8.0 8.5 9.0

Common Material for PSA

IIR NR SBR Acrylic

Common Material for Hotmelt type PSA

SEBS SIS EVA SBS



- Adhesive performance can be controlled by tackification.
  Tackifiers and plasticizers can be chosen referring to solubility parameter.
- Rosin ester, terpene phenol and styrenic resins with lower softening temperature are suitable.

13 Solvent Solubility of KURARITY™

Tested by Kuraray

Solvent	LA2140	LA2330	LA3320	LA2250	LA2270	LA4285	LK9243	KL-LK9333
Toluene	S	S	S	S	S	S	S	S
Xylene	S	S	S	S	S	S	S	S
Methyl acetate	S	S	S	S	S	S	S	S
Ethyl acetate	S	S	S	S	S	S	S	S
Butyl acetate	S	S	S	S	S	S	S	S
Acetone	S	S	S	S	S	S	S	S
Methyl ethyl ketone	S	S	S	S	S	S	S	S
Methyl isopropyl ketone	S	S	S	S	S	S	S	S
Methyl isobutyl ketone	S	S	S	S	S	S	S	S
Tetrahydrofuran	S	S	S	S	S	S	S	S
Ethylene glycol monoethyl ether acetate	S	S	S	S	S	S	S	S
Heptane	PS	PS	PS	PS	I	I	PS	PS
Cyclohexane	PS	PS	PS	PS	PS	PS	PS	PS
Methanol	PS	PS	PS	PS	PS	PS	PS	PS
Ethanol	PS	PS	PS	PS	PS	PS	PS	PS
Isopropyl alcohol	PS	PS	PS	PS	PS	PS	PS	PS

Test Method
2g of KURARITY™ (pellets) and 18g of solvent were mixed in a vessel and shaken at room temperature for 2 days.
The solvent solubility (S, PS, I) was determined by visual observation.

S: soluble
PS: partially soluble
I: insoluble

14 Properties of KURARITY™

Thermal Conductivity

Tested by Kuraray

Grade	Thermal Conductivity [W/(m*K)]
LA2140	0.17
LA2330	0.16
LA3320	0.16
LA2250	0.17
LA2270	0.15
LA4285	0.17
LK9243	0.15
KL-LK9333	0.15

Test method: ASTM E1530, 23°C
Test piece: 50mm * 50mm * 3mmt, Injection molded sample

Contact Angle

Grade	Angle (deg)
LK9243	103
LA3320	101
KL-LK9333	100
LA2330	98
LA2140	91
LA2250	88
LA4285	84
PC	89
PMMA	73

Test method: by image processing method
Solvent: purified water
Test piece size: 50mm * 50mm * 3mmt
Injection molded sample

Electrical Properties

Grade	Relative Permittivity ε_r			Dielectric Dissipation Factor tanδ		
	60 Hz	1 kHz	1 MHz	60 Hz	1 kHz	1 MHz
LA2330	5.08	4.94	4.39	0.0152	0.0147	0.0624
LA3320	5.24	5.14	4.60	0.0112	0.0113	0.0654
LA2270	4.84	4.60	3.97	0.0288	0.0267	0.0552
LA4285	4.56	4.26	3.68	0.0394	0.0338	0.0448
LK9243	4.58	4.46	3.95	0.0135	0.0136	0.0694
KL-LK9333	4.60	4.48	3.97	0.0150	0.0144	0.0678

Test method: JIS C 2138, 23°C
Test piece: 75mm * 75mm * 1mmt, Compression molded sheet

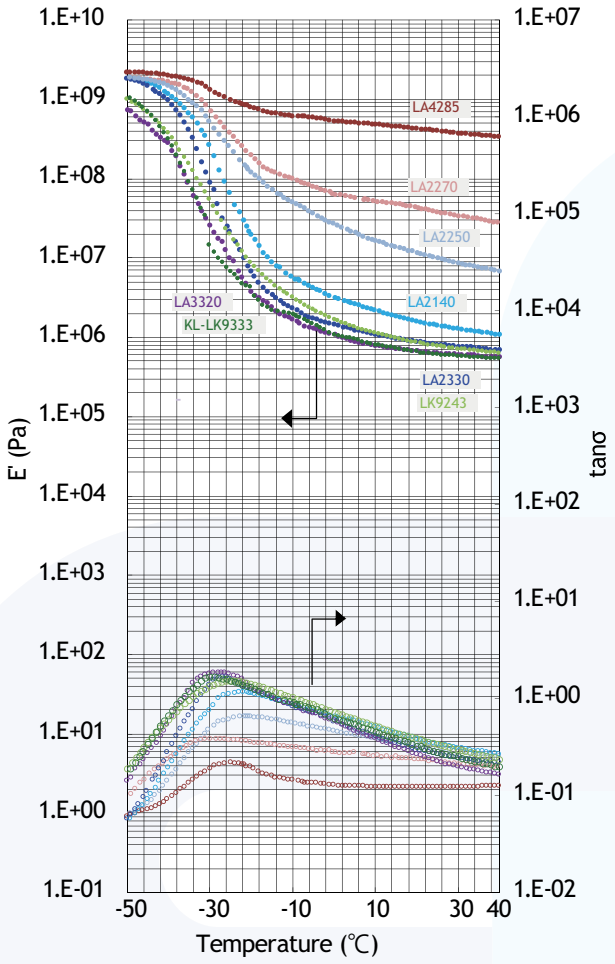
Moisture Permeability

Grade	Water Vapor Transmission Rate (g/m²*24hr)
LA2140	580
LA2330	610
LA3320	760
LA2250	480
LA2270	510
LA4285	320
LK9243	510
KL-LK9333	500

Test method: JIS Z 0208 (Dish method), 40°C 90%RH
Test piece: 60mm * 60mm * 0.1mmt, compression molded sheet

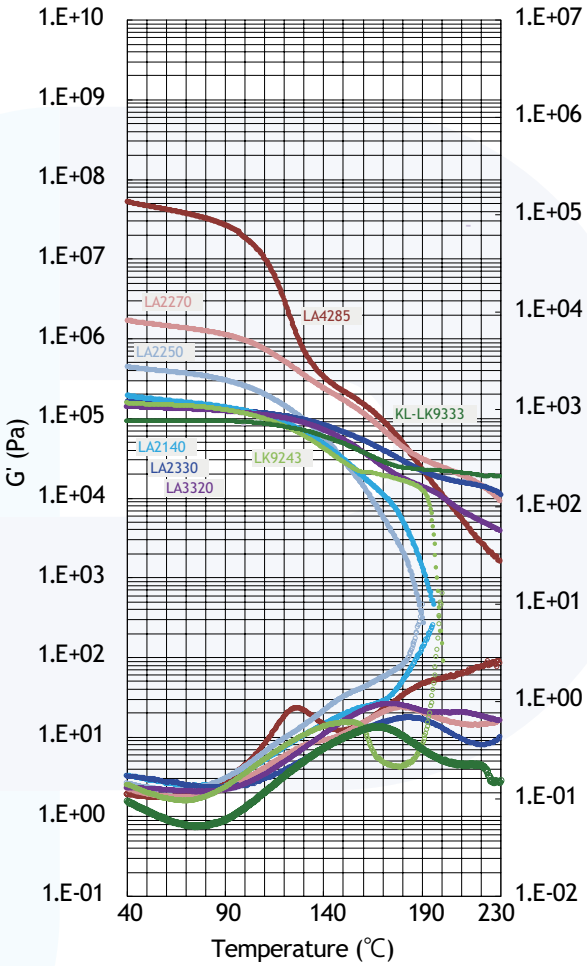
15 Dynamic Viscoelastic Behavior of KURARITY™

Tensile Mode



Test specimens: compression molded sheets
Frequency: 11Hz
Heating rate: 3˚C /min

Torsional Mode

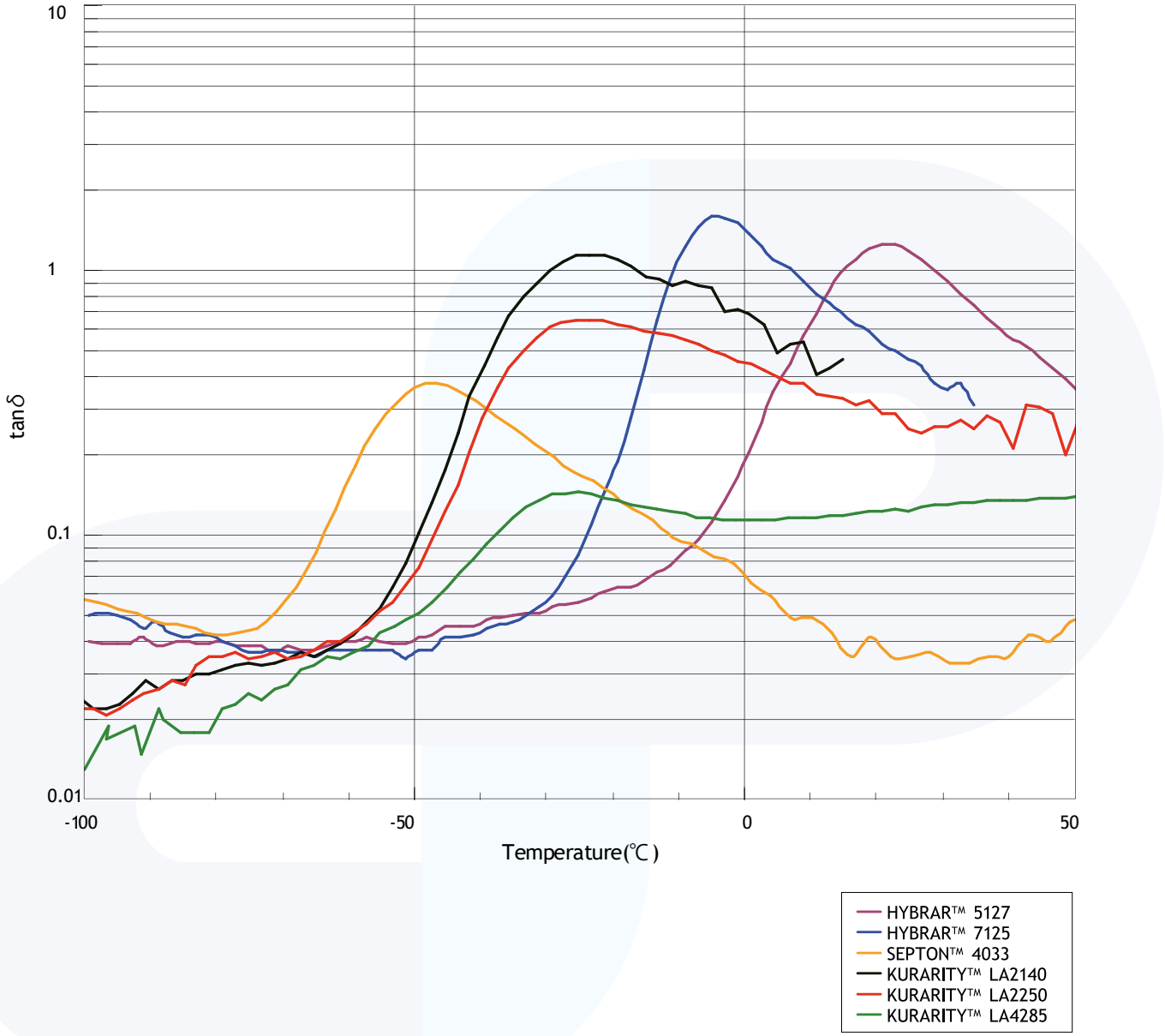


Tested by Kuraray

Test specimens: 8.0mm parallel plates
Frequency: 6.28rad/s
Heating rate: 2˚C /min

- All the KURARITY™ grades show similar low temperature properties which result from Tg of poly (n-butyl acrylate) or poly (n-butyl acrylate/2-ethylhexyl acrylate) and heat resistance from Tg of PMMA
- KURARITY™ is non-crystalline block copolymer and does not have melting point.

16 Temperature Dependency of tanδ



Test Conditions
Test specimen: compression molded sheet
Tensile mode
Frequency: 11Hz
Heating rate: 2°C /min

Tested by Kuraray

- HYBRAR™ is a series of styrenic elastomers developed by Kuraray Co., Ltd. which offer high vibration damping properties due to its tan δ peak near room temperature.
- SEPTON™ is a series of hydrogenated styrenic elastomers developed by Kuraray Co., Ltd. which has its tan δ peak at lower temperature and shows rubber-like properties at room temperature.

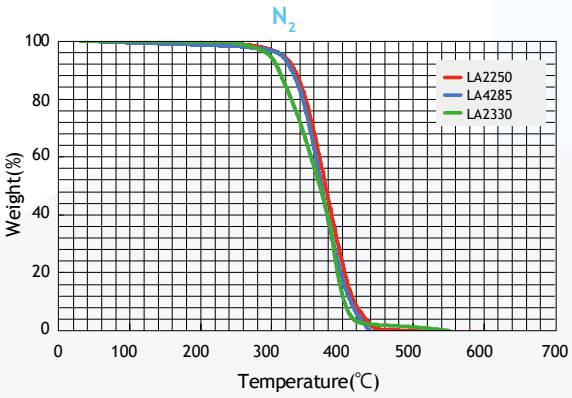
17 Thermal Stability of KURARITY™

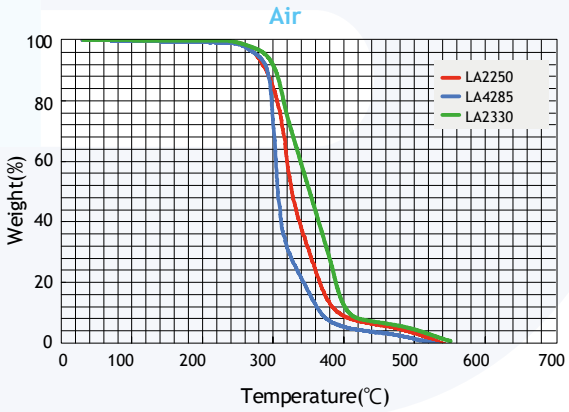
Test condition: heat-rate:10°C/min

Tested by Kuraray

N_2	LA2250	LA4285	LA2330
5% Weight Loss Temp.	316°C	315°C	299°C
99% Weight Loss Temp.	445°C	435°C	545°C

Air	LA2250	LA4285	LA2330
5% Weight Loss Temp.	276°C	278°C	293°C
99% Weight Loss Temp.	528°C	507°C	551°C



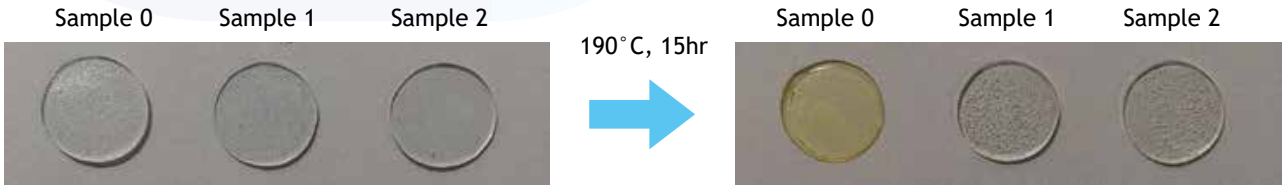


Recommended Antioxidants

To prevent yellowing due to heat,
using two types of antioxidants together is recommended.

(1) Hindered phenol type	0.05 - 0.10 (phr)
(2) Phosphite type	0.05 - 0.10 (phr)

Heat Stability Test

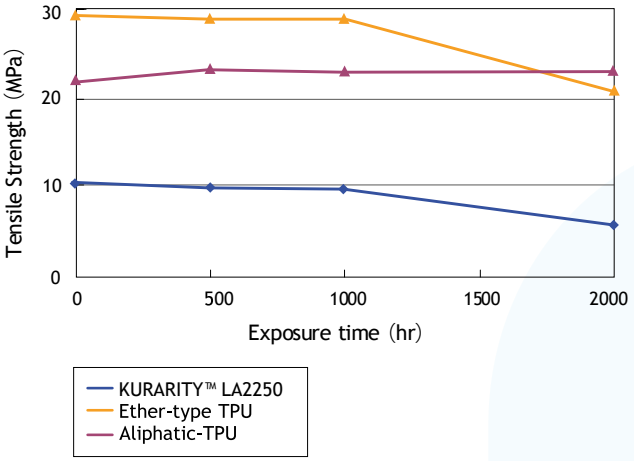


Sample	Formulation	Results
0	LA2330	Turned yellow
1	LA2330 + (1) 0.05phr + (2) 0.05phr	Slightly improved
2	LA2330 + (1) 0.10phr + (2) 0.10phr	Good Transparency

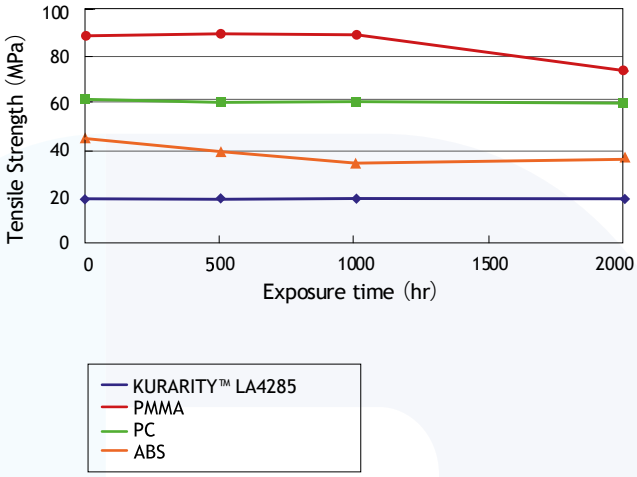
Test Specimens: Punched cast sheet

18 Wetherability of KURARITY™

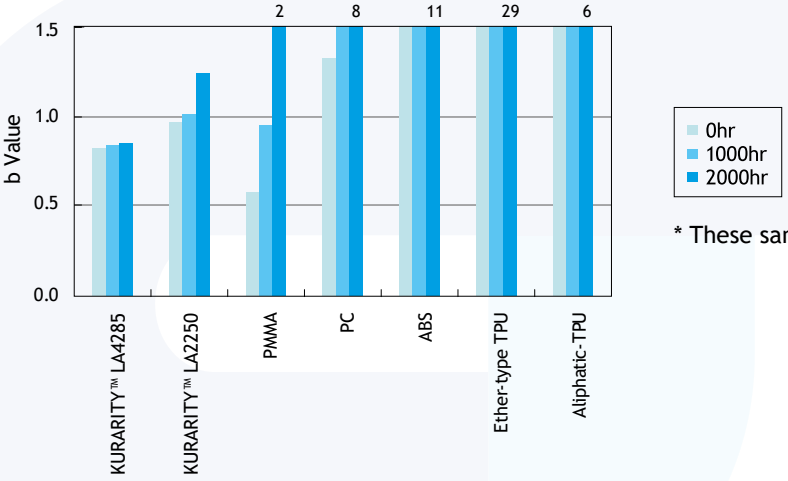
Tensile Strength (ISO37)



Tensile Strength (ISO527-2)



Color (b Value)



* These samples are without UVA, HALS

Test method: ISO4892-4 (SWOM)
BPT: 63°C
Exposure intensity: 255W/m² (300–700nm)
Exposure time: 500hr, 1,000hr, 2,000hr
Injection molded test specimen
Tested by Kuraray

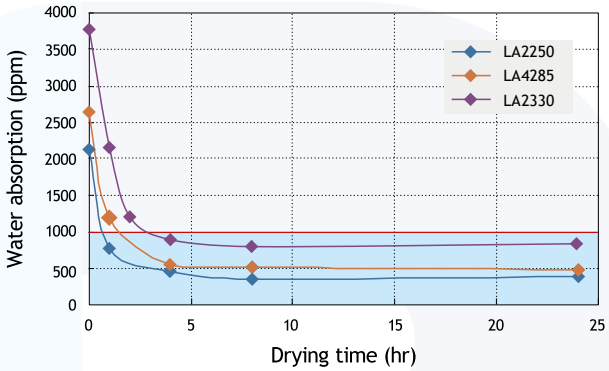
19 Moisture Absorption of KURARITY™

Recommended water absorption value of KURARITY™ is under 1,000 (ppm) for molding.

Drying Test

Test Specimens: Pellet
Test Conditions: Drying in air circulating oven dryer
LA2330, LA2250: 60˚C
LA4285: 70˚C

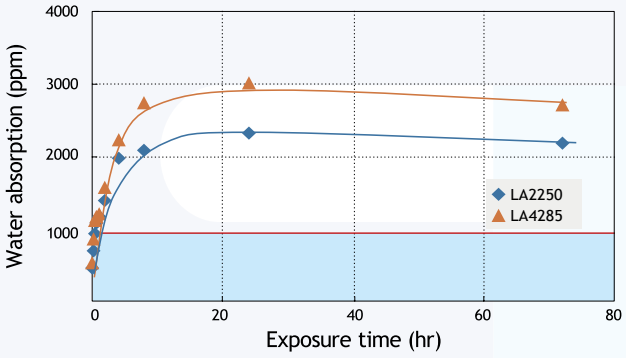
Blocking might be occurred after drying depending on the grades.
Adding silica in 0.01 – 0.1 (phr) is recommended to prevent blocking.

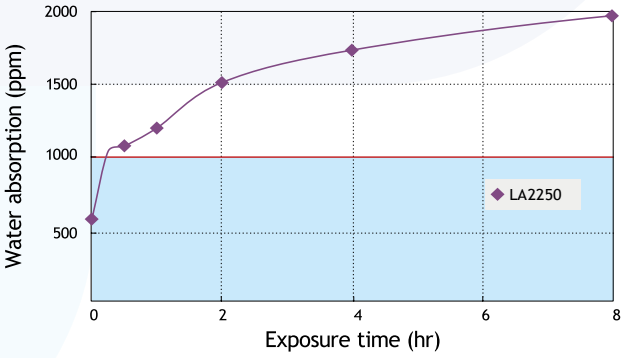


Tested by Kuraray

Moisture Absorption Test

Test specimens: Pellet
Test conditions: 25˚C, 50% RH
* Moisture content at drying time = 0hr is reference value.





Tested by Kuraray

The mechanical properties are largely unaffected by water absorption, though its appearance might be observed as opaque when it contains more water.
Opaque disappears when dried.

LA2250 in R.T.

After 80˚C, 90%RH, 1000hr

After R.T., 120hr

20 Chemical Resistance of KURARITY™

+ : No Change, - : Swell / Clouding

	Visual Check
Acids (H2SO4: 0.1N)	+
Alkaline solution (NaOH: 0.1N)	+
Hand cream	+
Castor oil	+
Gasoline	+
Kerosene	+
Oleic acid	-
Engine oil (Mineral oil)	+
Wax (liquid type: Alcohol 10%)	+
Ethanol aqueous solution (50wt%)	+
Methanol	-
Ethanol	-
Brake fluid (Glycol ether: 99%)	-

Test Method: The aforementioned chemical is soaked into cotton cloth, then wiped 8 times-RT*24hr-80ºC *1hr
Sample: LA2250 (Similar results are expected with other grades)
Tested by Kuraray

21 Painting and Printing Properties of KURARITY™

Tested by Kuraray

	KURARITY™ LA4285	PMMA
Painting**	+	+
Printing (Inkjet print:UV type)	+	+
Pad printing (UV Type)	+	+
Hard Coating (for Scratch Resistance)	+	+
Coating (Vacuum deposition) Al, Cr, Sn, SiO2, ITO	+	-
Dyeing***	+	+

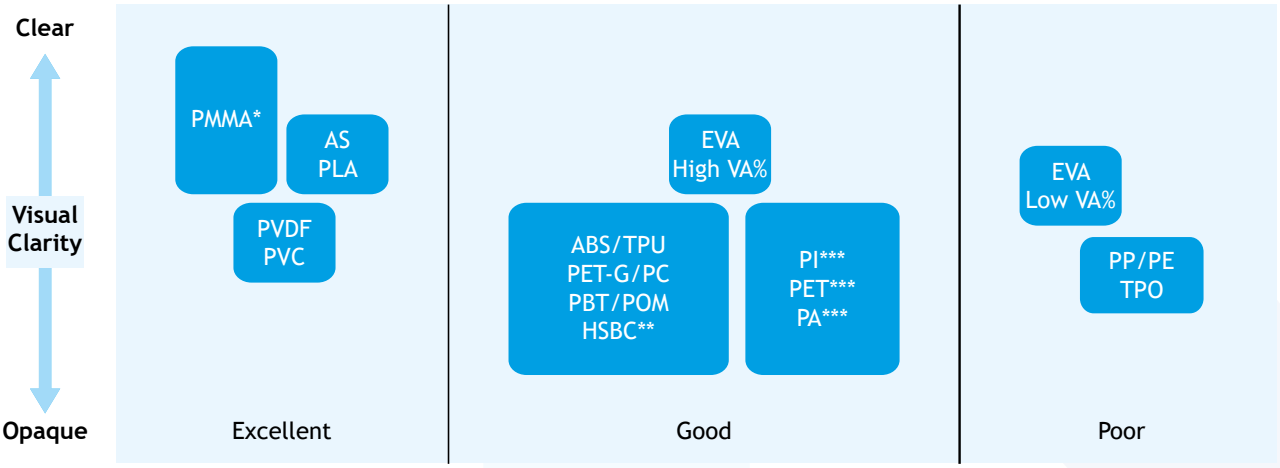
* The coating materials may crack depending on their flexibility.
** Acrylic urethane paints have proven well suited.
*** Pigments (organic or inorganic) have proven well suited.

Overmolding with Other Thermoplastics with KURARITY™

	Double Injection with KURARITY™	Co-Extrusion with KURARITY™
PMMA	+	+
PC	+	+*
PET-G	+	+
ABS	+	+
PS	+	+
PVC	+	+
TPU	+	+
PBT	-	-
POM	-	-
PET	-	-*
PA	-	-*
PE	-	-
PP	-	-

* Proper equipment and processing parameter adjustments are required since the processing temperature of these resins are widely different from KURARITY™.

22 KURARITY™ as Resin Modifier



* Mixing with lower MVR(MFR) MMA causes opaque appearance.
** High vinyl type HSBC shows good compatibility with KURARITY™.
For mixing with low vinyl type HSBC, proper compatibilizer should be selected.
*** Because of higher mixing temperature, attention should be paid to avoid degradation of KURARITY™.

Effect of Adding KURARITY™ to Other Plastics

KURARITY™ shows excellent compatibility with ABS in particular.
KURARITY™ softens plastics. This effect is different compered to general core-shell type impact modifiers.

The figures should be regarded as guide values only and not as binding minimum values.

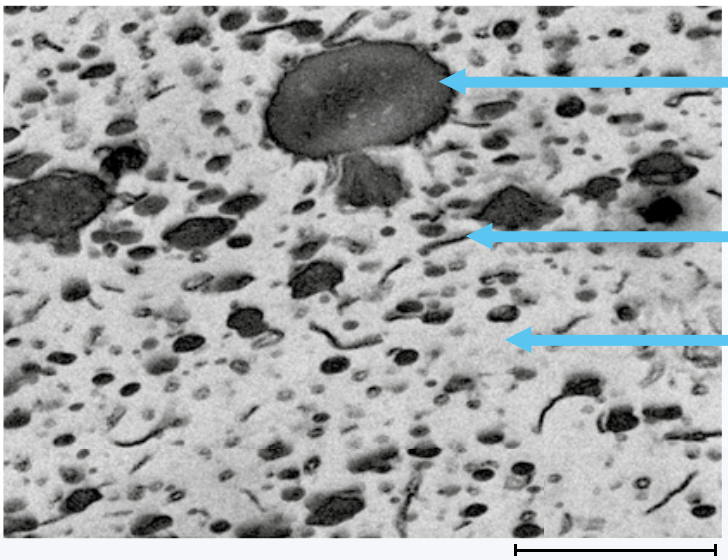
ABS			100	90	80	50						
PMMA							100	90				
PET-G									100	95		
AS											100	90
KURARITY™ LA4285				10	20	50		10		5		10
	Method		Unit									
Tensile Strength	ISO 527-2		(MPa)	34	32	30	23	60-80	57	40	44	72	72
Tensile Elongation	ISO 527-2		(%)	12	12	12	47	2-7	16	6	5	3	3
Flexural Modulus	ISO 178		(MPa)	2486	2303	2116	1404	3300	3145	1935	1899	3546	3301
Charpy Impact	ISO 179 (notched: 1eA)		(kJ/m^2)	19.7	21.8	27.0	43.0	1.4	1.2	7.3	10.9	1.1	0.9
Hardness	ISO 7619-1	Type A	(-)	91	90	89	88	95<	91	91	91	90	91
		Type D	(-)	77	76	72	62	85-90	86	76	74	84	83
Specific Gravity	ISO 1183		(-)	1.04	1.05	1.05	1.08	1.19	1.18	1.27	1.27	1.07	1.07
MFR	ISO 1133 (230°C 2.16kg)		(g/10min)	1.8	2.4	3.8	8.5	1.1	1.7	8.1	11.7	2.0	2.8
DTUL	ISO 75-1,2 (0.45MPa)		(°C)	102	101	101	97	98	99	72	71	102	101
Vicat Softening Point	ISO 306 (B50 Annealed)		(°C)	102	100	97	79	112	107	74	73	103	102

Tested by Kuraray

23 KURARITY™ as Resin Modifier

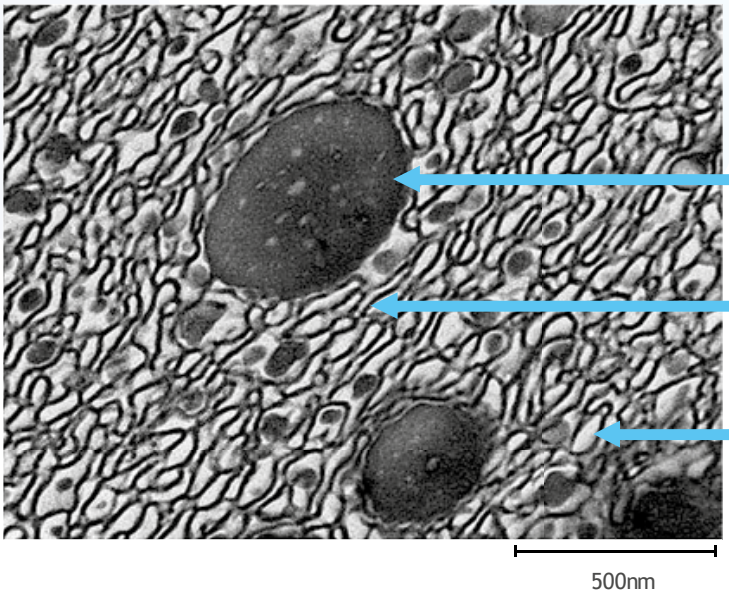
Example - Adding KURARITY™ to ABS

ABS/KURARITY™ LA4285 = 90/10



TEM Photo.

ABS/KURARITY™ LA4285 = 50/50



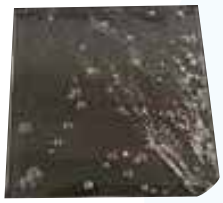
TEM Photo.

24 Standard Injection Molding Conditions of KURARITY™

Drying

KURARITY™ is hydrophilic. Pre-drying is recommended to ensure the highest molding quality and consistency. Excessive moisture causes streaking, bubbles, loss of clarity, etc., although the mechanical properties are largely unaffected by water absorption.
Circulating air ovens or vacuum oven dryers are recommended. A vented barrel and screw is satisfactory alternative to pre-drying.

LA2250: 60°C, more than 4 hours
LA4285: 70-80°C, more than 4 hours



Without drying

With drying

Cleaning

All traces must be fully purged with polypropylene or polyethylene.

Feeding

Poor feeding might occur depending on the grades.
Recommended agents to improve feeding are as follows.

Trouble	Detail	Recommended Agent
Blocking	Pellets tend to agglomerate due to the tackiness of the pellets.	Silica 0.01- 0.1 (phr)
Hopper Bridging	Pellets can bridge around the lower side of the hopper or the entrance of the molding machine due to the weight of the pellets.	Etylene bis stearamide 0.01-0.1 (phr)
Poor biting by screw	Pellets are agglomerated by shear stress between the screw and the barrel.	Etylene bis stearamide 0.01-0.1 (phr)

Demolding

The following slip agents have proven suitable to protect components with highly smooth surface from scratches as well as to reduce tackiness of components.

Zinc stearate 0.01-0.05 (phr)
Ethylene bis oleic amide 0.01-0.05 (phr)

Processing Parameters

Trouble	LA2250	LA4285
Cylinder Temperature (°C)	160-200	200-230
Mold Temperature (°C)	20-40	20-40
The bottom of hopper	Water Cooling	Water Cooling
Screw Revolution (rpm)	<100	<100
Back Pressure (kgf/cm^2)	0-50	0-50

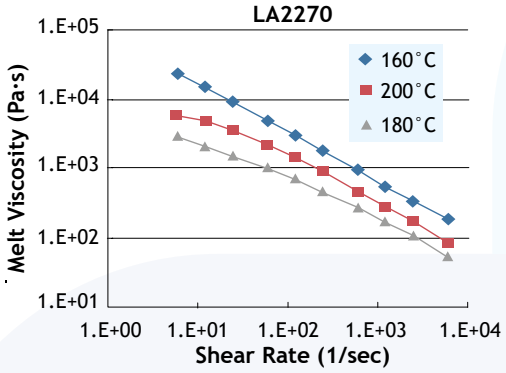
25 Standard Extrusion Molding Conditions of KURARITY™

Processing Parameters

	Hopper	Feeding zone	Compression zone	Metering zone	Adapter	Die Head
LA2270	Water Cooling (down to 40˚C)	100 ~ 130˚C	140 ~ 160˚C	150 ~ 170˚C	150 ~ 170˚C	150 ~ 170˚C

Single screw extruder with the following specs is recommended;
-machines using TPU, PVC
-full-flighted screw, L/D=24-28, compression ratio= 2.5 - 3.1

Melt Viscosity by Capilary Flow Tester



Drying

KURARITY™ must be dried prior to processing when using non-vented extruder.

LA2250: 60˚C, 4 hours
LA4285: 70~80˚C, more than 6 hours

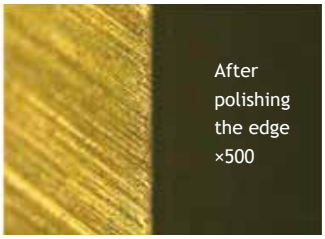
Feeding

Poor feeding might occur depending on the grades.
Recommended agents to improve feeding are as follows.

Trouble	Detail	Recommended Agent
Blocking	Pellets tend to agglomerate due to the tackiness of the pellets.	Silica 0.01- 0.1 (phr)
Hopper Bridging	Pellets can bridge around the lower side of the hopper or the entrance of the molding machine due to the weight of the pellets.	Etylene bis stearamide 0.01-0.1 (phr)
Poor biting by screw	Pellets are agglomerated by shear stress between the screw and the barrel.	Etylene bis stearamide 0.01-0.1 (phr)

- The screen pack should consist of two 80 and 100 mesh screens to remove any impurities that may damage the die, and also to ensure sufficient back pressure.
- A water cooling bath (5~30˚C) is recommended for the cooling of KURARITY™.
  *Air cooling or shower may give insufficient cooling, and also generate vibrations that may cause defects in appearance.
- The edge and inner surface of the die should be well-finished to achieve high-quality appearance.

Examples of Die Polishing



When switching from other resins, dismantling and cleaning of the extruder screw and die components is recommended to prevent contamination.
Purging with polypropylene or polyethylene is recommended to remove residual KURARITY™ in the extruder.

26 Standard Compounding Conditions of KURARITY™

Drying Conditions

Pre-drying is required if your twin screw extruder is not vented.
An air circulating oven dryer or vacuum oven dryer is recommended.

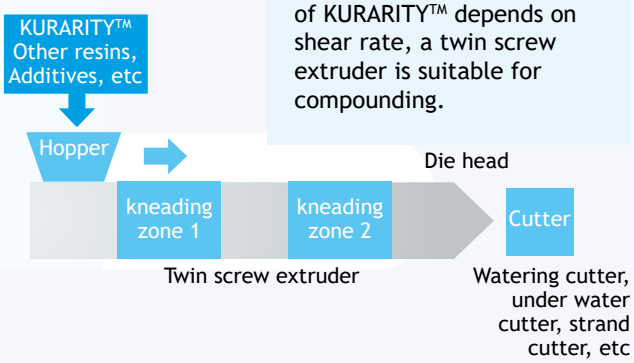
LA2250: 60°C, 4 hours
LA4285: 70-80°C, more than 6 hours

Example of compounding process parameters

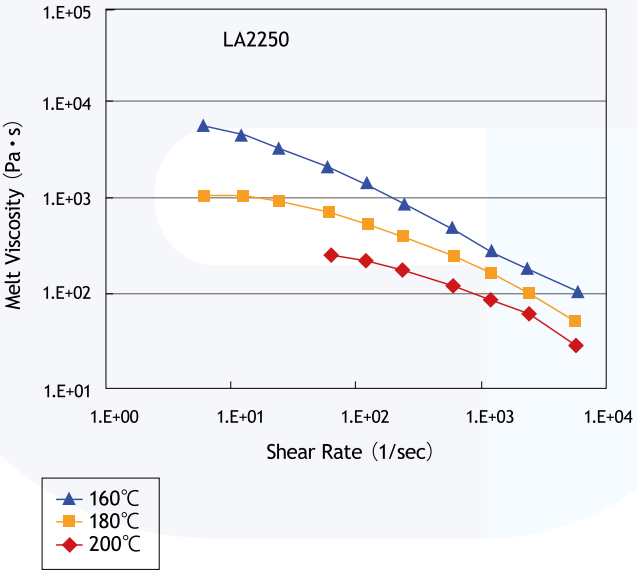
Equipment: TEX 44XCT Twin Screw Extruder (JSW)
Screw diameter: 44mm, L/D=42
Barrel temperature:

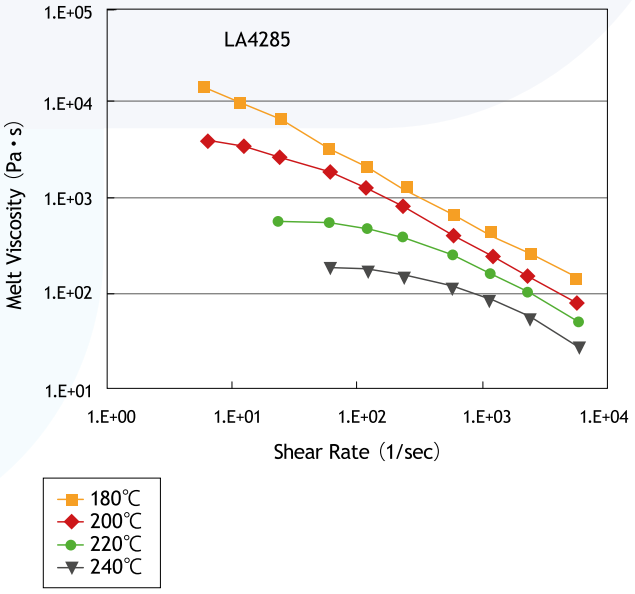
C2	50°C
C3 - C12	170 - 230°C
Die head	170 - 230°C
Screw rotation:	200 rpm

Since the melt viscosity of KURARITY™ depends on shear rate, a twin screw extruder is suitable for compounding.



Melt Viscosity by Capillary Flow Tester





Feeding

Poor feeding might occur depending on the grades.
Recommended agents to improve feeding are as follows.

Trouble	Detail	Recommended Agent
Blocking	Pellets tend to agglomerate due to the tackiness of the pellets.	Silica 0.01- 0.1 (phr)
Hopper Bridging	Pellets can bridge around the lower side of the hopper or the entrance of the molding machine due to the weight of the pellets.	Etylene bis stearamide 0.01-0.1 (phr)
Poor biting by screw	Pellets are agglomerated by shear stress between the screw and the barrel.	Etylene bis stearamide 0.01-0.1 (phr)

27 IMPORTANT NOTICE

- Precautions should be taken in handling and storing. Please refer to the appropriate Safety Data Sheet for further safety information.
- In using KURARITY™, please confirm related laws and regulations, and examine its safety and suitability for the application.
- For medical, health care and food contact applications, please contact your KURARITY™ representative for specific recommendations. KURARITY™ should not be used in any devices or materials intended for implantation in the human body.
- Nothing contained herein constitutes a license to practice under any patent and it should not be construed as an inducement to infringe any patent. The user is advised to take appropriate steps to be sure that any proposed use of the product will not result in patent infringement.

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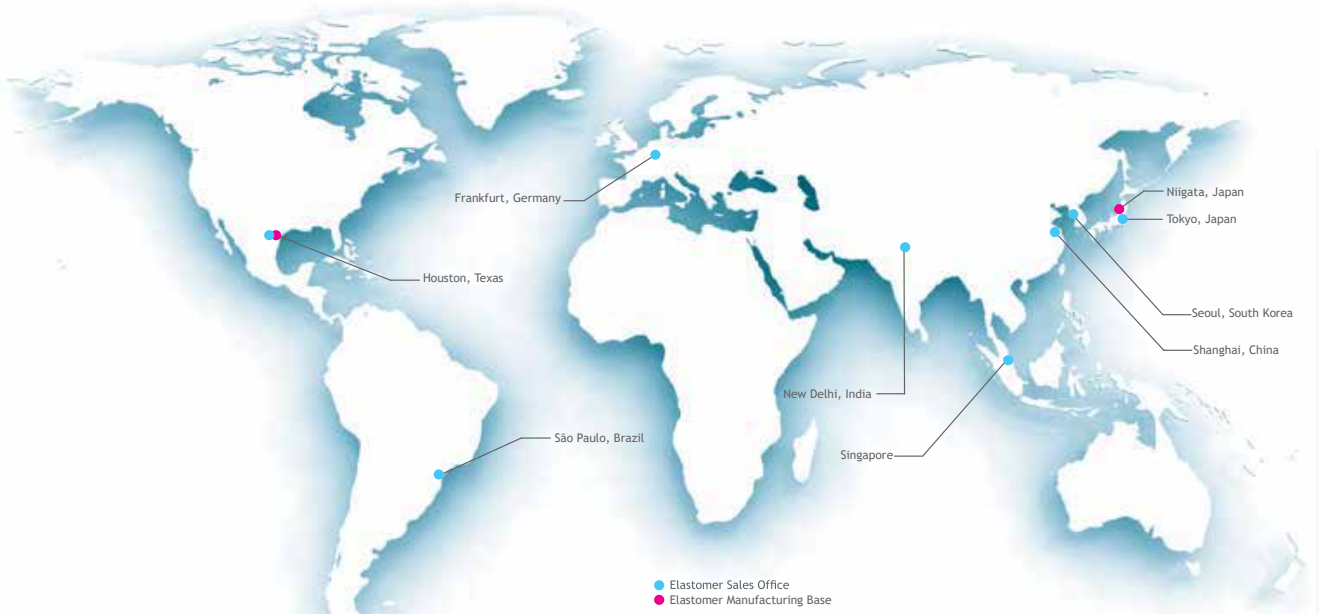
Adding value to your products – worldwide



SEPTON™, HYBRAR™ and KURARITY™ are Kuraray's trademarks for thermoplastic elastomers (TPEs). They are a special type of synthetic rubber that combine the elastic properties of rubber with the benefits of thermoplastics. They can be processed into almost any shape. TPEs have a pleasantly soft touch and good wear comfort. They also increase shock absorption. What's more, they are recyclable. Kuraray's TPEs are environmentally sound, free of PVC and do not need additional plasticizers. They are used for an extremely wide range of applications including many plastic compounds for everyday products. Examples include toys, toothbrushes, medical tubes, sports equipment, sealants and car tires. The flexible types are used as lubricant additives and base components in adhesives.
Kuraray is a leading supplier of TPEs and offers customers more than 30 different grades with individual properties.

For further information, please contact your local Kuraray office or visit our website.

www.elastomer.kuraray.com

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10/2019