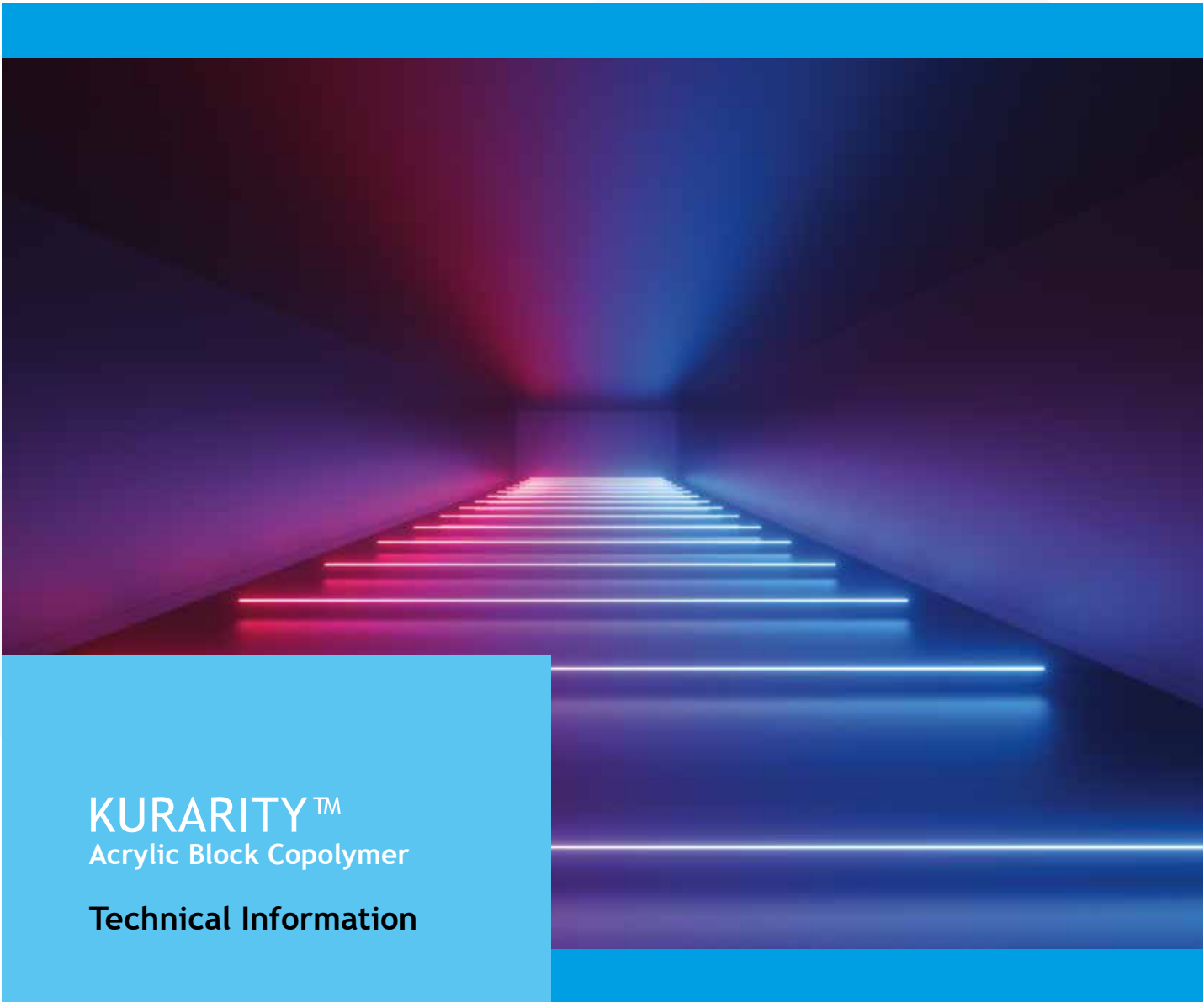


# *kuraray*

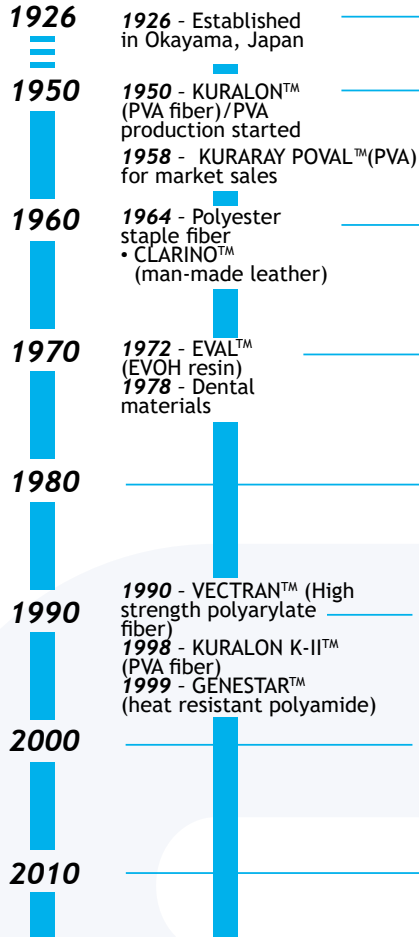
# KURARITY™



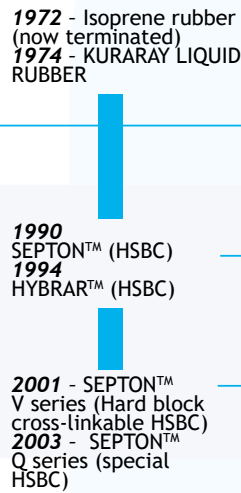
## KURARITY™ Acrylic Block Copolymer Technical Information

## Kuraray & its elastomer business

### Kuraray's development



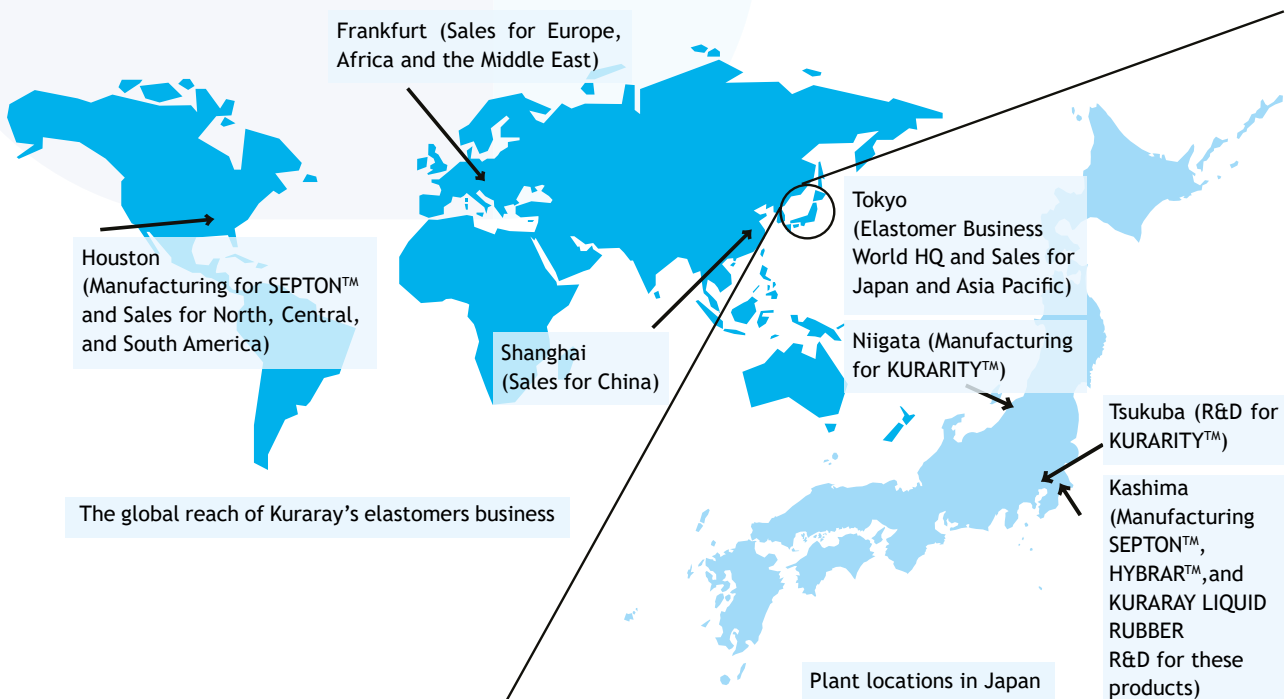
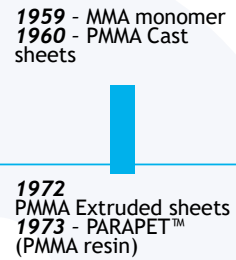
### Elastomers Business



### KURARITY™'s development



### Methacrylate Business



3

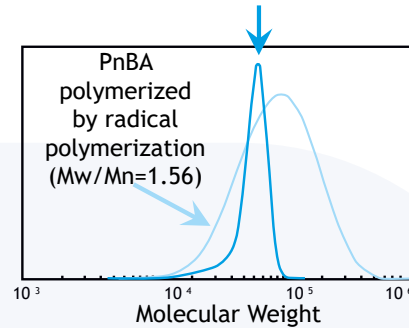
## Evolution of Kuraray's elastomers

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

2003-

**KURARITY™**

**KURARITY™**  
Mw distribution (Mw/Mn=1.13)



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

1990-

### 3<sup>rd</sup> Generation

“Hydrogenated Styrenic Block Copolymer” (HSBC)  
▪ SEPTON™  
▪ HYBRAR™

Advanced anionic living polymerization  
+ Hydrogenation

1974-  
1990

### 2<sup>nd</sup> Generation

“Isoprene based Rubbers”  
▪ Trans- Polyisoprene (TP)  
▪ KURARAY LIQUID RUBBER

Anionic living polymerization

1972-  
1974

### 1<sup>st</sup> Generation

▪ Isoprene Rubber for Natural rubber substitution  
(\*now terminated)

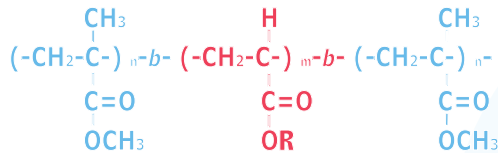
Ziegler-Natta

|                                                          |       |
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## MAM: All Acrylic Block Copolymer

### Methyl-methacrylate Acrylate Methyl-methacrylate

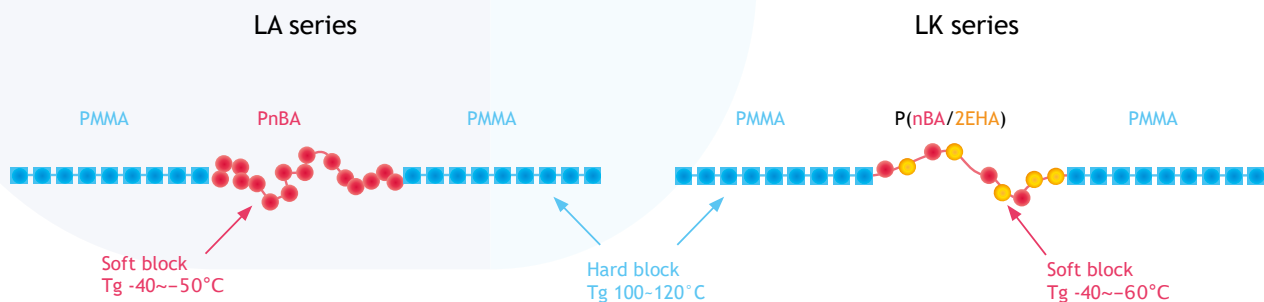


Kuraray leads the world in producing this novel acrylic block copolymer using its unique living anionic polymerization technology. Various type acrylates can be co-polymerized as A-B-A type or A-B type block co-polymer.

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.



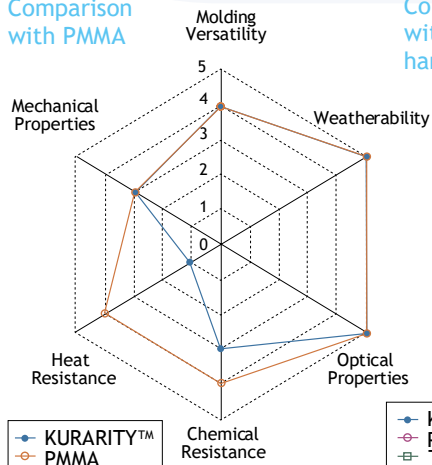
By forming PMMA as the hard block(s) and poly (n-butyl acrylate) or a poly (n-butyl acrylate/2-ethylhexyl acrylate) as the soft block, KURARITY™ exhibits elastomer properties at temperatures lower than Tg of PMMA.

## Comparison of KURARITY™ with Other Transparent Materials

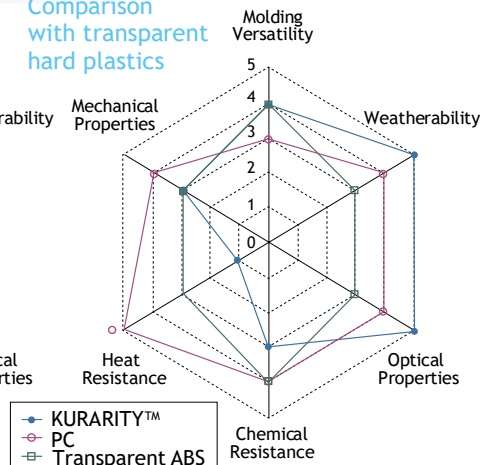
|                                  | Method      | Condition (Unit)                                  | KURARITY™<br>LA4285  | PMMA                 | PC                   | Transparent<br>ABS   | Aliphatic<br>TPU                   |
|----------------------------------|-------------|---------------------------------------------------|----------------------|----------------------|----------------------|----------------------|------------------------------------|
| 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/m²)                                        | NB                   | 19-23                | NB                   | NB                   | NB                                 |
| Charpy Impact Strength notched   | ISO 179     | 1eA(kJ/m²)                                        | 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 <sup>16</sup> | 10 <sup>16</sup> <   | 10 <sup>15</sup> <   | 10 <sup>16</sup> <   | 10 <sup>13</sup> -10 <sup>15</sup> |
| Volume Resistivity               | IEC 60093   | (Ωcm)                                             | 1.1*10 <sup>15</sup> | 2.7*10 <sup>16</sup> | 2.0*10 <sup>17</sup> | 5.5*10 <sup>16</sup> | 10 <sup>13</sup> -10 <sup>17</sup> |
| 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 <sup>-5</sup> K <sup>-1</sup> ) | 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

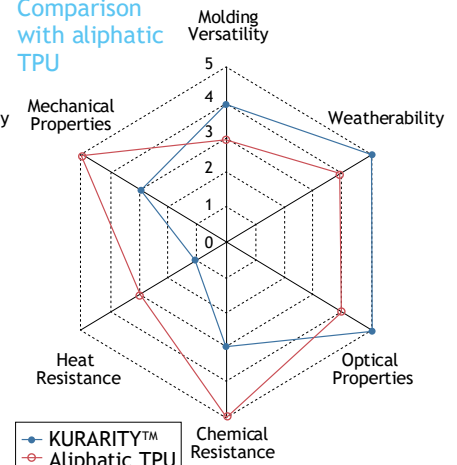
Comparison  
with PMMA



Comparison  
with transparent  
hard plastics

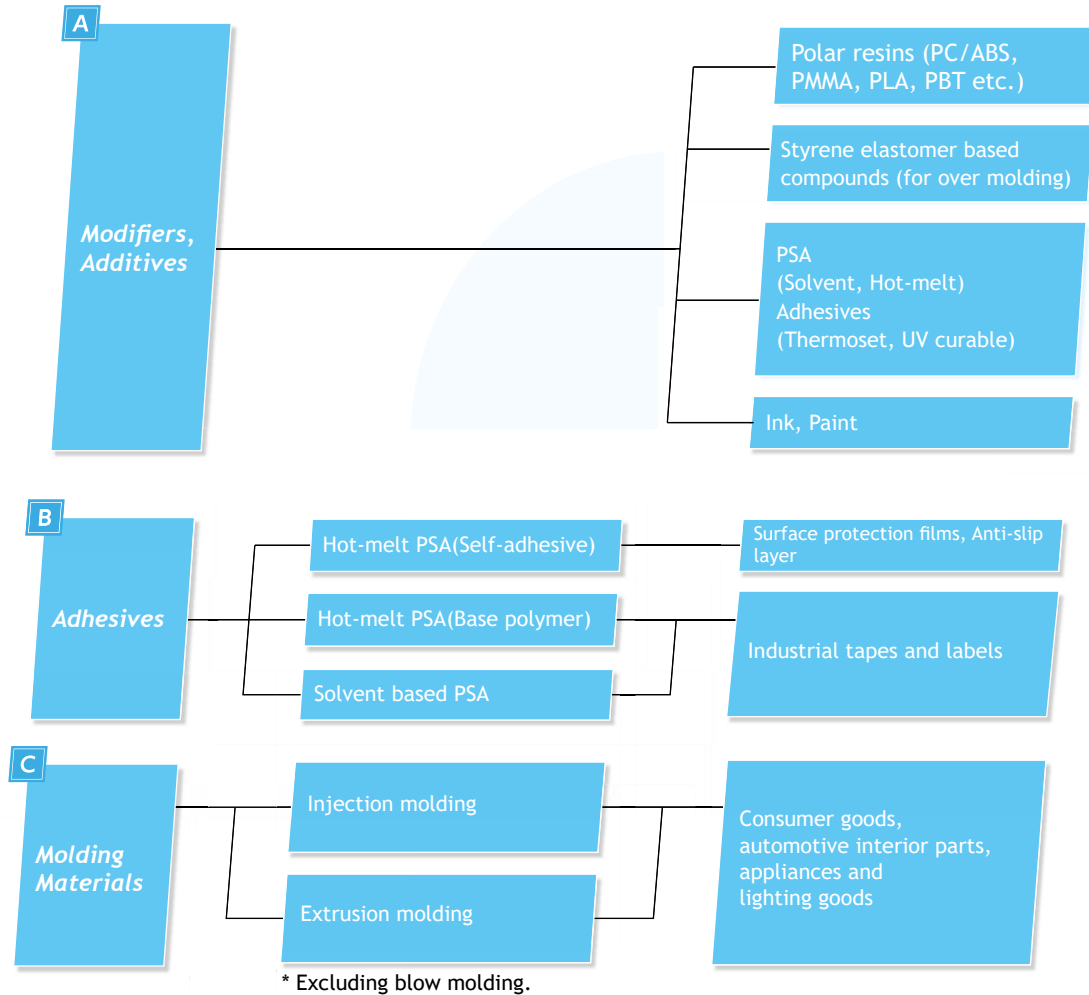


Comparison  
with aliphatic  
TPU



7

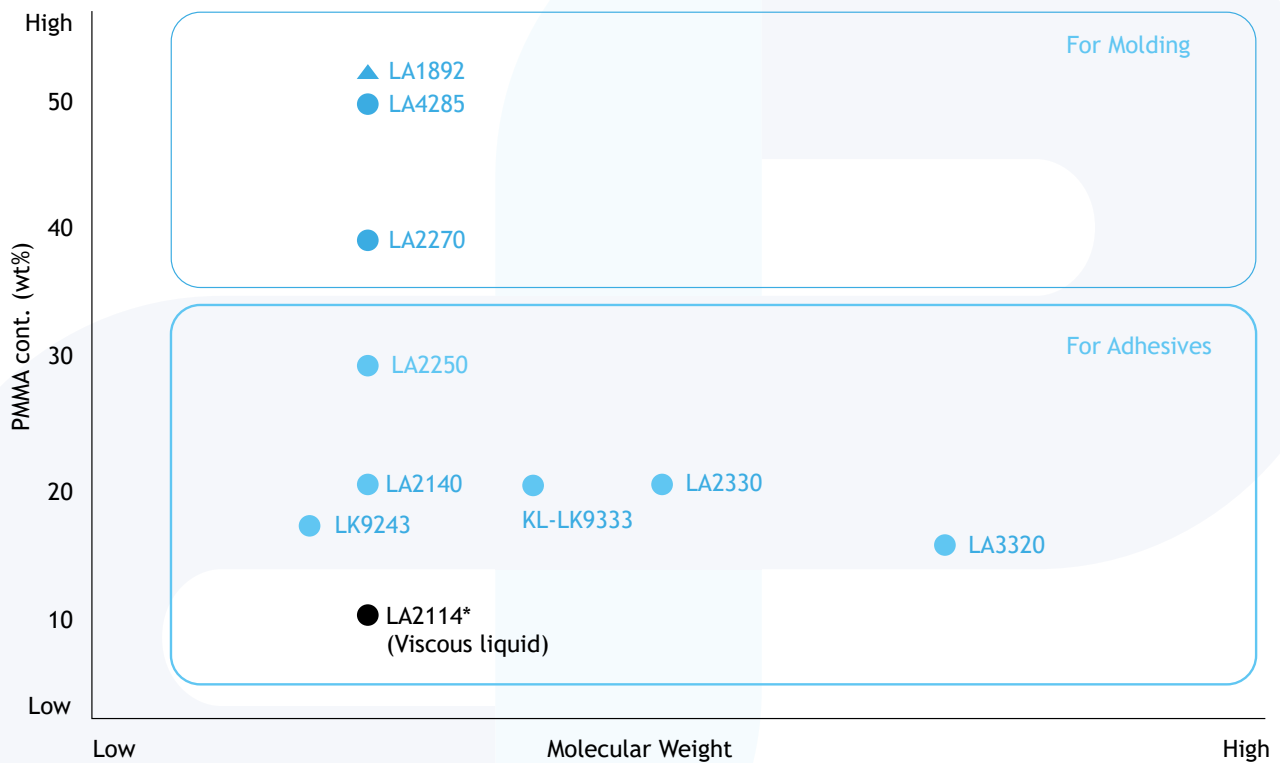
## Potential Applications for KURARITY™



**LA series** : n-butyl acrylate based block copolymers

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

### The Grade Map of KURARITY™

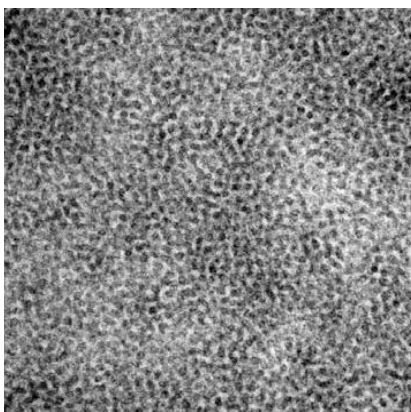


KL-LK9333 is a developmental grade.

### Microphase Separation Structure of LA series

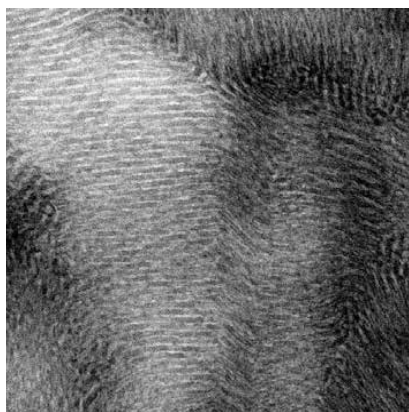
Black: PMMA, White: PnBA

LA2140



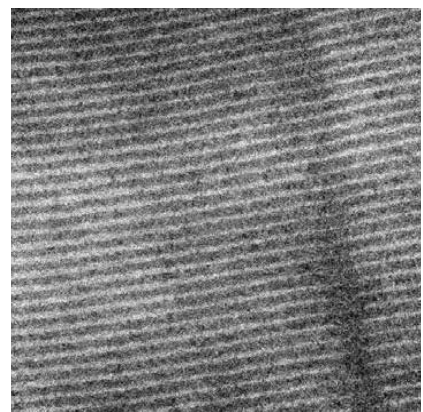
100 nm

LA2250



100 nm

LA4285



100 nm

## 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/m²)   | 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/m²)   | 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.

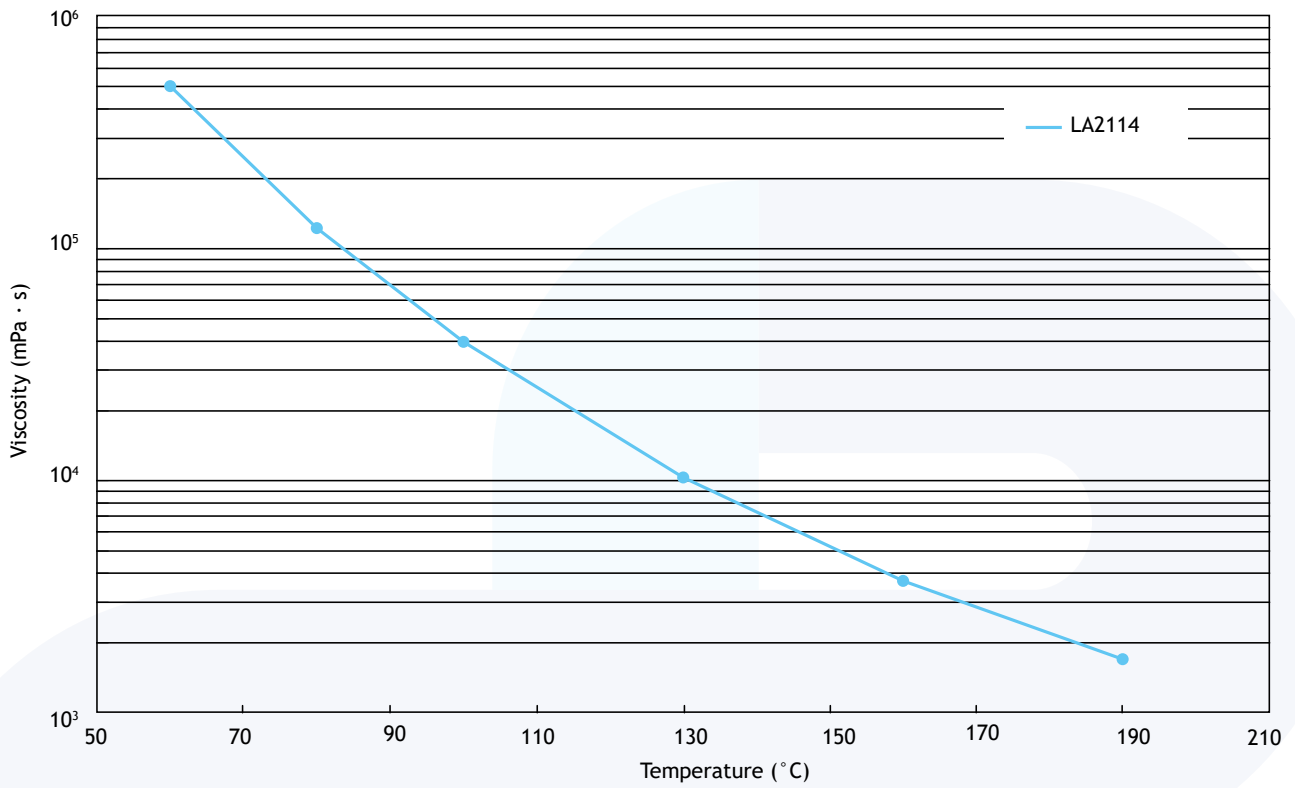
Some solutions to break it should be implemented.

Tested by Kuraray

KL-LK9333 is a developmental grade.

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## 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



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      |

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

Tested by Kuraray  
KL-LK9333 is a developmental grade.



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## Solubility Parameters of KURARITY™



- 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.



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



## 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 \* 3mm, 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 \* 3mm  
Injection molded sample

## Electrical Properties

| Grade     | Relative Permittivity $\epsilon_r$ |       |       | Dielectric Dissipation Factor $\tan\delta$ |        |        |
|-----------|------------------------------------|-------|-------|--------------------------------------------|--------|--------|
|           | 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 \* 1mm, Compression molded sheet

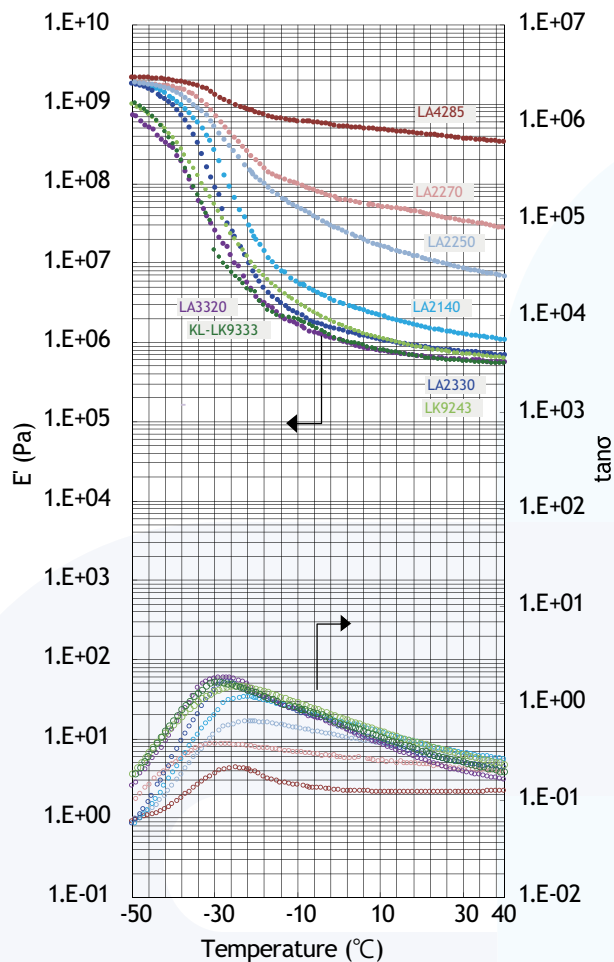
## Moisture Permeability

| Grade     | Water Vapor Transmission Rate (g/m <sup>2</sup> *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

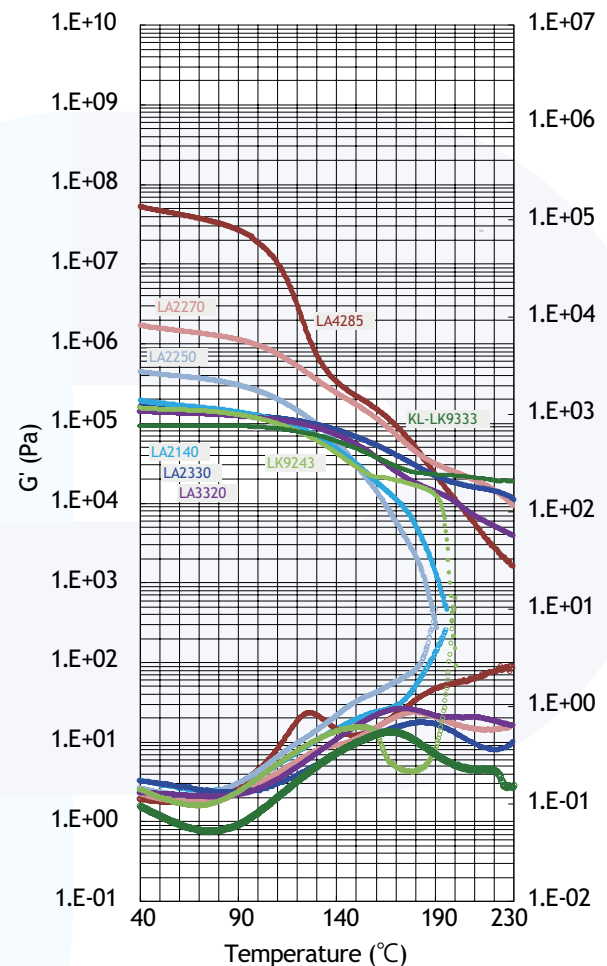
Test piece: 60mm \* 60mm \* 0.1mm, compression molded sheet

Tensile Mode



Test specimens: compression molded sheets  
Frequency: 11Hz  
Heating rate: 3  $^{\circ}\text{C}$  /min

Torsional Mode



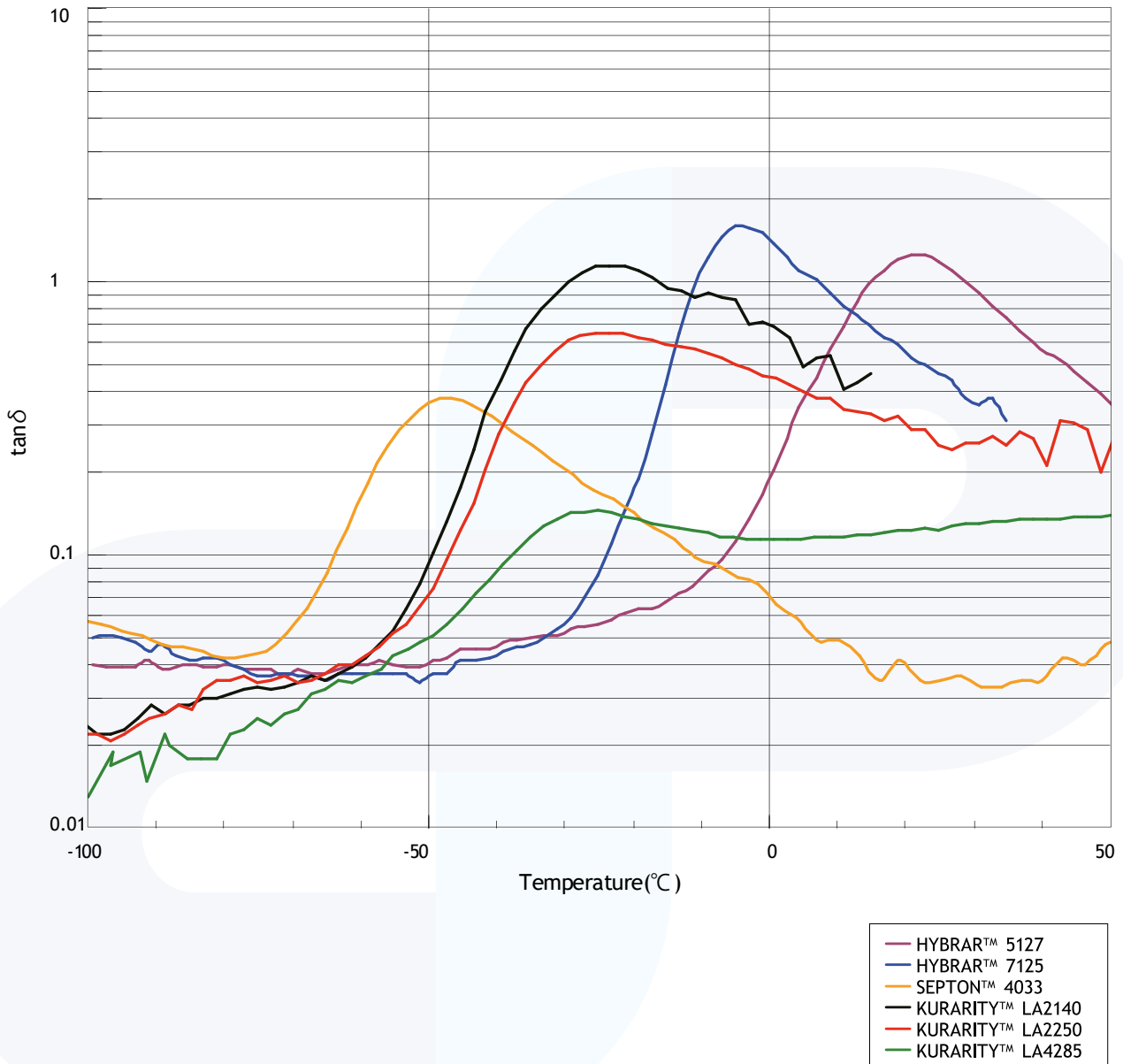
Tested by Kuraray

Test specimens: 8.0mm parallel plates  
Frequency: 6.28rad/s  
Heating rate: 2  $^{\circ}\text{C}$  /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 $\tan \delta$



### 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  $\tan \delta$  peak near room temperature.
- SEPTON™ is a series of hydrogenated styrenic elastomers developed by Kuraray Co., Ltd. which has its  $\tan \delta$  peak at lower temperature and shows rubber-like properties at room temperature.

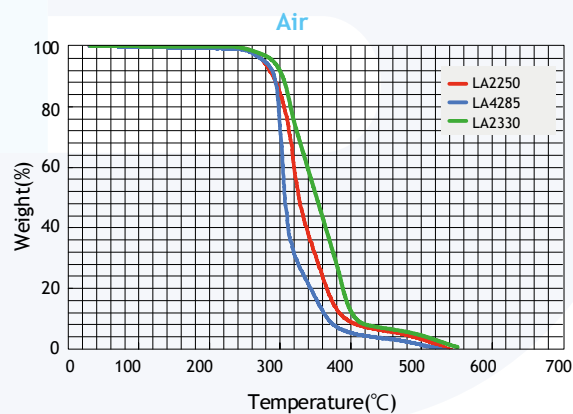
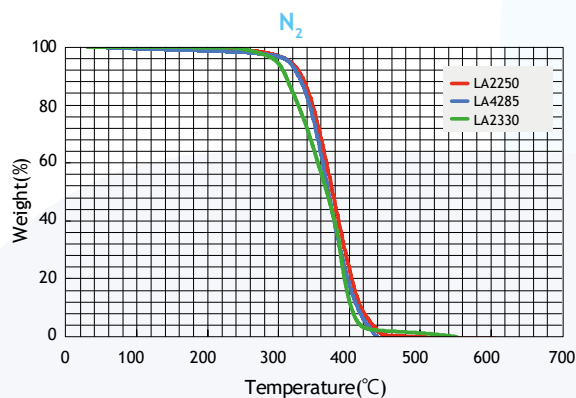
## 17 Thermal Stability of KURARITY™

Test condition: heat-rate:10°C/min

Tested by Kuraray

| N <sub>2</sub>        | 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  |

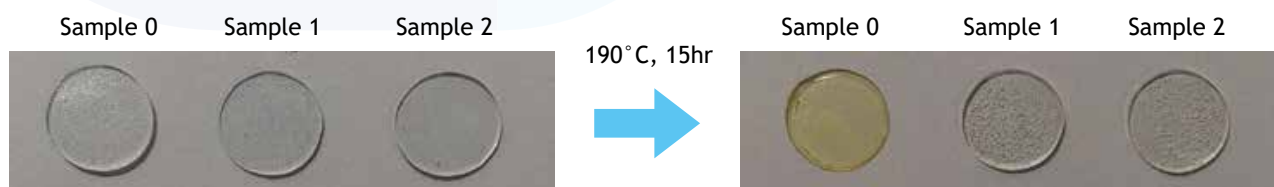


### Recommended Antioxidants

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

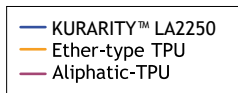
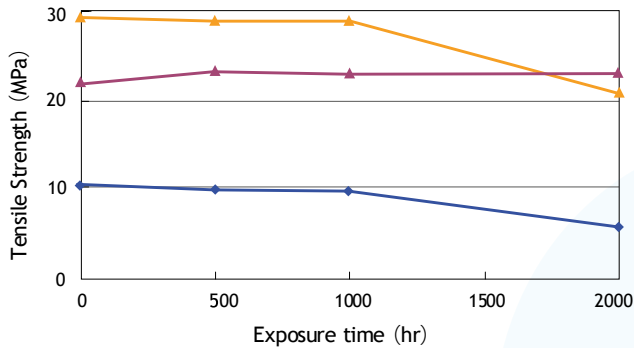


| Sample | Formulation                        | Results           |
|--------|------------------------------------|-------------------|
| 0      | LA2330                             | Turned yellow     |
| 1      | LA2330 + (1) 0.05phr + (2) 0.05phr | Slightly improved |
| 2      | LA2330 + (1) 0.10phr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

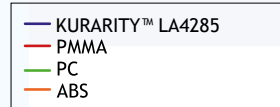
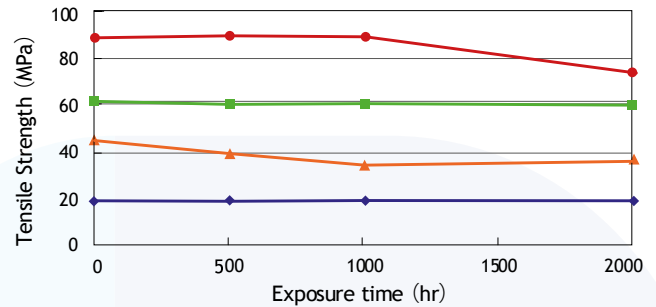
Test Specimens: Punched cast sheet

## Wetherability of KURARITY™

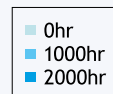
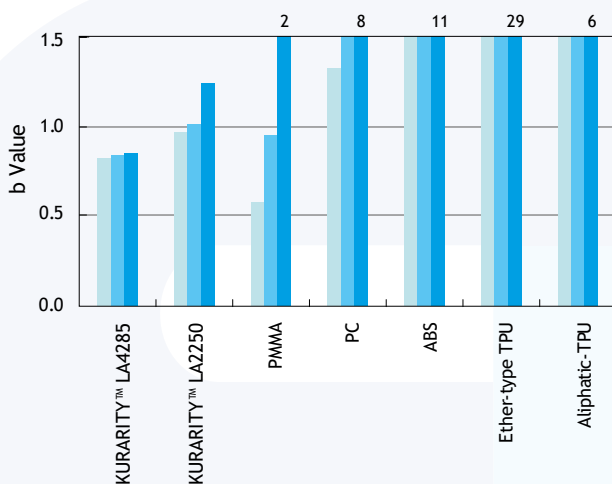
### Tensile Strength (ISO37)



### Tensile Strength (ISO527-2)



### Color (b Value)



\* These samples are without UVA, HALS

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

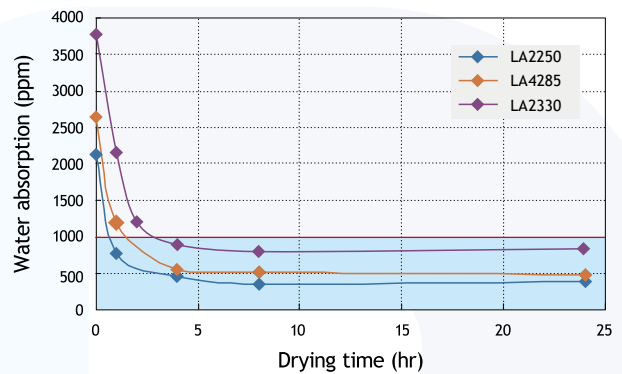


Recommended water absorption value of KURARITY™ is under 1,000 (ppm) for molding.

## Drying Test

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

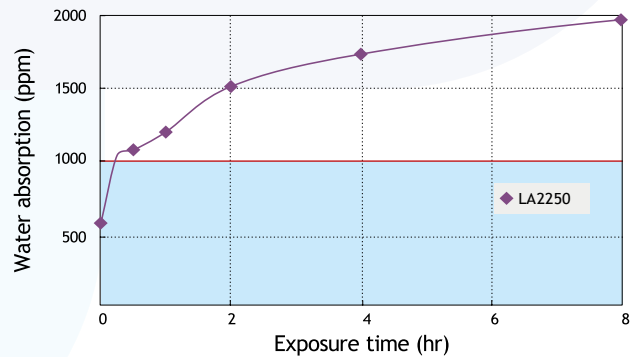
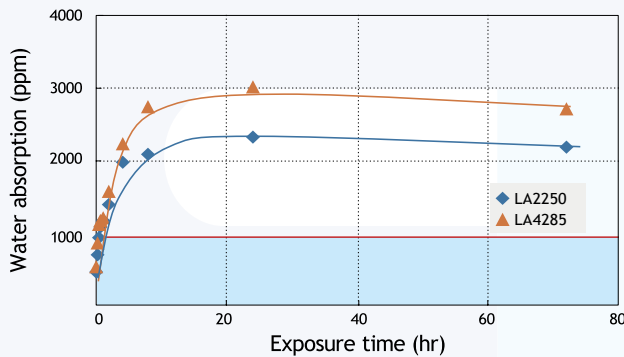
Blocking might be occurred after drying depending on the grades.  
Adding silica in 0.01 - 0.1 (phr) is recommended to prevent blocking.



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



+ : No Change, - : Swell / Clouding

|                                               | Visual Check |
|-----------------------------------------------|--------------|
| Acids (H <sub>2</sub> SO <sub>4</sub> : 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-80°C \*1hr  
Sample: LA2250 (Similar results are expected with other grades)  
Tested by Kuraray



Tested by Kuraray

|                                                                | KURARITY™<br>LA4285 | PMMA |
|----------------------------------------------------------------|---------------------|------|
| Painting**                                                     | +                   | +    |
| Printing (Inkjet print:UV type)                                | +                   | +    |
| Pad printing (UV Type)                                         | +                   | +    |
| Hard Coating (for Scratch Resistance)                          | +                   | +    |
| Coating (Vacuum deposition) Al, Cr, Sn, SiO <sub>2</sub> , ITO | +                   | -    |
| Dyeing***                                                      | +                   | +    |

\* The coating materials may crack depending on their flexibility.

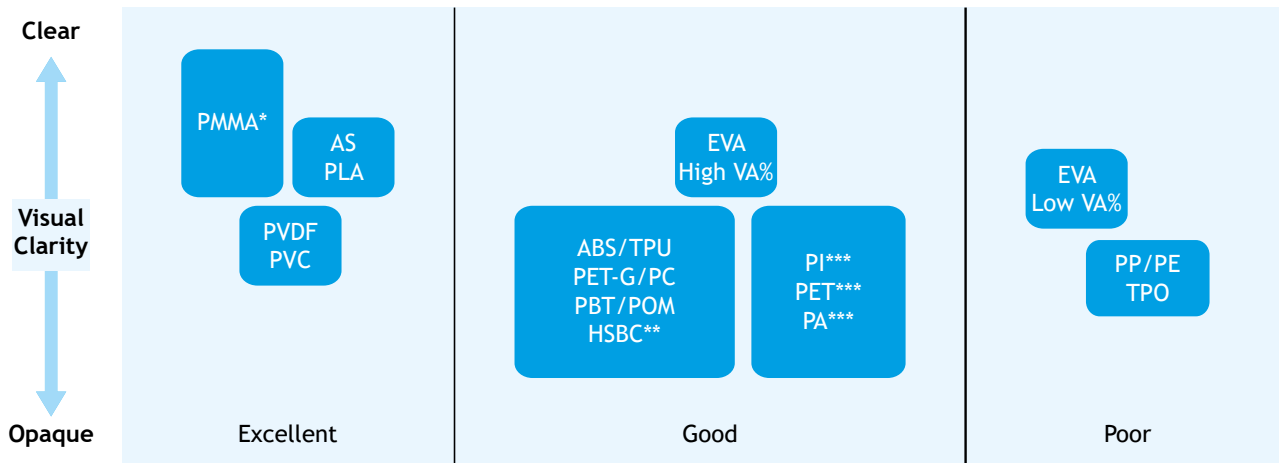
\*\* Acrylic urethane paints have proven well suited.

\*\*\* Pigments (organic or inorganic) have proven well suited.

## Overmolding with Other Thermoplastics with KURARITY™

|       | Double Injection<br>with KURARITY™ | Co-Extrusion<br>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™.



\* 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 compared 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 <sup>2</sup> ) | 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   |
|                       | ISO 7619-1 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  |

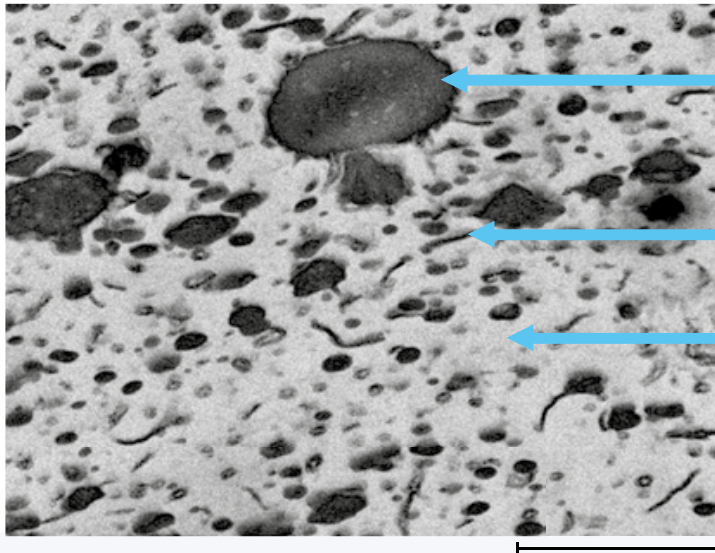
Tested by Kuraray

23

## KURARITY™ as Resin Modifier

### Example - Adding KURARITY™ to ABS

ABS/KURARITY™ LA4285 = 90/10



Butadiene rubber (Black)

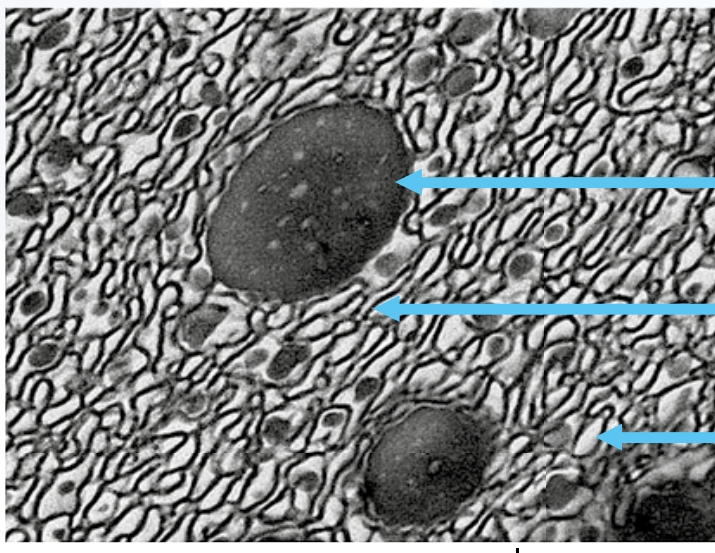
KURARITY™ (Black, Thread shape)

AS (White, Foaming matrix)

TEM Photo.

500nm

ABS/KURARITY™ LA4285 = 50/50



Butadiene rubber (Black)

KURARITY™ (Black, Foaming network)

AS (White)

TEM Photo.

500nm

### 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

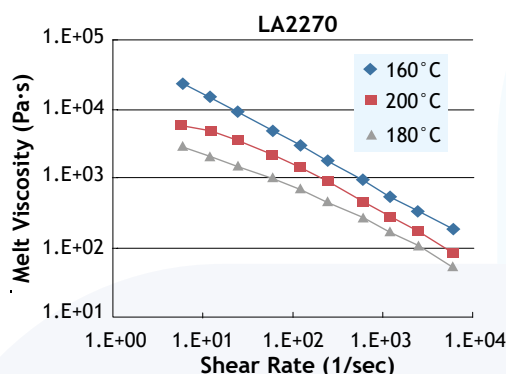
| Trouble                              | LA2250        | LA4285        |
|--------------------------------------|---------------|---------------|
| Cylinder Temperature (°C)            | 160-200       | 200-230       |
| Mold Temperature (°C)                | 20-40         | 20-40         |
| The bottom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

## Processing Parameters

|        | Hopper                          | Feeding zone   | Compression zone | Metering zone  | Adapter        | Die Head       |
|--------|---------------------------------|----------------|------------------|----------------|----------------|----------------|
| LA2270 | Water Cooling<br>(down to 40°C) | 100<br>~ 130°C | 140<br>~ 160°C   | 150<br>~ 170°C | 150<br>~ 170°C | 150<br>~ 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 Capillary 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. | Ethylene bis stearamide 0.01-0.1 (phr) |
| Poor biting by screw | Pellets are agglomerated by shear stress between the screw and the barrel.                                                      | Ethylene 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.

## 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

KURARITY™  
Other resins,  
Additives, etc

Hopper



kneading zone 1

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

Die head

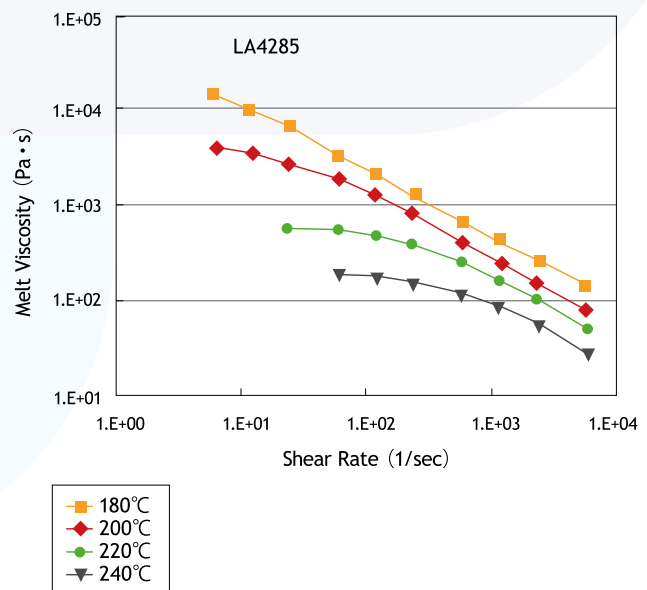
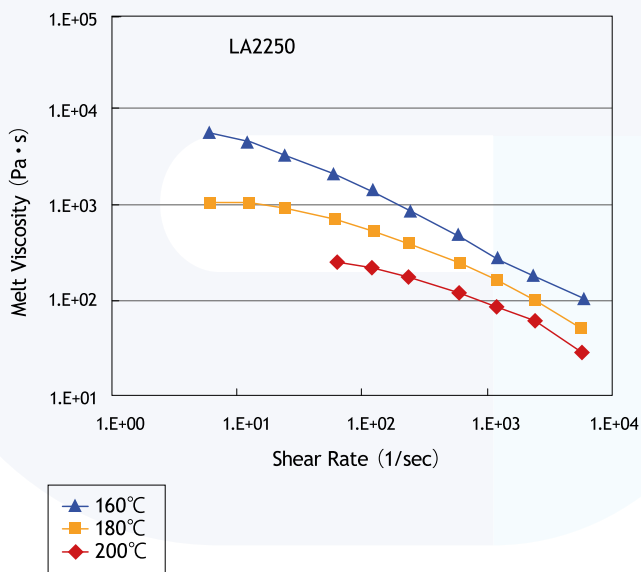
Twin screw extruder

kneading zone 2

Cutter

Watering cutter,  
under water  
cutter, strand  
cutter, etc

## 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) |

## 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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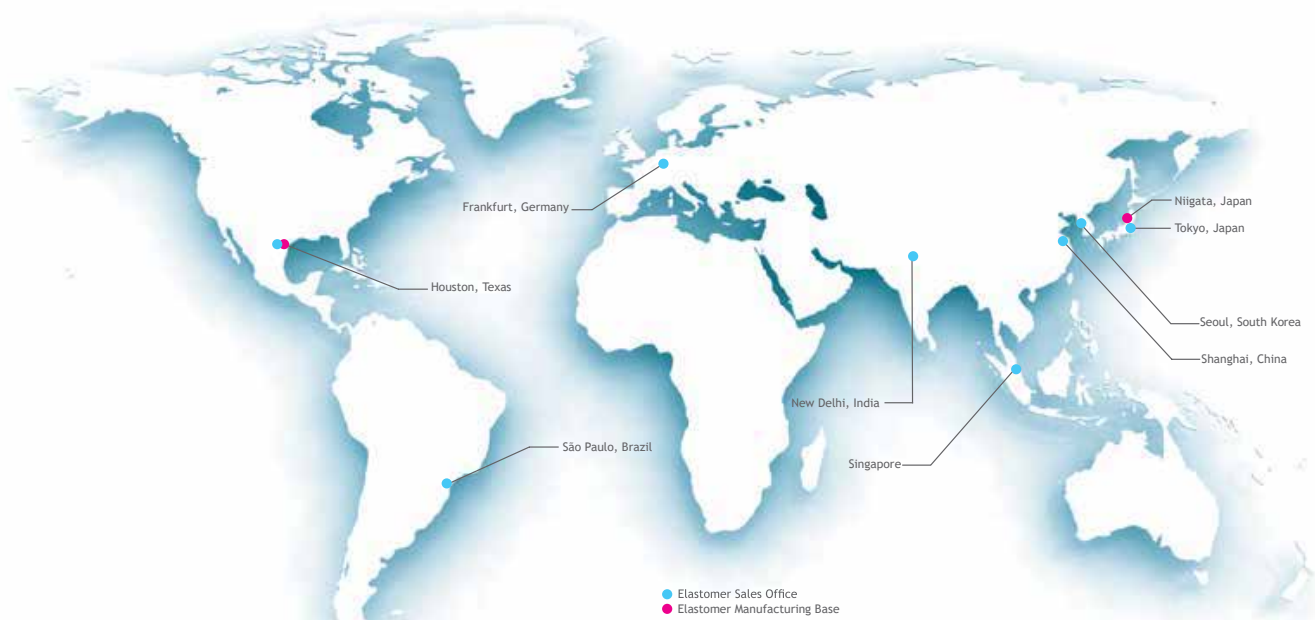
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# kuraray

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 every-

day 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](http://www.elastomer.kuraray.com)

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**Disclaimer:** Precautions should be taken in handling and storage. 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 Kuraray 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 and the user is advised to take appropriate steps to be sure that any proposed use of the product will not result in patent infringement.

10/2019