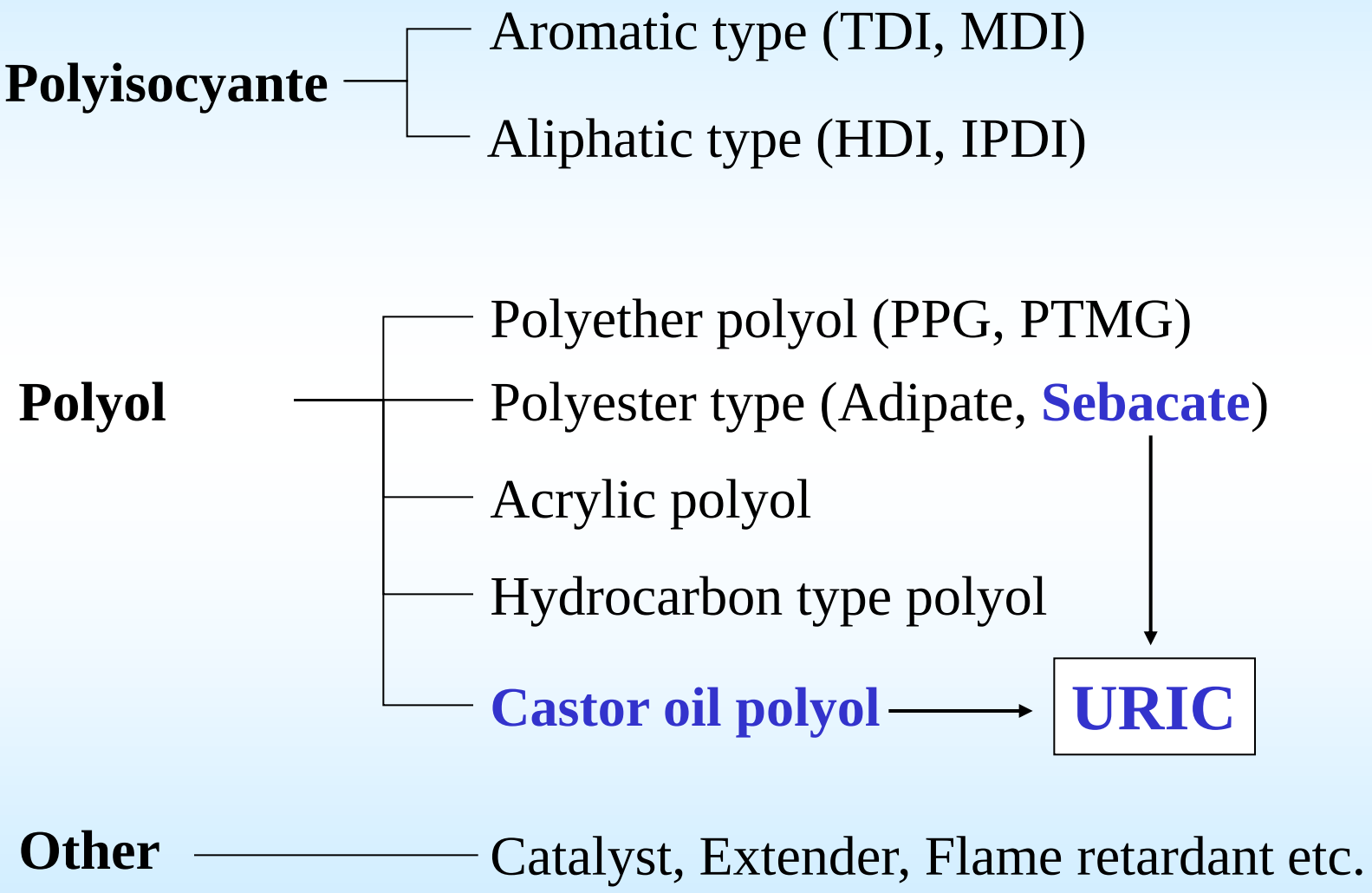
# Castor oil polyol for polyurethane resin material

# URIC

ITOH OIL CHEMICALS CO., LTD.

# Polyurethane raw materials



# Feature of polyurethane

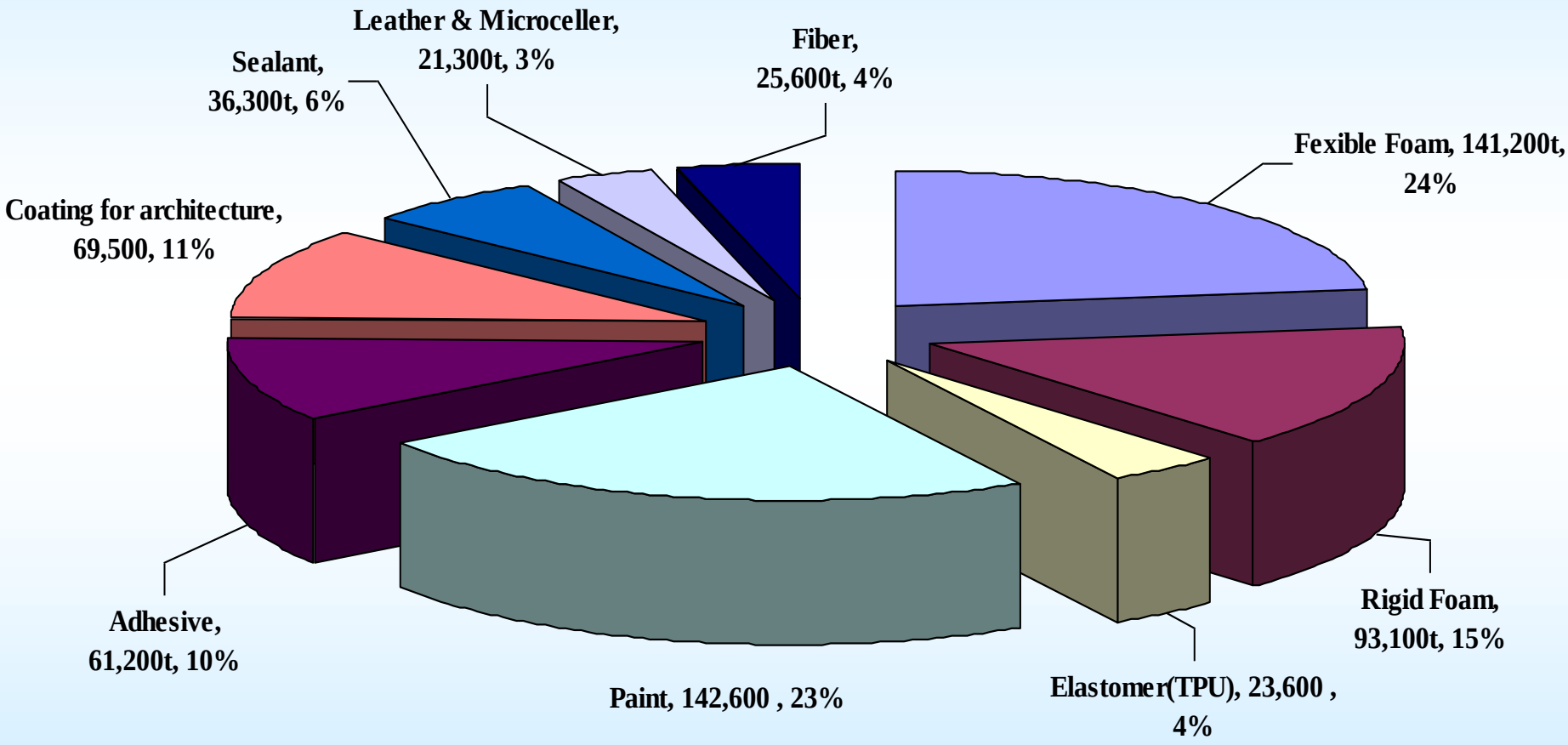
Polyurethane resin has various hardness by selecting polyol, so that its application is far-reaching.

Since polyurethane resin is easy to foam, it finds active uses as flexible foams for furniture, automobiles or trains, and rigid foams for heat insulator etc.

Polyurethane resins are excellent physical strength, abrasive resistance, elasticity etc.

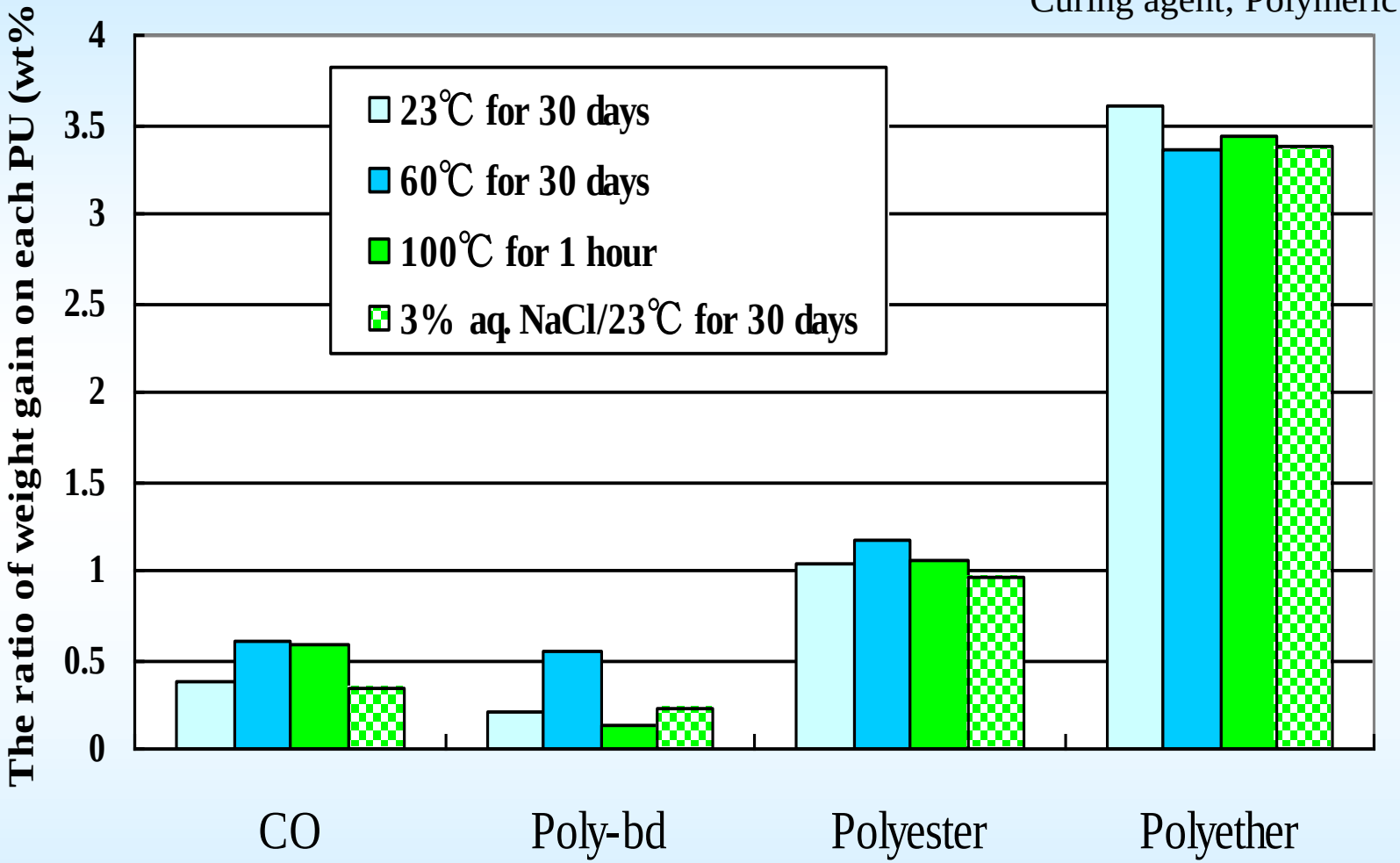
# Japan's PU market in FY07

(Total: 614,400 tons)



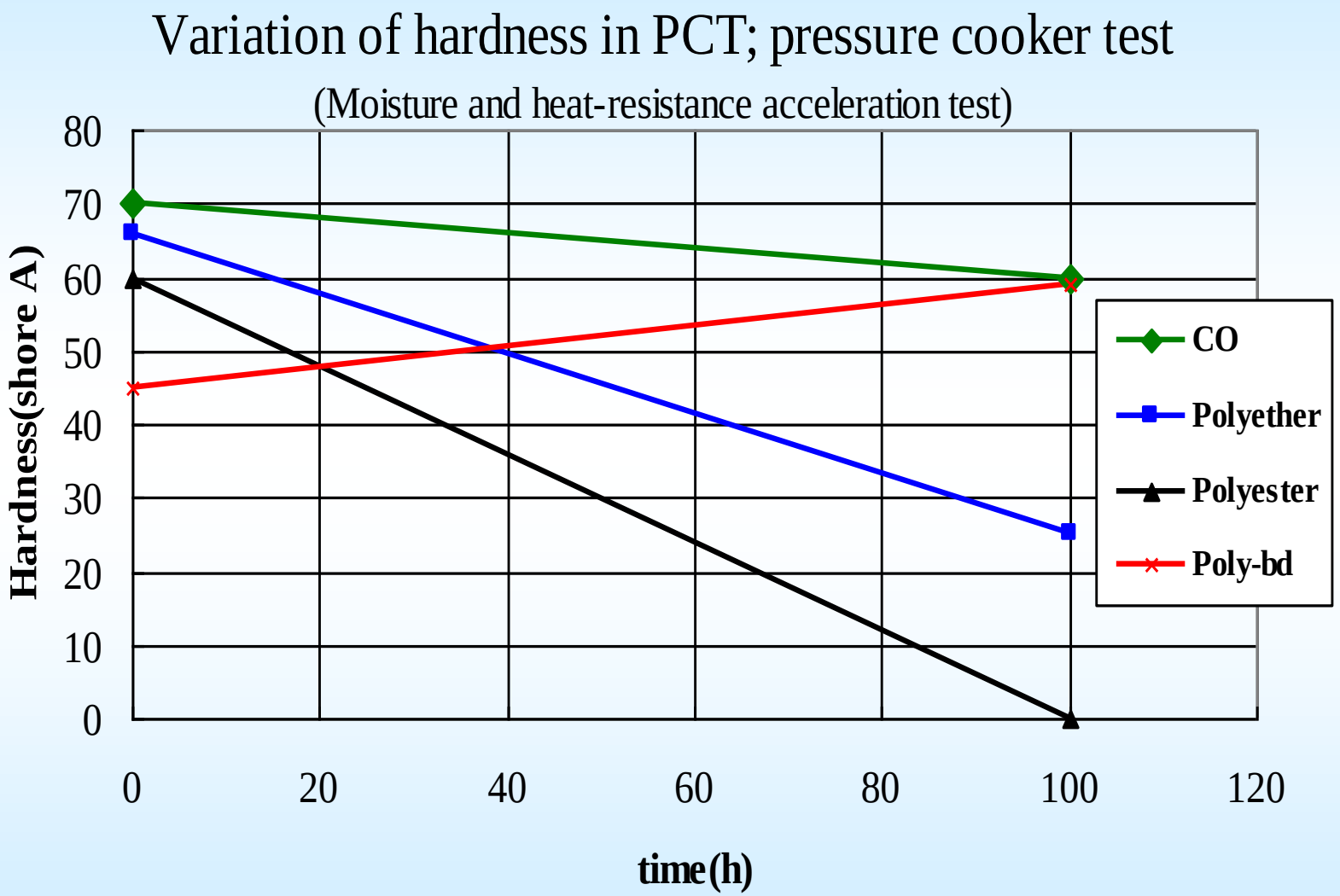
# Water Resistance

Curing agent; Polymeric MDI



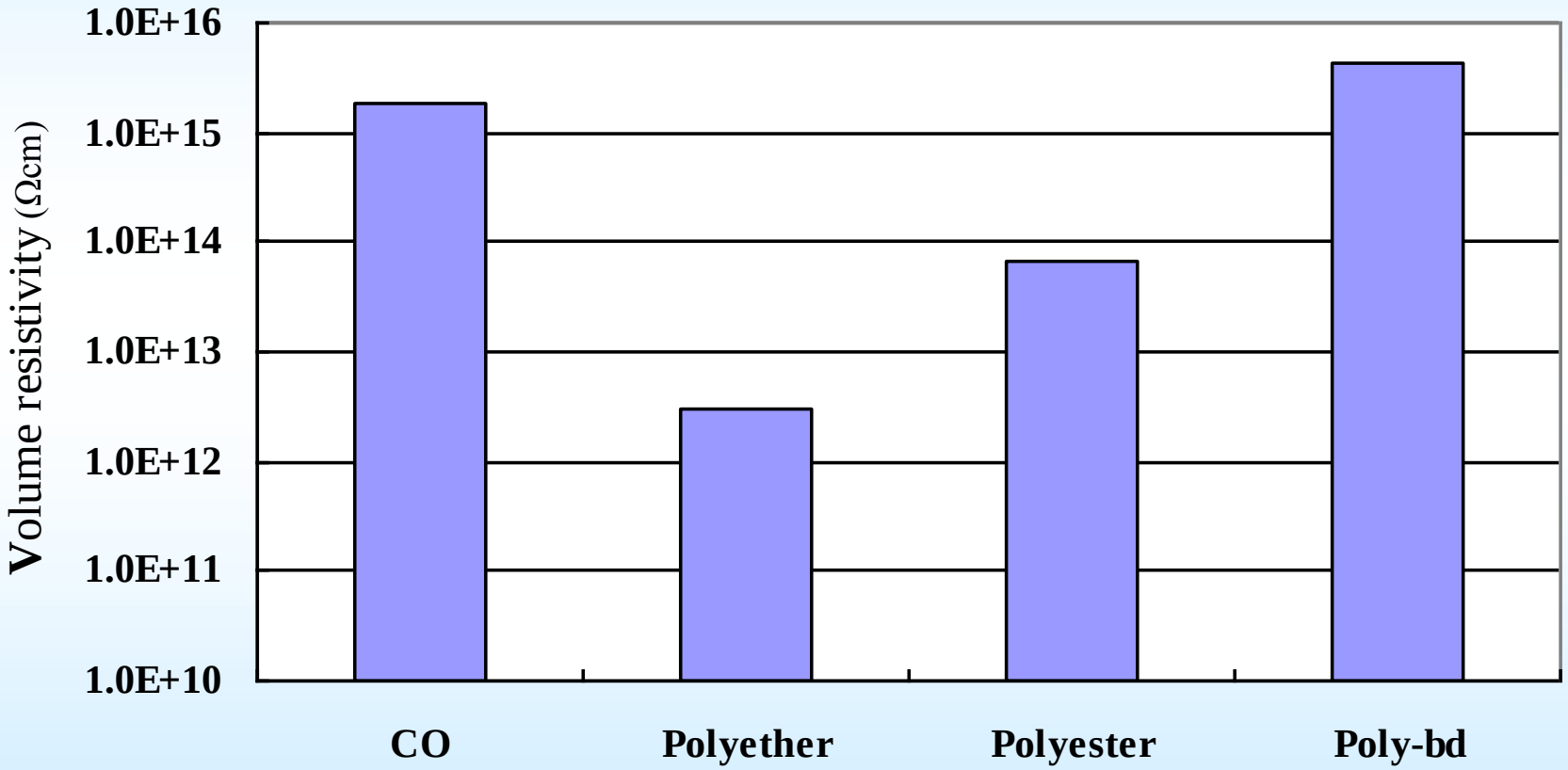

Curing agent; Polymeric MDI(NCO INDEX=1.05)
Poly-bd; Polybutadiene polyol (MW=1200, F=2.2),
Polyester; AA type(MW= 1000, F=3), Polyether; PPG(MW=1000, F=3)

# Hydrolysis resistance



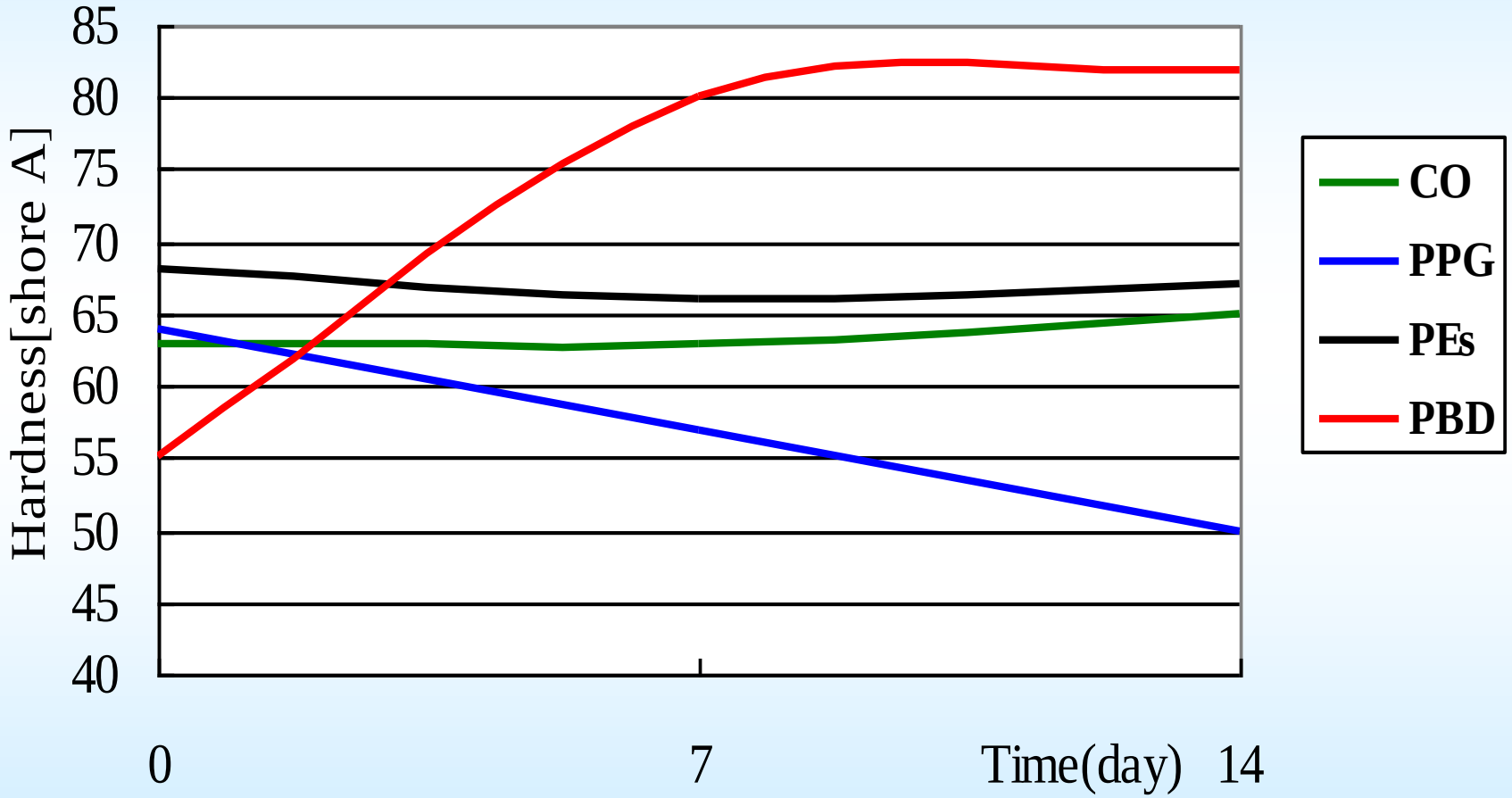

Curing agent; Polymeric MDI(NCO INDEX=1.05)
PCT condition; 121℃, 100wt%, 0.2MPa

# Electrical characteristics




Curing agent; Polymeric MDI(NCO INDEX=1.05)

# Heat Resistance




Curing agent; Polymeric MDI(NCO INDEX=1.05)
Condition; 150℃ in air

# Performance Comparison

| | Castor Oil | PPG | PE's | Poly-bd |
|---|---|---|---|---|
| Water | **G** | **P** | **F** | **G** |
| Boiling water | **G** | **P** | **P** | **G** |
| 10% aq. NaOH | **G** | **P** | **F** | **G** |
| 10% aq. $H_2SO_4$ | **G** | **P** | **F** | **G** |
| Methanol | **G** | **P** | **F** | **G** |
| Acetone | **P** | **P** | **P** | **P** |
| Ethyl Acetate | **P** | **P** | **P** | **P** |
| Paraffin oil | **G** | **G** | **G** | **P** |

G: Good
F: Fair
P: Poor

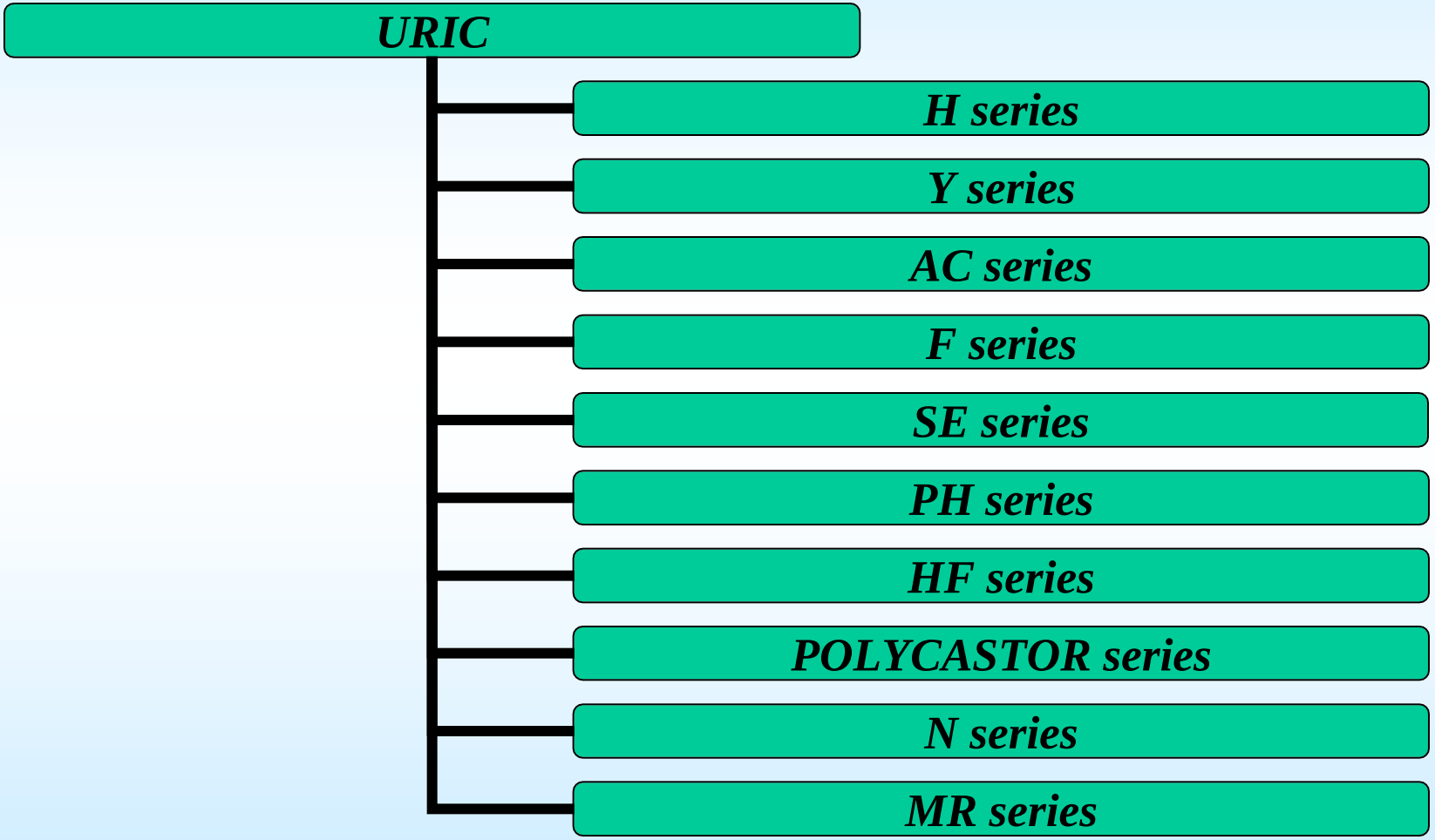
Curing agent; Polymeric MDI(NCO INDEX=1.05)
Solvent dipping condition; 23℃ for 10 days

**URIC Series** consists of polyol derived primarily from castor oil. The URIC Series is widely used in anti-corrosion paints, adhesives, floor coating materials and a variety of elastomers.

**Features:**

- Low viscosity & low foaming
- Excellent pigment wetting, water resistance and electrical insulation.
- Mechanical strength utilizing castor oil characteristics

# *URIC castor oil polyurethane systems*



# URIC castor oil polyurethane systems

| | |
|---|---|
| ***H series*** | General purpose grade. High quality castor oil based polyols |
| ***Y series*** | Excellent compatibility and lower viscosity with hydrocarbon polyols |
| ***AC series*** | Castor oil mod. polyols which have aromatic structure |
| ***F series*** | Castor oil polyols for floor coating materials |

# URIC castor oil polyurethane systems

***SE series*** Environmental friendly polyester polyol based on sebacic acid

***PH series*** Special modified castor oil polyols for urethane gel

***HF series*** CO polyols for flexible & rigid foam etc.

***POLYCASTOR series***

Polymerized castor oil for elastomers and coatings. It is also used as surfactants or plasticizers.

# Solvent-free 2KPU systems using URIC

| USE | FEATURE |
|---|---|
| Floor coating materials | Low foaming at applying |
| Electric sealants | Excellent insulation, Water proof, Good combination with others |
| Anti-corrosive paints & Adhesives | Flexibility, Impact resistance and Excellent adhesive properties to metal, plastics etc. |
| Foams (flexible & rigid) | Environmental friendly, low elastic, high heat insulating properties |

# URIC H Series

**URIC H Series** is the general purpose grade. The H Series is a high quality castor oil based polyol, which can be used for a wide range of polyurethane applications. There are a variety of grades with different viscosities and reactions making it suitable for many applications.

Using the H Series with Polyurethane elastomers will provide better heat stability, hydrolysis resistance, acid resistance and chemical resistance than general polyester based polyurethanes. It also gives outstanding flexibility, insulation and mechanical properties such as adhesion or impact resistance.

# Typical Properties of H Series

| | OHV [mgKOH/G] | AV [mgKOH/G] | Water content [wt%] | Viscosity [mPs.s, 25℃] | Functionality |
|---|---|---|---|---|---|
| H-30 | 160 | 0.2 | 0.03 | 690 | 2.7 |
| H-31 | 164 | 1.0 | 0.03 | 30 | 1 |
| H-52 | 200 | 0.5 | 0.03 | 630 | 3 |
| H-56 | 90 | 2.0 | 0.03 | 230 | 2 |
| H-57 | 100 | 2.0 | 0.03 | 460 | 3 |
| H-62 | 260 | 2.5 | 0.03 | 265 | 2 |
| H-73X | 270 | 2.0 | 0.03 | 1000 | 3 |
| H-81 | 340 | 2.0 | 0.03 | 1200 | 3 |
| H-420 | 320 | 1.0 | 0.10 | 800 | 3 |
| H-854 | 215 | 1.0 | 0.05 | 800 | 3 |

# Typical Properties of H Series

Crosslinked with polymeric MDI, NCO content 31%, NCO Index:1.05 at 25 ℃

| | Hardness Shore A/D | Pot life *1 [min] | Elongation [%] | Tensile strength [MPa] | Tear st. [N/mm] | VR [Ω·cm] |
|---|---|---|---|---|---|---|
| H-30 | 74/23 | 62 | 132 | 8 | 25 | 2.0E+14 |
| H-31 | - / - | - | - | - | - | - |
| H-52 | 91/38 | 58 | 100 | 10 | 27 | 4.0E+14 |
| H-56 | 30/ 5 | - | 120 | 0.5 | 2 | 2.0E+11 |
| H-57 | 44/ 9 | 200 | 480 | 0.9 | 3 | 2.0E+12 |
| H-62 | - /55 | 30 | 81 | 6 | 51 | 2.2E+14 |
| H-73X | - /70 | 24 | 39 | 28 | 55 | 9.5E+14 |
| H-81 | - /68 | 17 | 35 | 23 | 87 | 1.1E+15 |
| H-420 | - /80 | 41 | 10 | 48 | 25 | 3.0E+15 |
| H-854 | - /60 | 57 | 172 | 13 | 28 | 5.0E+15 |

*1; Time its viscosity reaches 50,000 mPa·s at 25℃ after mixing polyol and polymeric MDI

# Typical Properties of H Series

| | Properties and Applications |
|---|---|
| H-30 | Refined castor oil for 2KPU elastomers & coatings. |
| H-31 | Reactive diluent for PU polyols, epoxy and acrylic resin etc. |
| H-52 | Castor oil polyol for 2KPU system. |
| H-56 | Castor oil polyol for 1KPU system except electric sealants. |
| H-57 | Castor oil polyol for 2KPU system except electric sealants. |
| H-62 | Castor oil polyol for 2KPU elastomers and coatings. |
| H-73X | Great anti-hydrolysis and physical properties for 2KPU elastomers and coatings. |
| H-81 | |
| H-420 | Great physical property and heat resistance for 2KPU coatings, adhesives and sealants. |
| H-854 | Great anti-hydrolysis and adhesive properties for 2KPU heavy duty coatings. |

# URIC Y Series

**URIC Y Series** is specialty polyol, derived from castor oil and other fatty acids, which has 2 or 2.2 functional groups. It is suitable as a reactive diluent for insoluble 2KPU systems. It has excellent compatibility and lower viscosity with hydrocarbon based polyols, such as poly-butadiene polyol, which is incompatible with most polyols. The Y Series improves mechanical properties, such as tensile strength and elongation. The Y Series also prevents bleeding or shrinkage from heat after molding, unlike typical non-reactive diluents.

Y-332 has excellent weather ability and non-yellowing property. It can also be used as reactive diluents for isoprene polyol. There is just one of the Y Series outstanding benefits due to its non-double bonding characteristics.

# Typical Properties of Y Series

| | OHV mgKOH/g | AV mgKOH/g | Mois. (%) | Vis. mPa·s, 25℃ | F*1 | Properties & Applications |
|---|---|---|---|---|---|---|
| Y-202 | 120 | 1.0 | 0.03 | 650 | 2 | Good water resistance and anti-foaming property. In addition, great reactive diluents for polybutadiene polyols for 2KPU sealants, adhesives etc. |
| Y-403 | 160 | 1.0 | 0.03 | 220 | 2 | |
| Y-406 | 165 | 1.5 | 0.03 | 250 | 2.2 | |
| Y-332 | 123 | 0.5 | 0.03 | 1250 | 2 | Good weather ability for 2KPU systems. Great reactive diluents for isoprene polyols. |

*1; Functionality

# Urethane Properties of Y Series

| | Hardness Shore A/D | Pot life *1 [min] | Elongation [%] | Tensile strength [MPa] | Tear st. [N/mm] | VR [Ω·cm] |
|---|---|---|---|---|---|---|
| Y-202 | 55/10 | 344 | 87 | 2.5 | 4.0 | 7.0E+13 |
| Y-403 | 33/4 | - | 109 | 0.6 | 3.0 | 1.40E+14 |
| Y-406 | 59/12 | 48 | 110 | 3.0 | 6.0 | 1.40E+14 |
| Y-332 | 53/12 | - | 107 | 2..4 | 5.0 | 1.60E+14 |

Crosslinked with polymeric MDI, NCO content 31%, NCO Index:1.05 at 23℃
In case of Y-332, it is crossliked with HDI isocyanurate; NCO content 21% at 25℃)

*1; Time its viscosity reaches 50,000 mPa·s at 25℃ after mixing polyol and polymeric MDI

# Formulation Example

| | Blank 1 | e.g. 1 | e. g. 2 | e.g. 3 |
|---|---|---|---|---|
| Poly-bd *1 | 100 | 50 | 50 | 50 |
| Y-202 | | 50 | | |
| Y-403 | | | 50 | |
| Y-406 | | | | 50 |
| Viscosity [mPa·s, 25℃] | 7000 | 3200 | 1600 | 1750 |
| Hardness [shore A] | 46 | 46 | 50 | 58 |
| Elongation [%] | 160 | 190 | 640 | 720 |
| Tensile Strength [MPa] | 1.4 | 1.9 | 3.7 | 5.2 |

*1; Polybutadiene polyol (OHV 46.6, Functionality 2.2)

# URIC AC Series

**URIC AC Series** is castor oil modified polyol which has aromatic structure. It can be used in insoluble polyurethane systems with the use of isocyanates such as polymeric MDI etc.

Combined with MDI, the AC Series performs with outstanding mechanical strength and excellent adhesion to metals. It also shows exceptional impact resistance and water resistance.

# Typical Properties of AC Series

| | OHV mgKOH/g | AV mgKOH/g | Mois. (%) | Vis. mPa·s, 25℃ | F*1 | Properties & Applications |
|---|---|---|---|---|---|---|
| AC-005 | 210 | 1.5 | 0.03 | 1200 | 2 | BPA modified castor oil polyols for 2KPU adhesives and coatings. Great adhesive for metals and good anti-corrosive properties. |
| AC-006 | 178 | 3.0 | 0.03 | 4000 | 2 | |
| H-368 | 195 | 1.0 | 0.03 | 1300 | 2.5 | |
| AC-008 (NEW) | 180 | 1.5 | 0.03 | 1600 | 2.5 | Improved the existing AC series, which are stricken a balance between handling & adhesive property, not mention, chemical resistance. |
| AC-009 (NEW) | 225 | 1.5 | 0.03 | 1500 | 2.5 | |

*1 ; Functionality

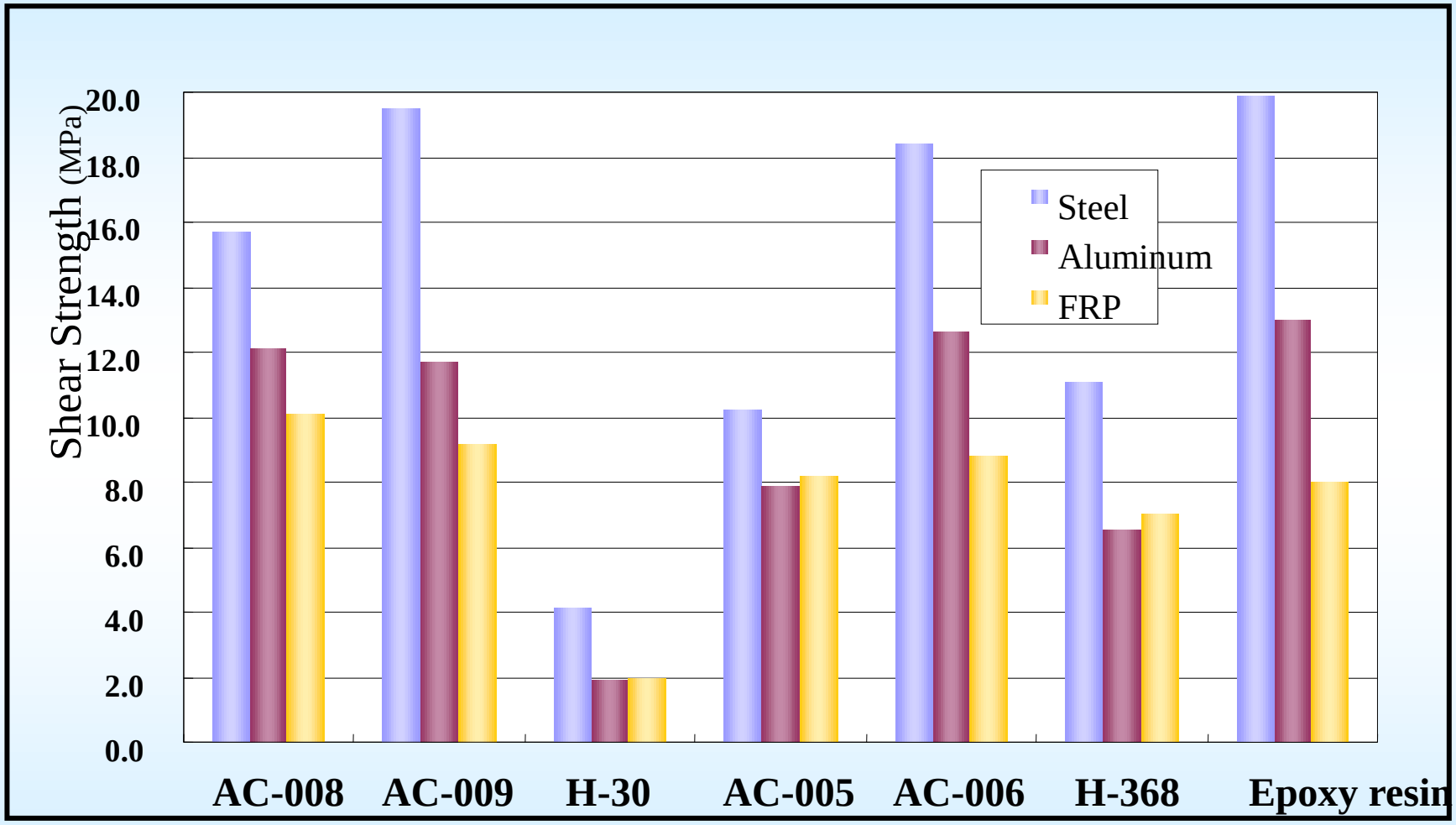
# Urethane Properties of AC Series

| | Hardness Shore D | Pot life *1 [min] | Elongation [%] | Tensile strength [MPa] | Tear strength. [N/mm] | Volume resistance [Ω·cm] |
|---|---|---|---|---|---|---|
| AC-005 | 73 | 52 | 25 | 39 | 136 | 1.2E+15 |
| AC-006 | 78 | 74 | 17 | 51 | 34 | 3.0E+15 |
| H-368 | 68 | 53 | 120 | 23 | 112 | 1.8E+15 |
| AC-008 | 47 | 73 | 95 | 15 | 50 | 5.5E+16 |
| AC-009 | 69 | 37 | 100 | 30 | 30 | 1.8E+16 |
| H-30 (CO) | 23 | 62 | 132 | 8 | 25 | 2.0E+14 |

Crosslinked with polymeric MDI, NCO content 31%, NCO Index:1.05 at 85℃ for 16 hours

*1; Time its viscosity reaches 50,000 mPa·s at 25℃ after mixing polyol and polymeric MDI

# Adhesion Test




| **Substrate:** | **Material:** | **Surface Treatment:** |
|---|---|---|
| Steel Panel | spcc-sd | Sand-blasted |
| Aluminum panel | A1050P | Sand-blasted |
| FRP | | Polyester |

# Impact Resistance

**Du Pont test** 1)

| Falling weight | Contact (radius mm) | AC-005 | AC-006 | H-368 | AC-008 (NEW) | AC-009 (NEW) | Epoxy Resin 2) |
|---|---|---|---|---|---|---|---|
| 1000g | 6.35 | Good | Good | Good | Good | Good | Good |
| | 3.18 | Good | Good | Good | Good | Good | Bad |
| | 1.59 | Good | Good | Good | Good | Good | Bad |

1)Falling height; 500 mm,
Test film is coated on 3mm in thickness on the sand blast surface carbon steel (SIS Sa 2 ½)
2)Epoxy resin; EPYCOAT 828 crosslinked with polyamine; VERSAMID 115

# URIC F Series

**URIC F Series** was developed for floor coating materials with the use of crude MDI, which has excellent hardness and elongation.

One of the most challenging issue of polyurethane floor coating is heat and humidity at applying. However, the film coating with URIC F series is very stable under high heat and humidity.

# Urethane Properties

(Crosslinked with polymeric MDI , NCO: 31%, INDEX: 1.05)

| | F-15 | F-25 | F-40 |
|---|---|---|---|
| OHV [mgKOH/g] | 167 | 188 | 236 |
| AV [mgKOH/g] | 1.5 | 0.6 | 1.5 |
| Viscosity [mPa·s, 25℃] | 3,000 | 2,600 | 3,900 |
| Hardness [Shore D] | 67 | 70 | 80 |
| Elongation [%] | 122 | 96 | 85 |
| Tensile Strength [MPa] | 26 | 28 | 43 |
| Tear Strength [N/mm] | 58 | 86 | 170 |
| Feature | General purpose grade | General & refinish use | High hardness, impact resistance |

# Comparison of PU floor coatings

**Typical Formulation**

| | |
|---|---|
| Polyol: | 63.0 |
| Extender pigment: | 26.0 |
| Dehydrating agent: | 7.0 |
| Coloring agent: | 3.5 |
| Defoamer: | 0.5 |
| Crosslinker (P. MDI): | 25.0 |

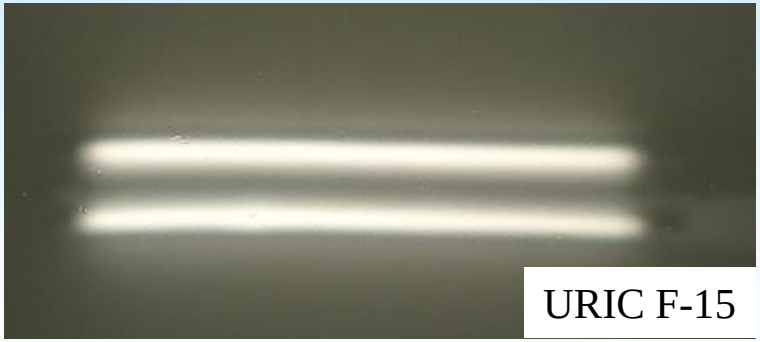
*Formation rate:3/1

**Condition;**

Coating condition; 35℃, 90%

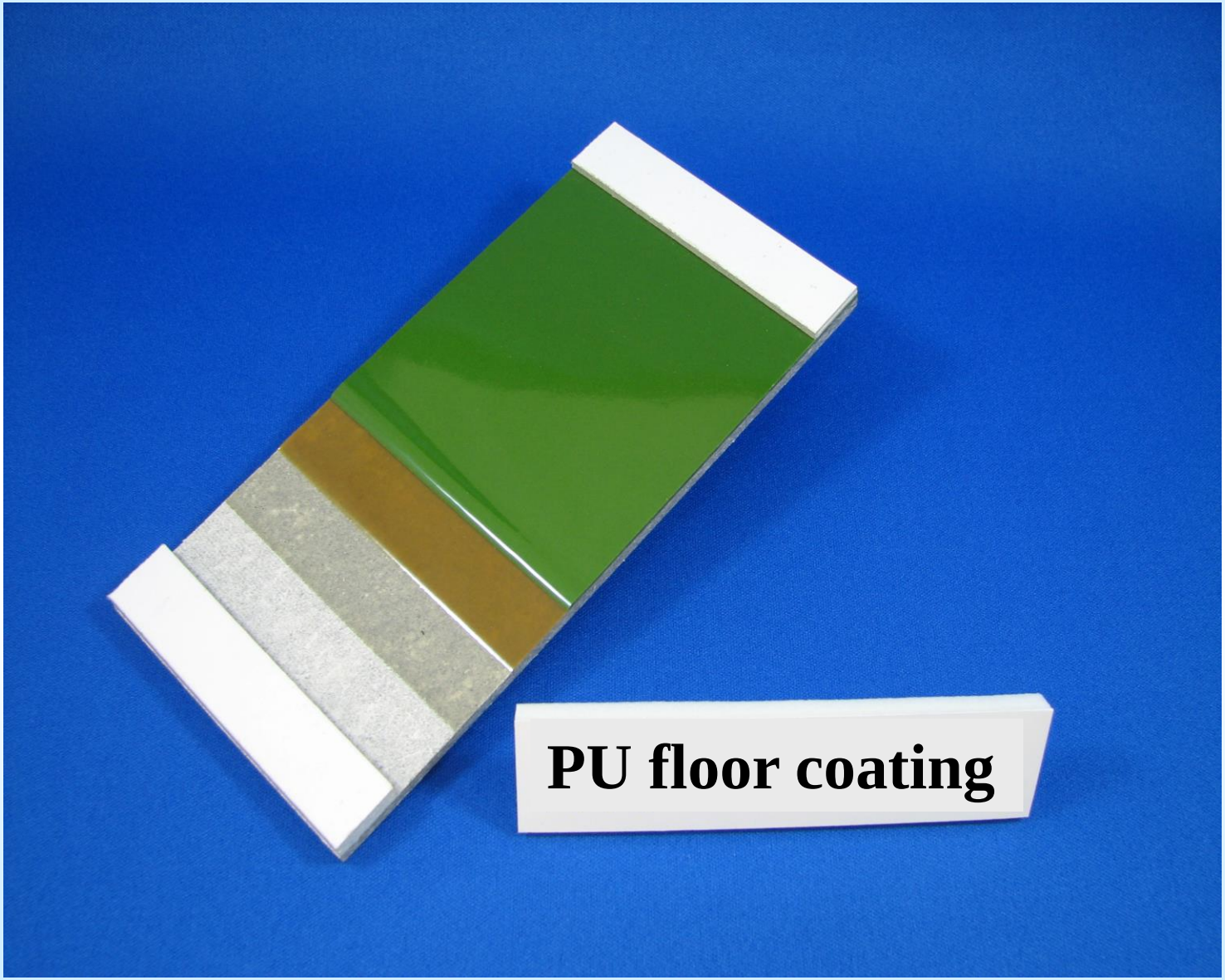
Curing agent; Crude MDI
(Polymeric MDI)

Film thickness; 500 micron with applicator





# Example 1 URIC F-15, F-25, F-40



# URIC SE Series

**URIC SE Series** is polyester polyol using sebacic acid. SE series shows better water resistance and good performance at low temperature compared with the adipate type polyester polyols. It can be used as a material for TPU, reaction hot melt or fiber. And it finds uses in adhesives for automobile and retort pouches for food.

Especially, SE-2003 is an environment-friendly product which is made from sebacic acid and 1,3-propanediol. The former is derived from castor oil, and the latter is made from corn seed oil.

# SE Series

Environmental friendly polyester polyol; better water resistance and excellent performance in lower temperature crosslinked with pure MDI)

| | SE-2003 | SE-2606 |
|---|---|---|
| Appearance | White solid | White solid |
| Acid Value [mgKOH/g] | 0.3 | 0.1 or less |
| Hydroxyl Value [mgKOH/g] | 56 | 43 |
| Melting Point [℃] | 54 | 66 |
| Composition | SA/PDO | SA/HG |
| Molecular weight | 2,000 | 2,600 |
| Hardness [shore A, D] | 94A | 49D |
| Modulus at 100% [MPa] | 4.4 | - |
| Modulus at 300% [MPa] | 6.6 | - |
| Elongation [%] | >700 | - |



※SA; Sebacic acid, PDO; 1,3-Propanediol, HG; Hexylene glycol

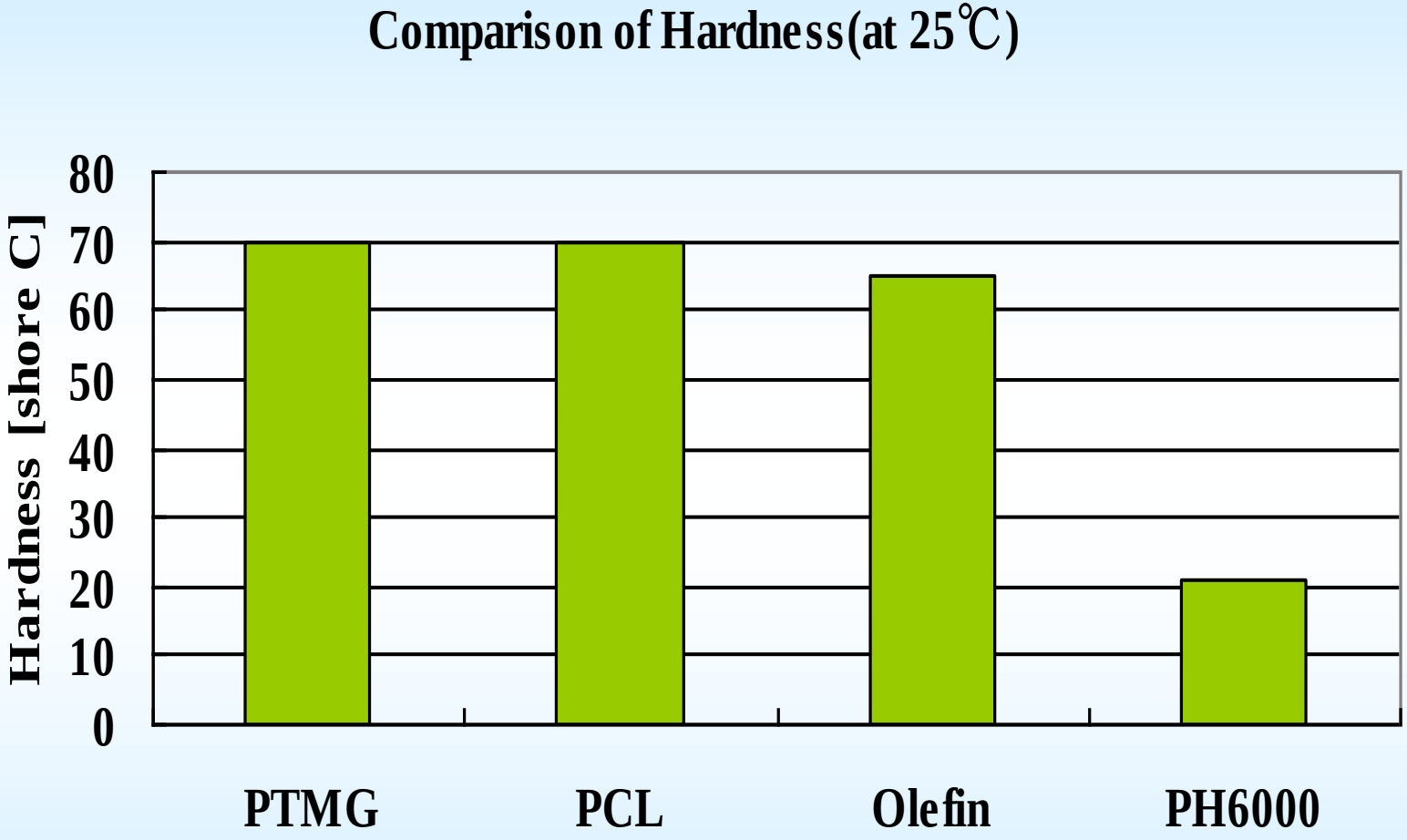
# PH Series Special modified castor oil polyols for urethane gel

## Urethane Properties

(crosslinked with liquid MDI; NCO content: 29%, NCO index: 1.05)

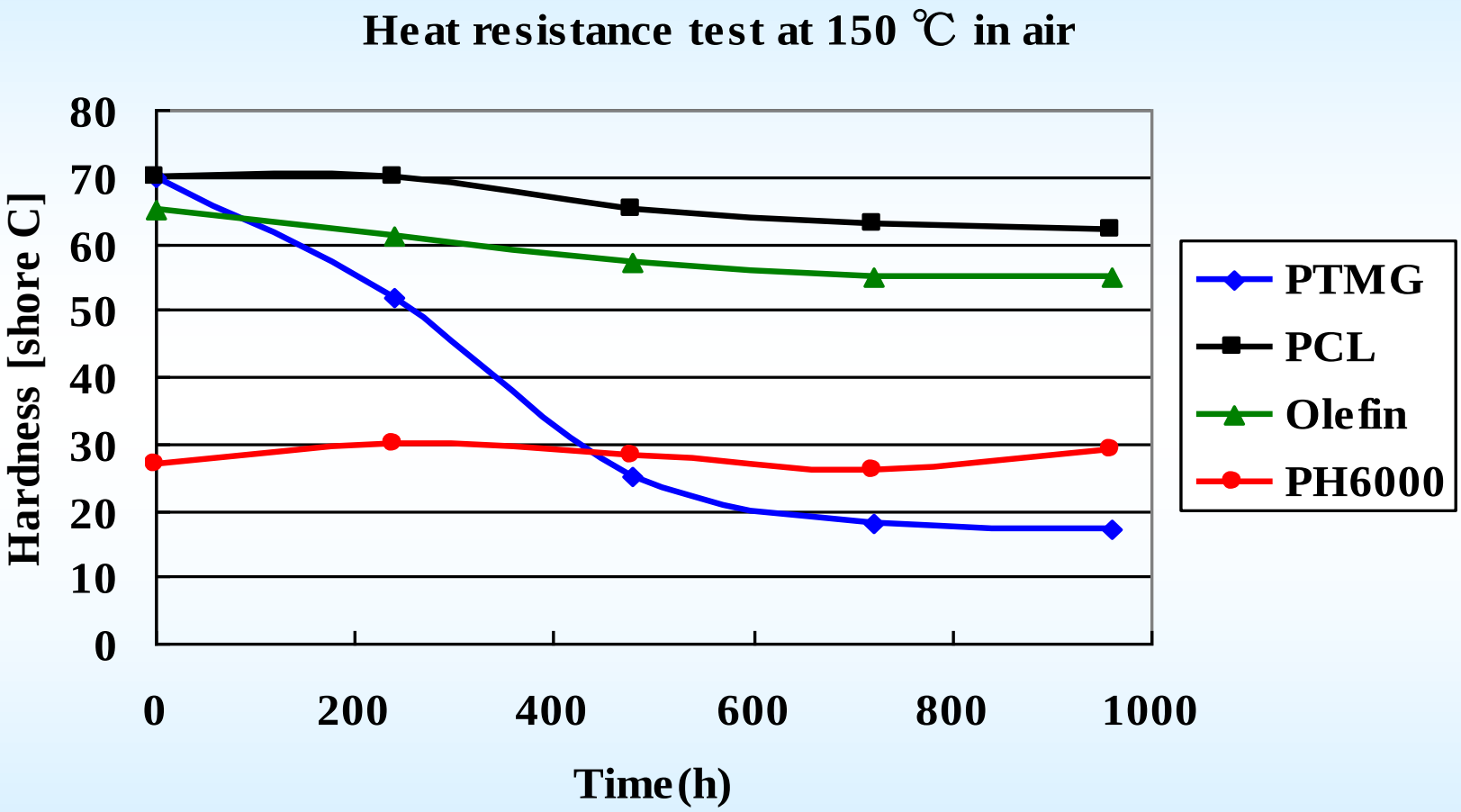
| | PH-5001 | PH-5002 | PH-6000 |
|---|---|---|---|
| OHV [mgKOH/g] | 45 | 43 | 46 |
| Viscosity [25℃, mPa·s] | 5,400 | 8,300 | 5,800 |
| Functionality | 2 | 2 | 2 |
| Hardness [shore C] | 18 | 21 | 17 |
| Elongation [%] | 670 | 890 | 590 |
| Feature | General purpose use | Excellent elongation | Excellent heat resistance |

# Comparison of hardness




Curing agent; Liquid MDI(NCO INDEX=1.05)
PTMG, PCL; (MW=3000, F=2.0), Olefin; Isoprene polyol (MW= 2500, F=2.2)

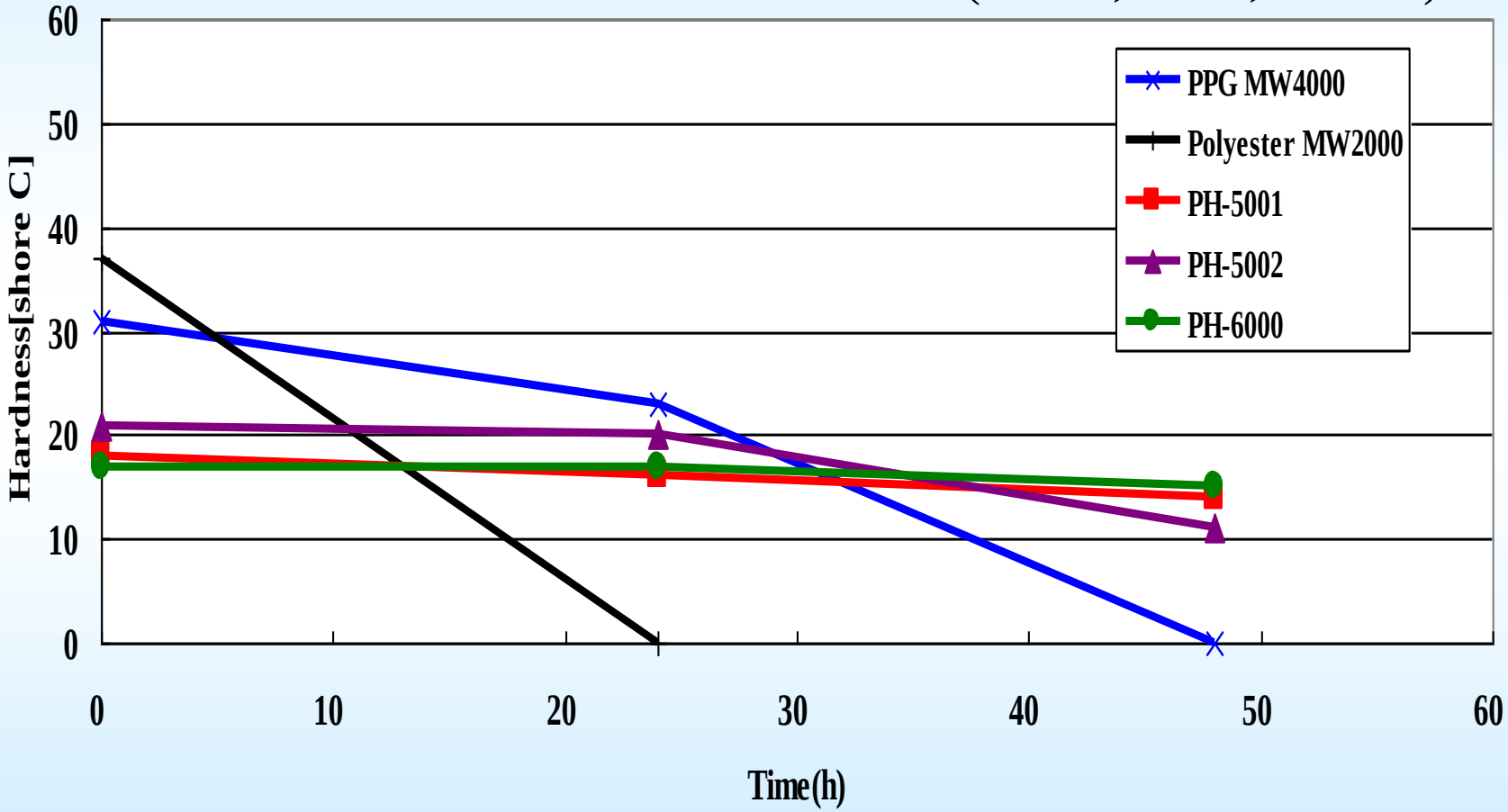
# Thermal resistance



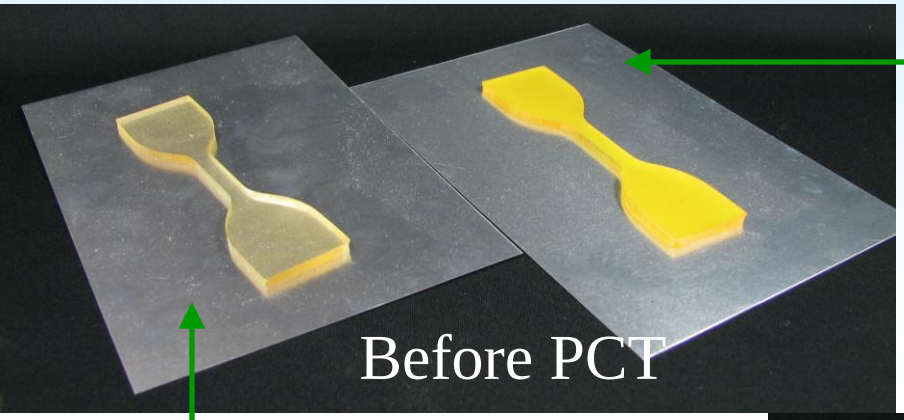
# PCT (Presser cooker test)

## (Moisture & Heat resistance acceleration test)

(121 ℃, 100%, 0.2MPa)

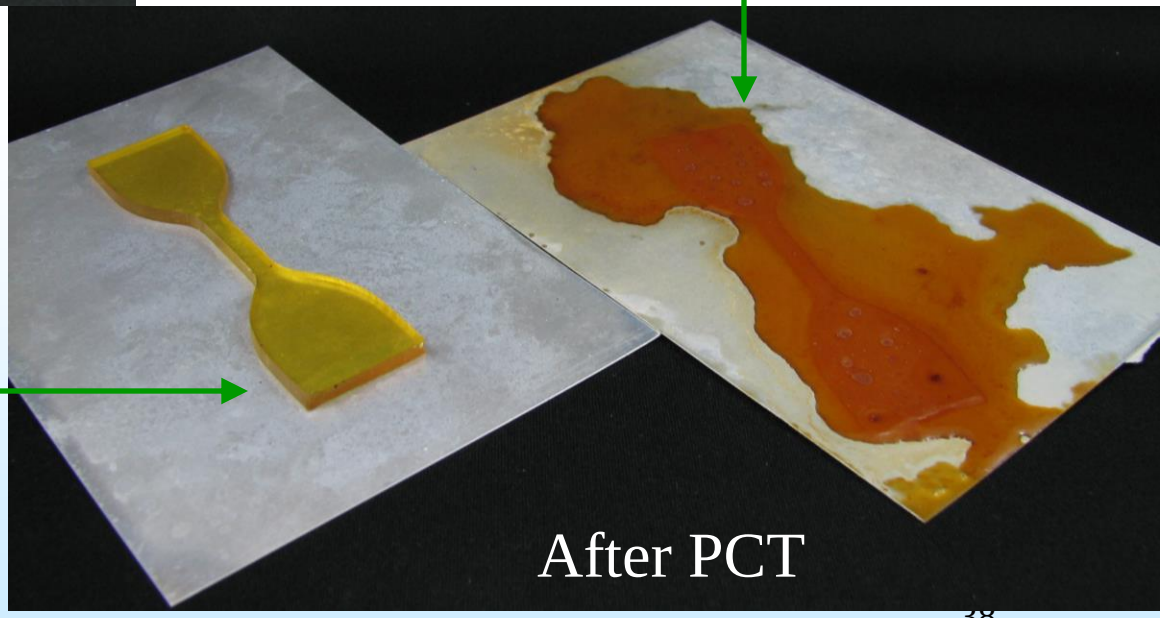


# Comparison between CO-PU and PEs' one




Polyester polyurethane

CO polyurethane



# POLYCASTOR Series

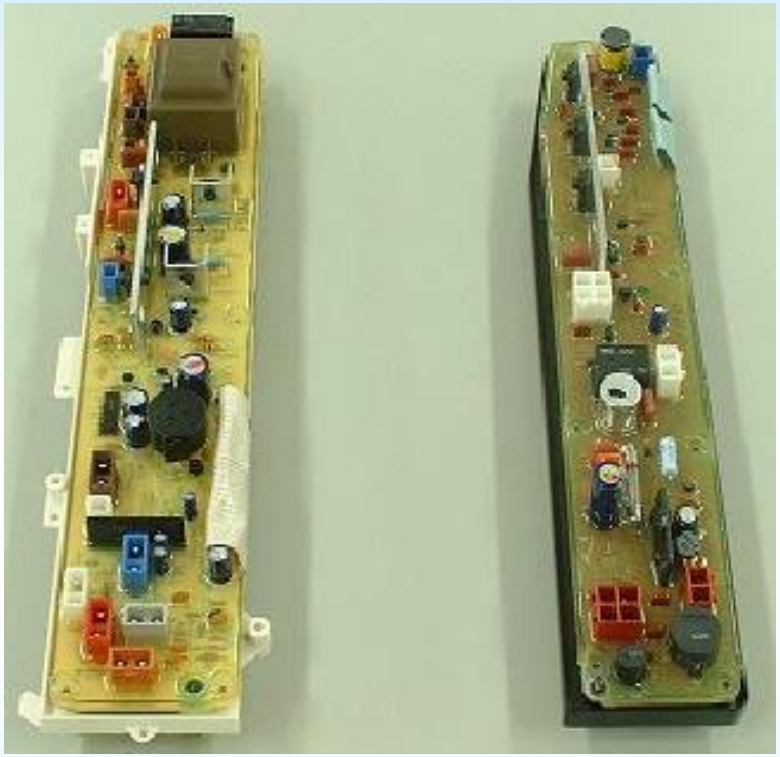
Polymerized CO for 2KPU system, which shows excellent heat resistance and insulation. It also finds uses in materials for surfactants, lubricants, plasticizers, etc.

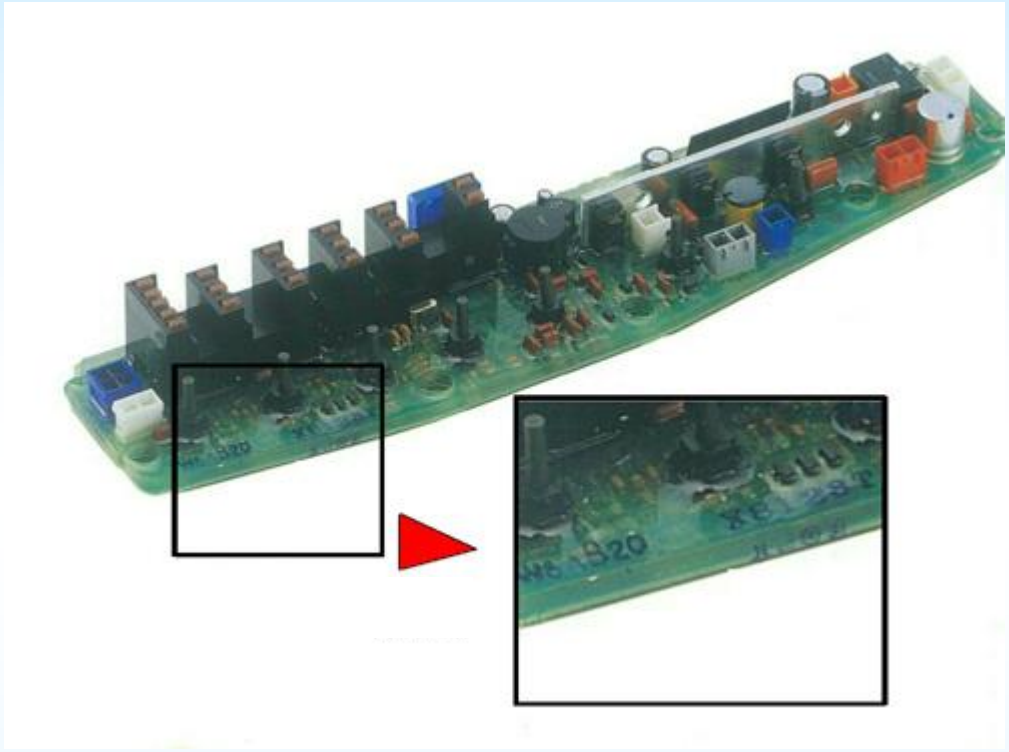
| | #10 | #30 |
|---|---|---|
| Appearance | Yellow tint liquid | Yellow tint liquid |
| Acid value [mgKOH/g] | 2.0 | 2.0 |
| Hydroxyl value [mgKOH/g] | 160 | 155 |
| Viscosity [25℃, mPa·s] | 2600 | 4750 |
| Water content [%] | <0.05 | <0.05 |
| Functionality | 5-6 | 5-6 |
| Hardness [shore A, D] | 88A, 39D | 96A, 49D |
| Pot life *1 [min] | 31 | 26 |
| Elongation [%] | 97 | 84 |
| Tensile strength [MPa] | 10 | 12 |
| Tear strength [N/mm] | 21 | 36 |
| Volume resistance [Ω·cm] | 7.4E+14 | 1.3E+15 |

# Application field of URIC

| | |
|---|---|
| **H-30, Y-403, H-420, H-1824, AC-005** | **Insulation sealant for home electric appliance, such as washing machines and dishwaters which can easily become wet. In addition, these are used in electronic parts for automobiles.** |

# PU electric insulator





URIC H & Y Series

# PU electric insulator for home-appliance

URIC H-30, Y-403

# PU electric insulator for home-appliance

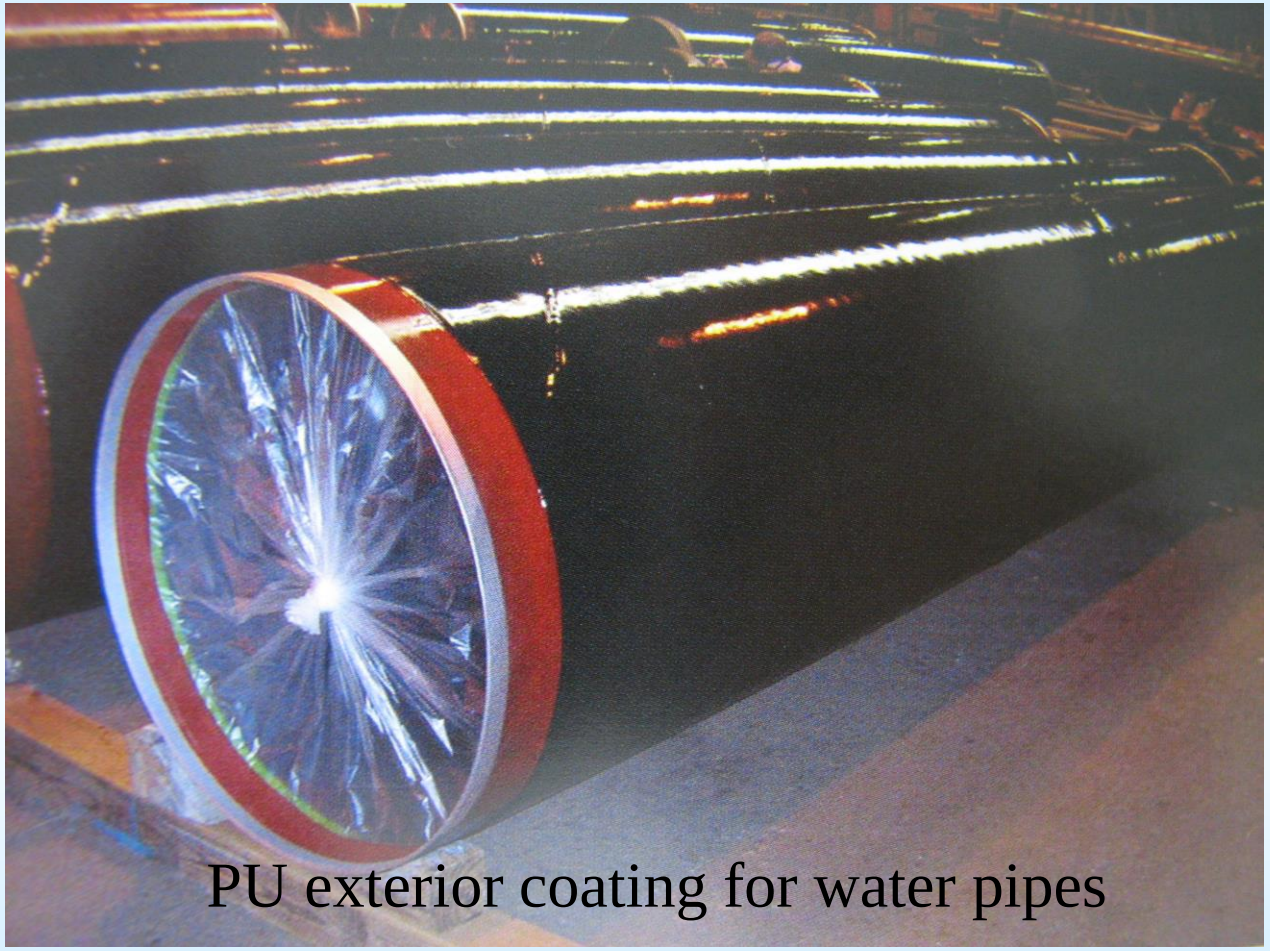

URIC H-30, Y-403

# Application field of URIC

| | |
|---|---|
| H-30, Y-403, H-420, H-1824, AC-005 | Insulation sealant for home electric appliance, such as washing machines and dishwaters which can easily become wet. In addition, these are used in electronic parts for automobiles. |
| **H-30, H-368 H-854, H-870** | **2KPU anti-corrosive paints for water & gas pipes, steel stakes etc.** |

# Example 2

**URIC H-30**
**URIC H-368**
**URIC H-854**



PU exterior coating for water pipes

# 2KPU anti-corrosive paints for iron & steel stakes

URIC H-368, H-854, H-870

# Application field of URIC

| | |
|---|---|
| H-30, Y-403, H-420, H-1824, AC-005 | Insulation sealant for home electric appliance, such as washing machines and dishwaters which can easily become wet. In addition, these are used in electronic parts for automobiles. |
| H-30, H-368 H-854, H-870 | 2KPU anti-corrosive paints for water & gas pipes, steel stakes etc. |
| **F-15, F-25, F-40** | **PU floor coating materials** |

# PU floor coating materials


URIC F Series

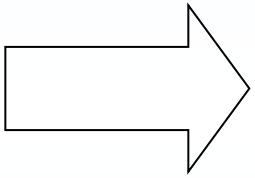
# PU floor coating materials

URIC F Series

# PU floor coating materials

URIC F Series

# PU solar heat-shielding paints for road




**Before application**

**After application**

URIC F Series

# Application field of URIC

| | |
|---|---|
| H-30, Y-403, H-420, H-1824, AC-005 | Insulation sealant for home electric appliance, such as washing machines and dishwaters which can easily become wet. In addition, these are used in electronic parts for automobiles. |
| H-30, H-368 H-854, H-870 | 2KPU anti-corrosive paints for water & gas pipes, steel stakes etc. |
| F-15, F-25, F-40 | PU floor coating materials |
| **H-30, H-368 H-420, AC-006** | **2KPU adhesives for automotive, architectural parts and materials for waterproofing etc.** |

# Materials for PU waterproofing


URIC H-368

# Materials for PU waterproofing


**Before** ⇨ **After**

URIC H-368

# Materials for asphalt refinishing


URIC H-420

# Application field of URIC

| | |
|---|---|
| **SE Series** | **PU adhesive for automotive wind-shield and retort pouches for food** |

# PU adhesive for wind-shield

URIC SE Series

# PU adhesive for retort pouches for food

URIC SE Series

# Application field of URIC

| | |
|---|---|
| SE series | PU adhesive for automotive wind-shield and retort pouches for food |
| **PH Series** | **Urethane gel like insulation sealant for the electronic parts for automobiles and buffer mold for building etc.** |

# Insulation sealant for electronic parts for automobiles



URIC PH Series

# Application field of URIC

| | |
|---|---|
| SE series | PU adhesive for automotive wind-shield and retort pouches for food |
| PH Series | Urethane gel like insulation sealant for the electronic parts for automobiles and buffer mold for building etc. |
| **HF Series** | **Polyurethane flexible or rigid foam and a special cloth like a mountain jacket** |

# PU flexible foam for automobile

URIC HF Series

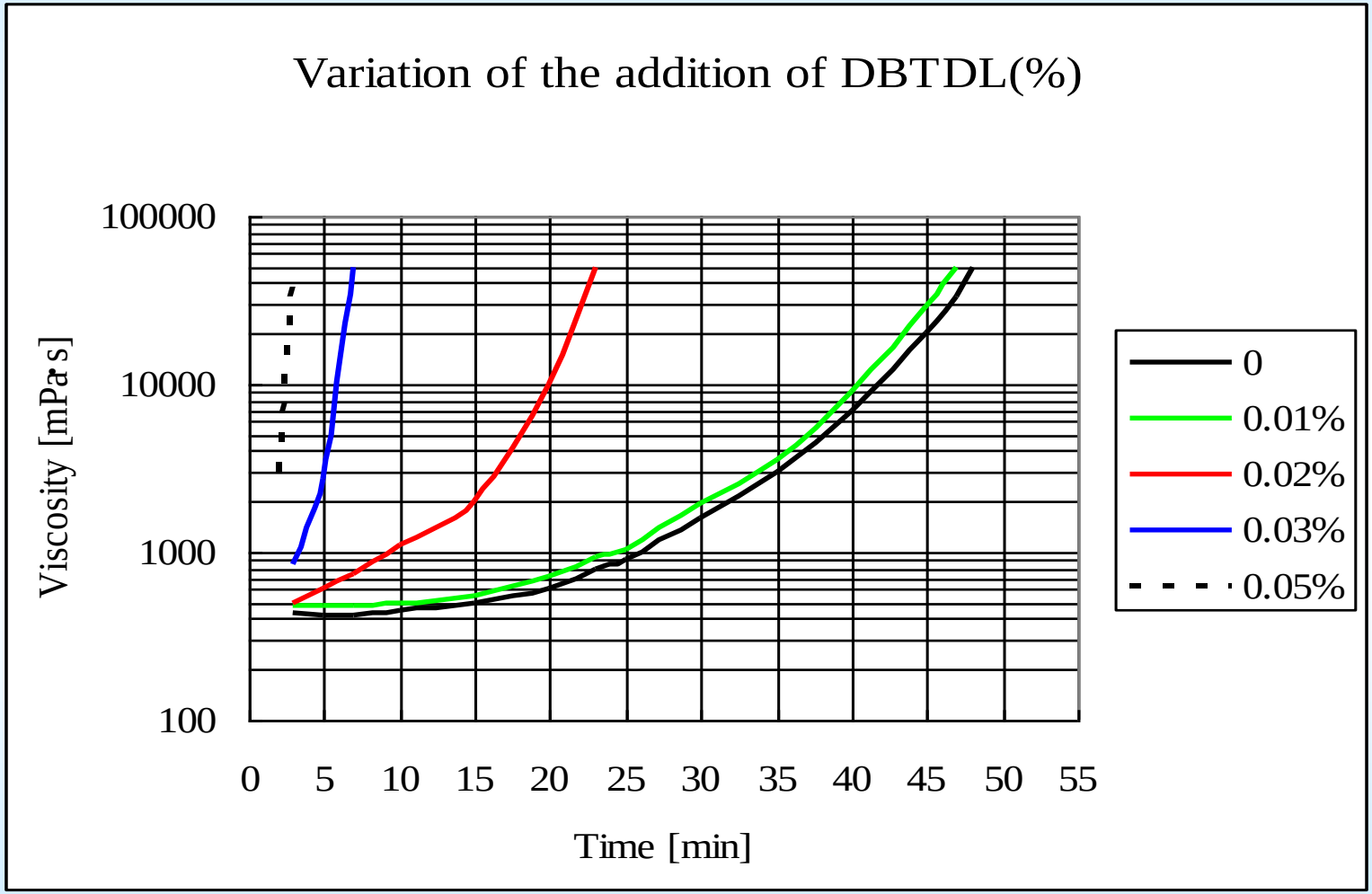
# PU fiber for mountain jacket

URIC HF Series

# Thank you for your attention.

reference

# The influence of catalyst upon the gel time of castor oil polyurethane



reference

# Urethane Polyols (Characteristics)

| resistance→ | Water | Oil | Cold | Heat | P. Strength | Price |
|---|---|---|---|---|---|---|
| PPG | × | ○ | ○ | × | △ | ○ |
| Polyester | × | ○ | △ | ○ | ○ | △ |
| Acrylic | ○ | ○ | × | ○ | ○ | △ |
| Hydrocarbon | ○ | × | ○ | × | △ | △ |
| **Castor oil** | ○ | △-○ | ○ | ○ | △-○ | △-○ |

# Polyurethane application

reference

Polyisocyanate

**Polyol**

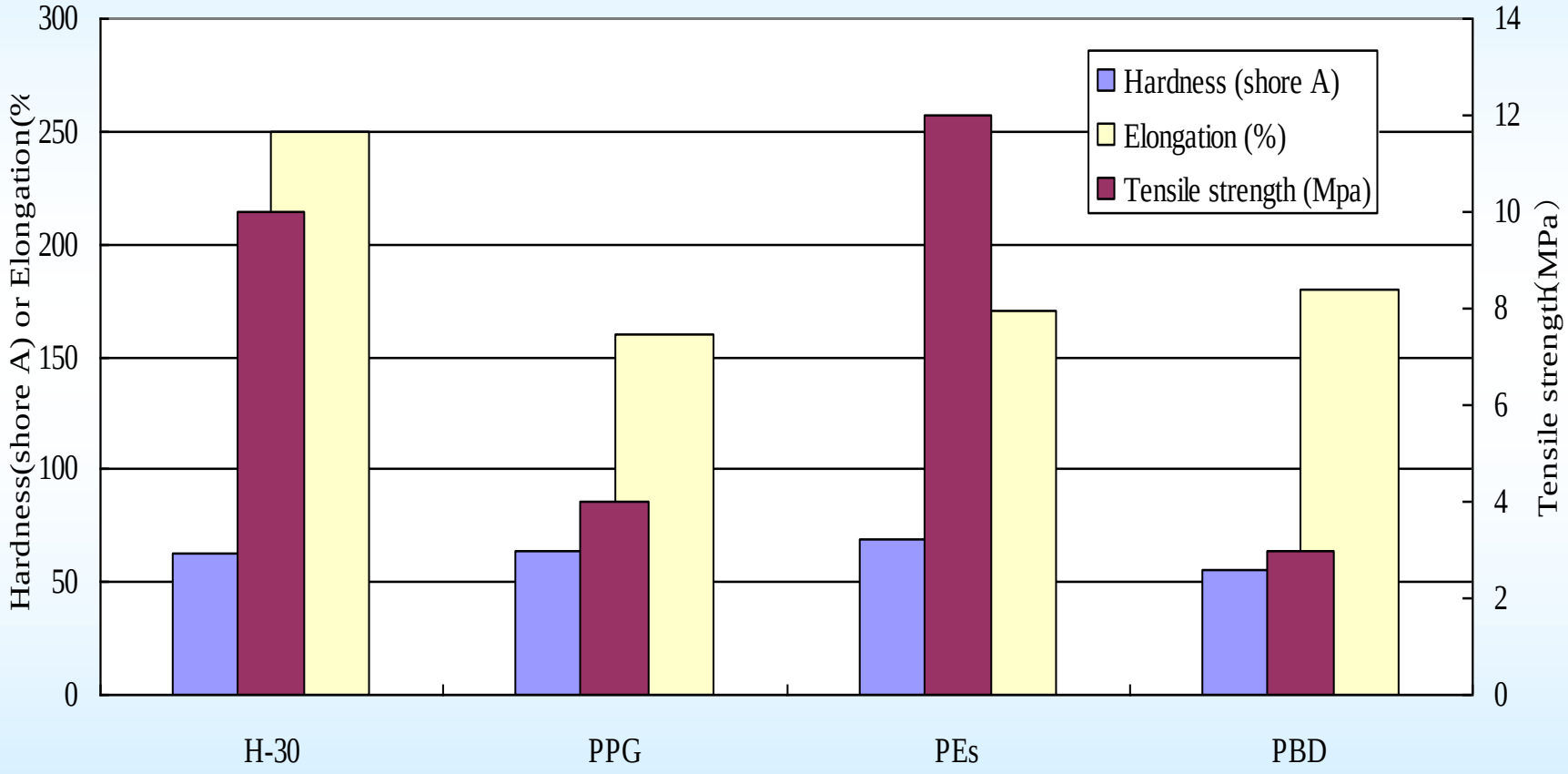
Others

- **Foam** — Flexible, Semi-rigid, Rigid foam
- **Elastomer** — Thermoplastic & Thermosetting
- **Paint** — Both 1 & 2 Component
- **Adhesive** — Both 1 & 2 Component
- **waterproofing sealant** — 2 Component
- **Artificial leather**
- **Elastic fiber**

reference

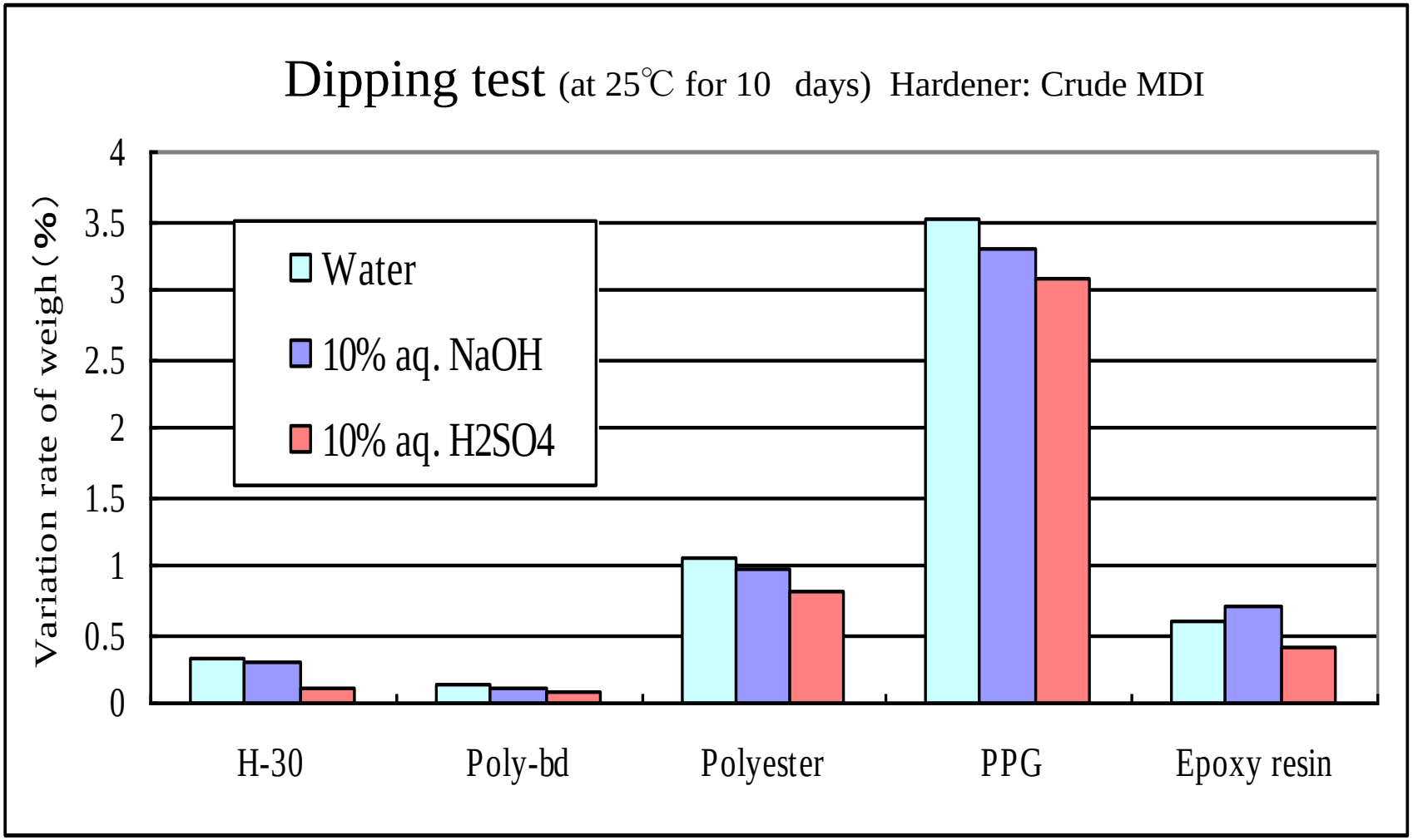
# Castor Oil (Physical properties)

Hardener; Pure MDI



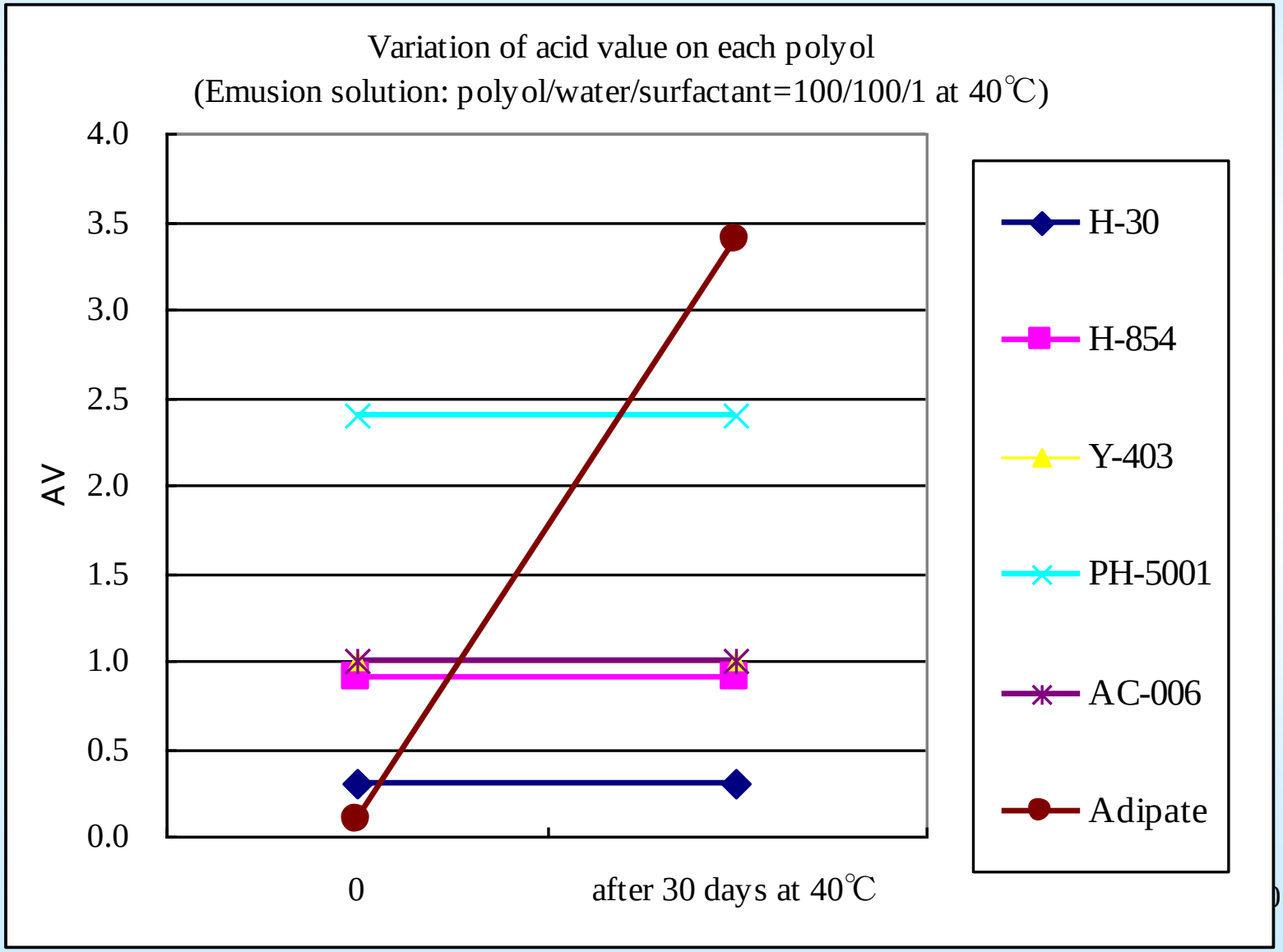
reference

# Castor Oil (Chemical resistance)



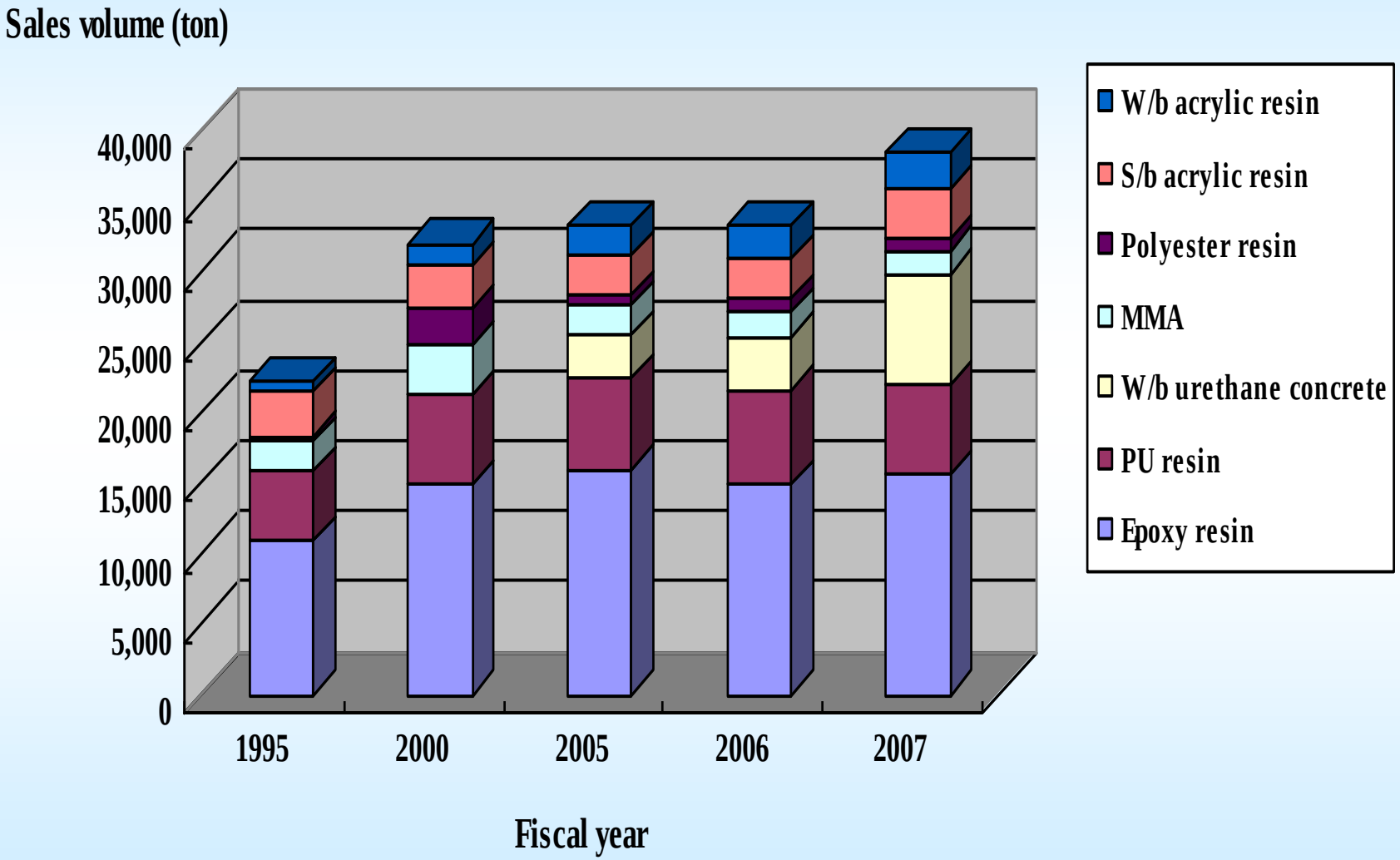
reference

# Comparison of hydrolysis resistance



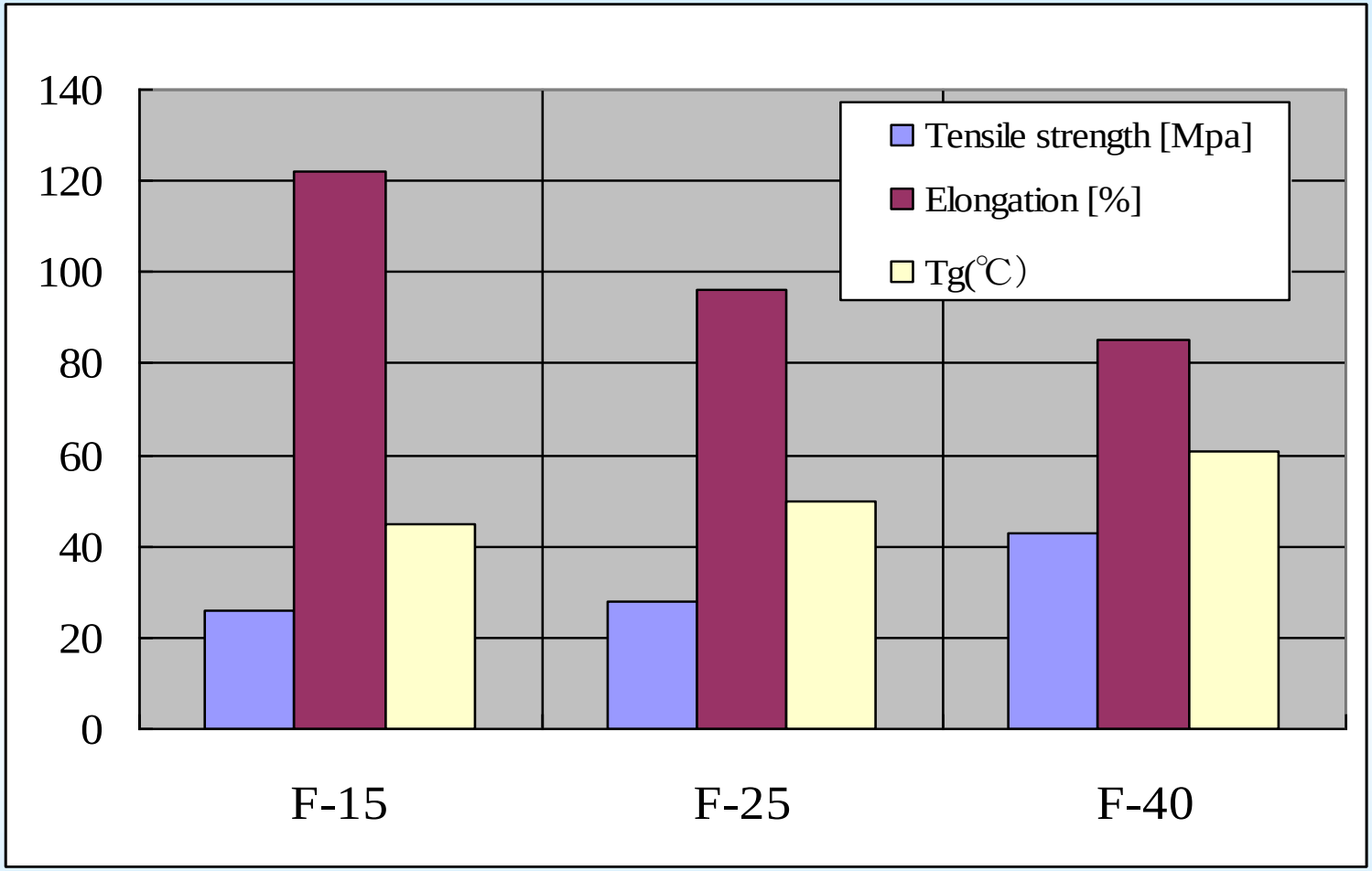
reference

# PU floor coating market in Japan



# Physical properties of F series

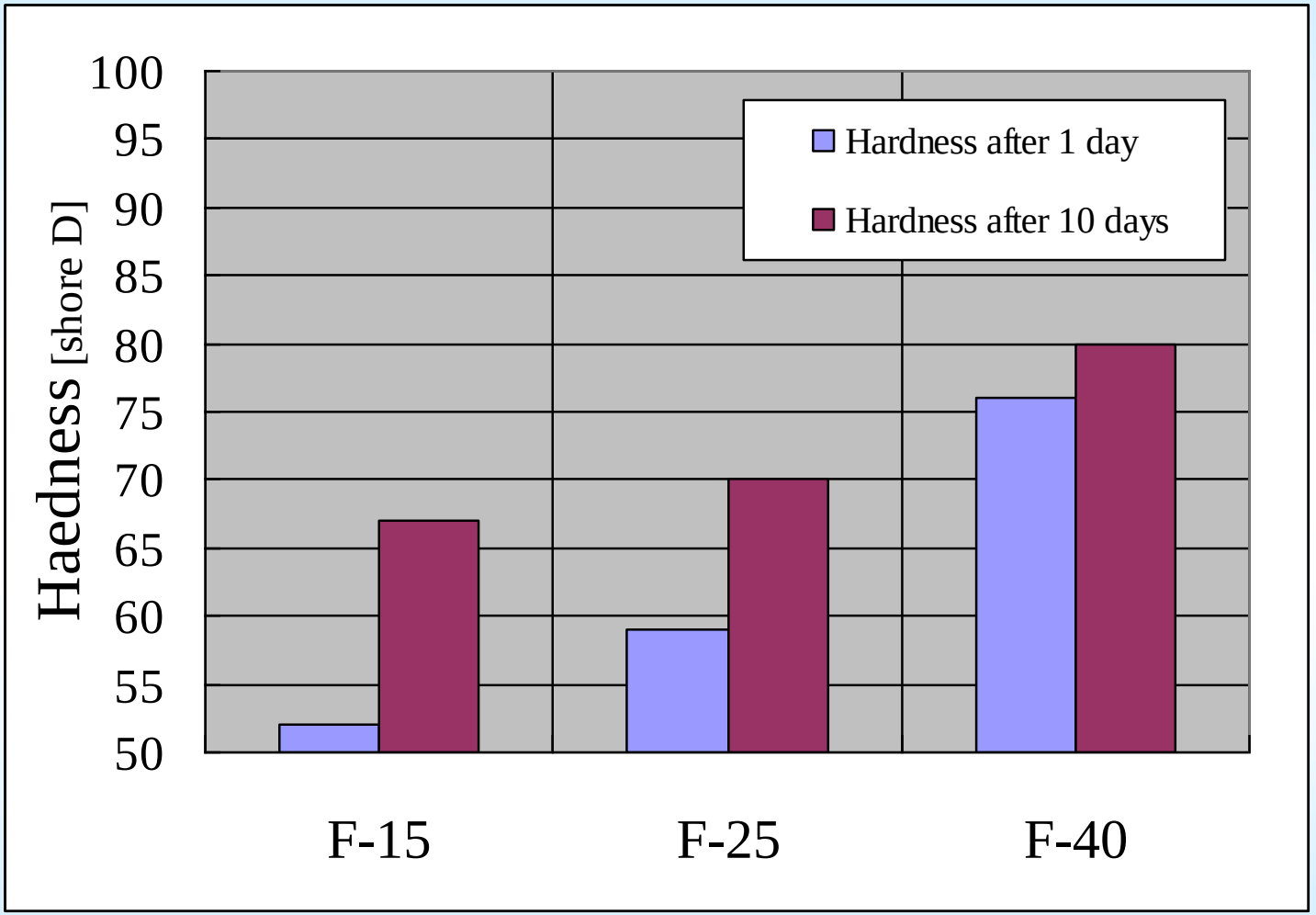
reference




Hardener; Crude MDI

reference

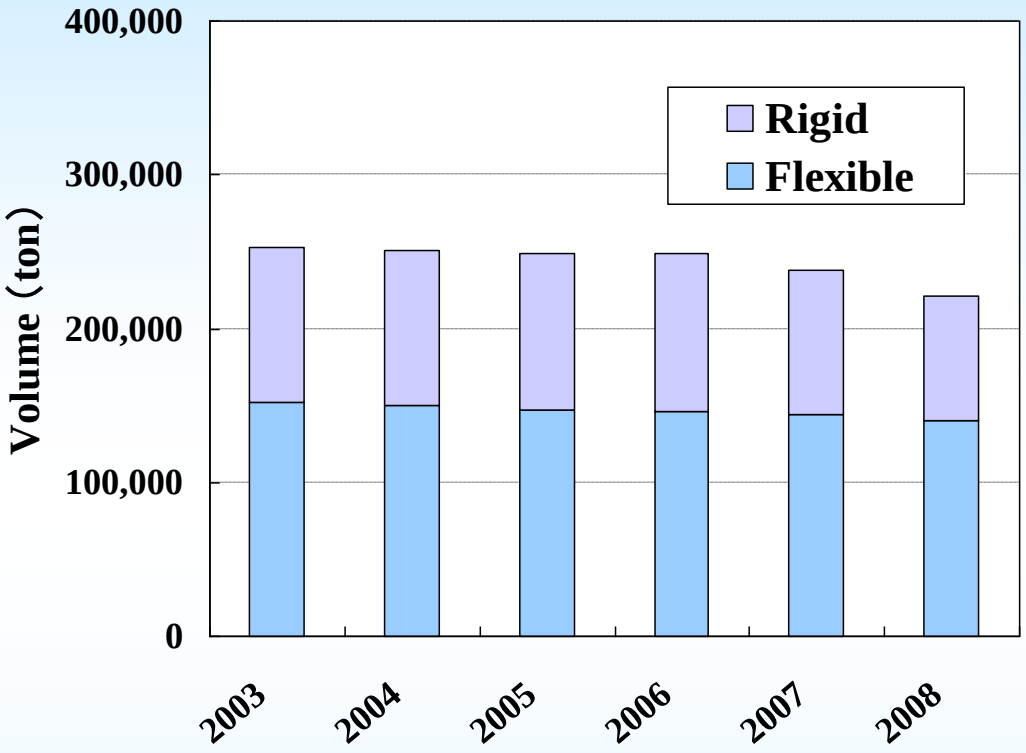
# Variation of hardness after coating




Hardener; Crude MDI

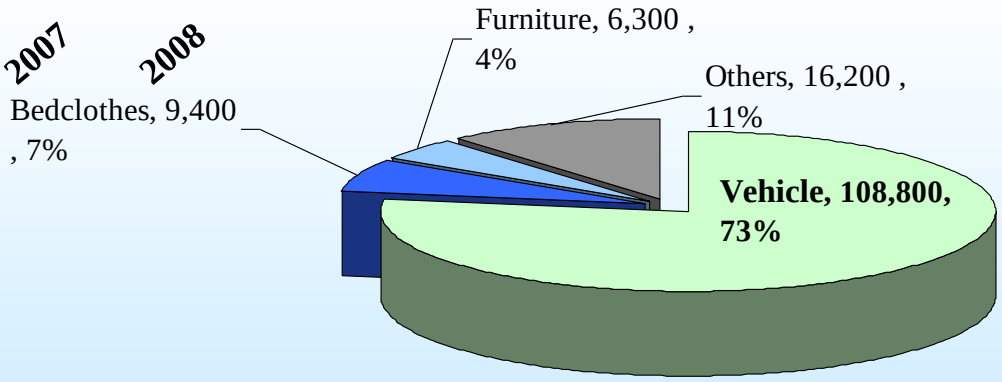
reference

# PU foam market in Japan




## Flexible foam (Technical trend)

- Lightening (Low density)
- Low elasticity (flexible at low temp.)
- Shock absorbent
- Acoustic




## Rigid foam (Technical trend)

- Flame retarding
- Foaming agent ; water only

Application of PU flexible foam; 141,200 tons（FY07）

reference

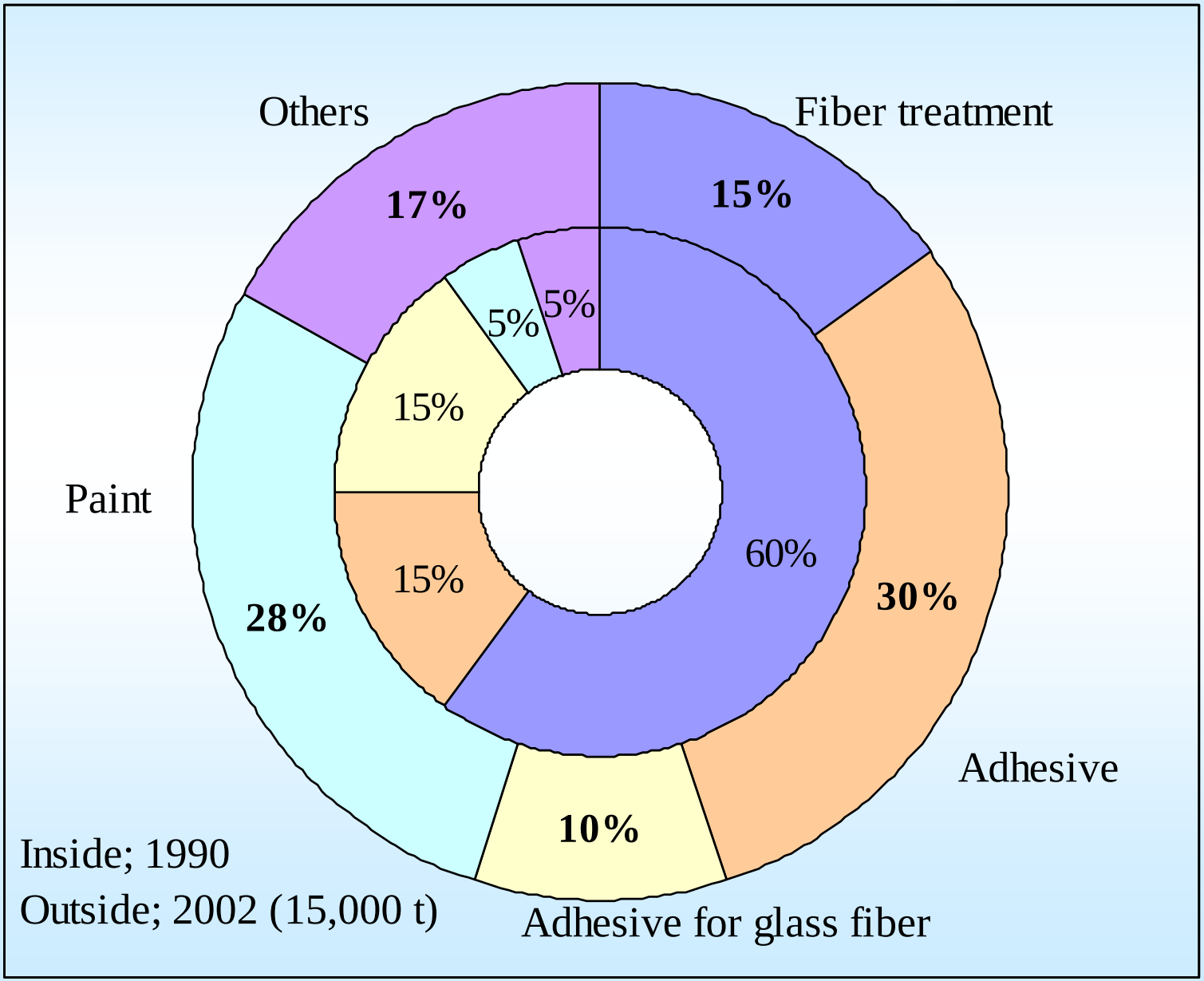
# Comparison

| | | Flexible foam | | Rigid foam |
|---|---|---|---|---|
| | **Method** | Slab (general purpose use) | Mold | Slab or Mold |
| | **State of cell** | Linking-cell | | Non-linking-cell |
| **Polyether polyol** | **Functionality** | 3 | | 3 - 8 |
| | **Epoxide** | PO、EO、PO/EO | | PO(EO) |
| | **OHV** | 56 | 28 - 36 | 380 - 550 |
| | **Viscosity** | < 2000 | < 2000 | |
| | **MW** | 3000 | 4600 - 6000 | 305 - 1100 |
| **Polyester polyol** | **Functionality** | 3 or more | | 3 or more |
| | **OHV** | 45 - 70 | | 350 - 400 |
| | **AV** | < 2 | | < 2 |
| | **Viscosity** | 10000 - 20000 | | 2000～3000 |
| | **Polymer-polyol** | No use | Use | No use |
| | **Foaming agent** | water | | Water, HFC-245fa, HFC-365mfc etc. |
| | **Polyisocyanate** | TDI | TDI<br>TDI/ P. MDI＝8 / 2 | Polymeric MDI |

※Polymer-polyol; Combination between PPG & vinyl modified polyol

reference

# Domestic Market of PU Dispersion



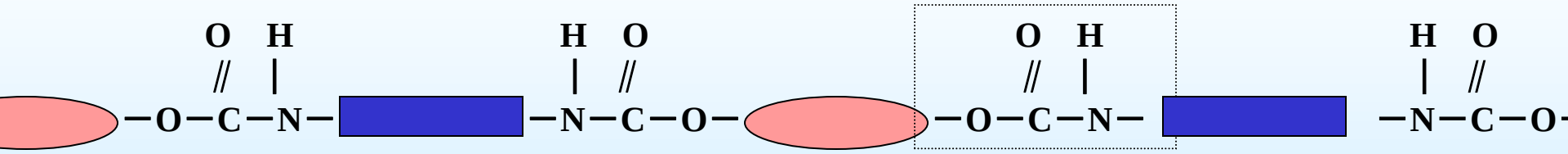
reference

# Polyurethane Resin

**Polyurethane resins consist of Polyols and Polyisocyanates**


ISOCYANATE


POLYOL



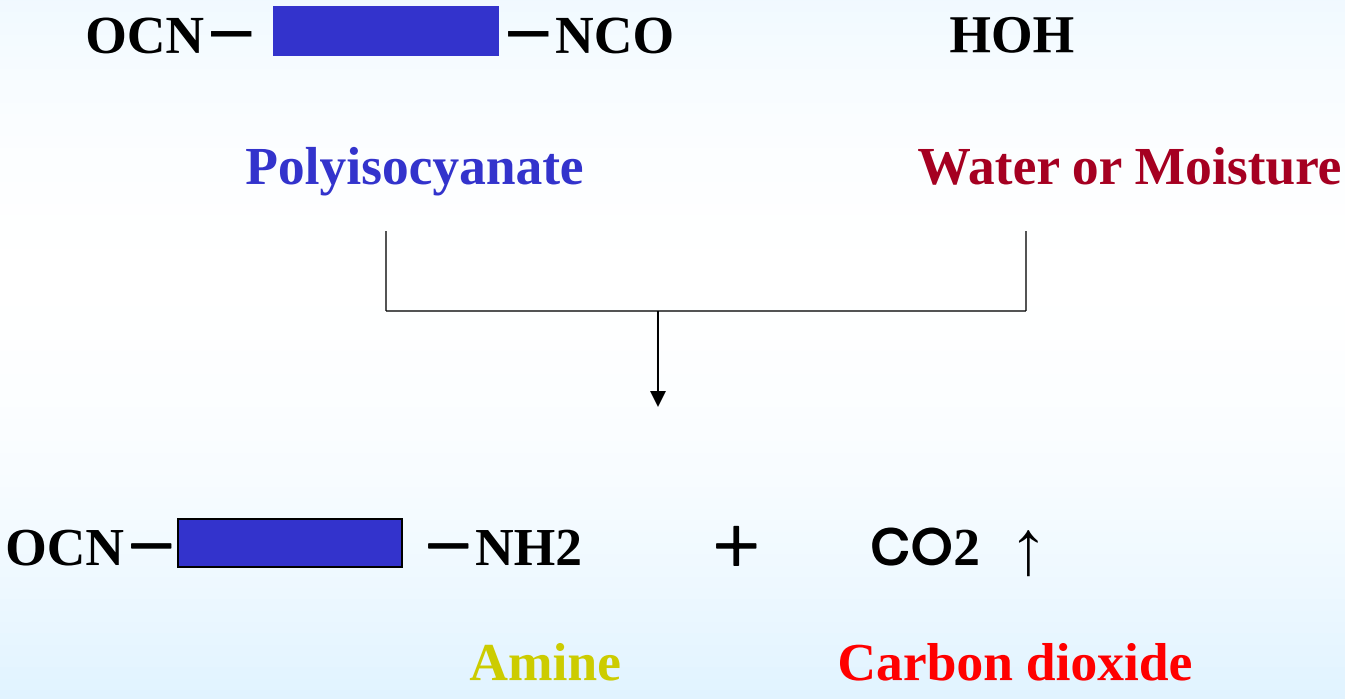

URETHANE BOND

POLYURETHANE

reference

# Foaming phenomenon

**Polyisocyanate and water or moisture forms carbon dioxide after reacting**

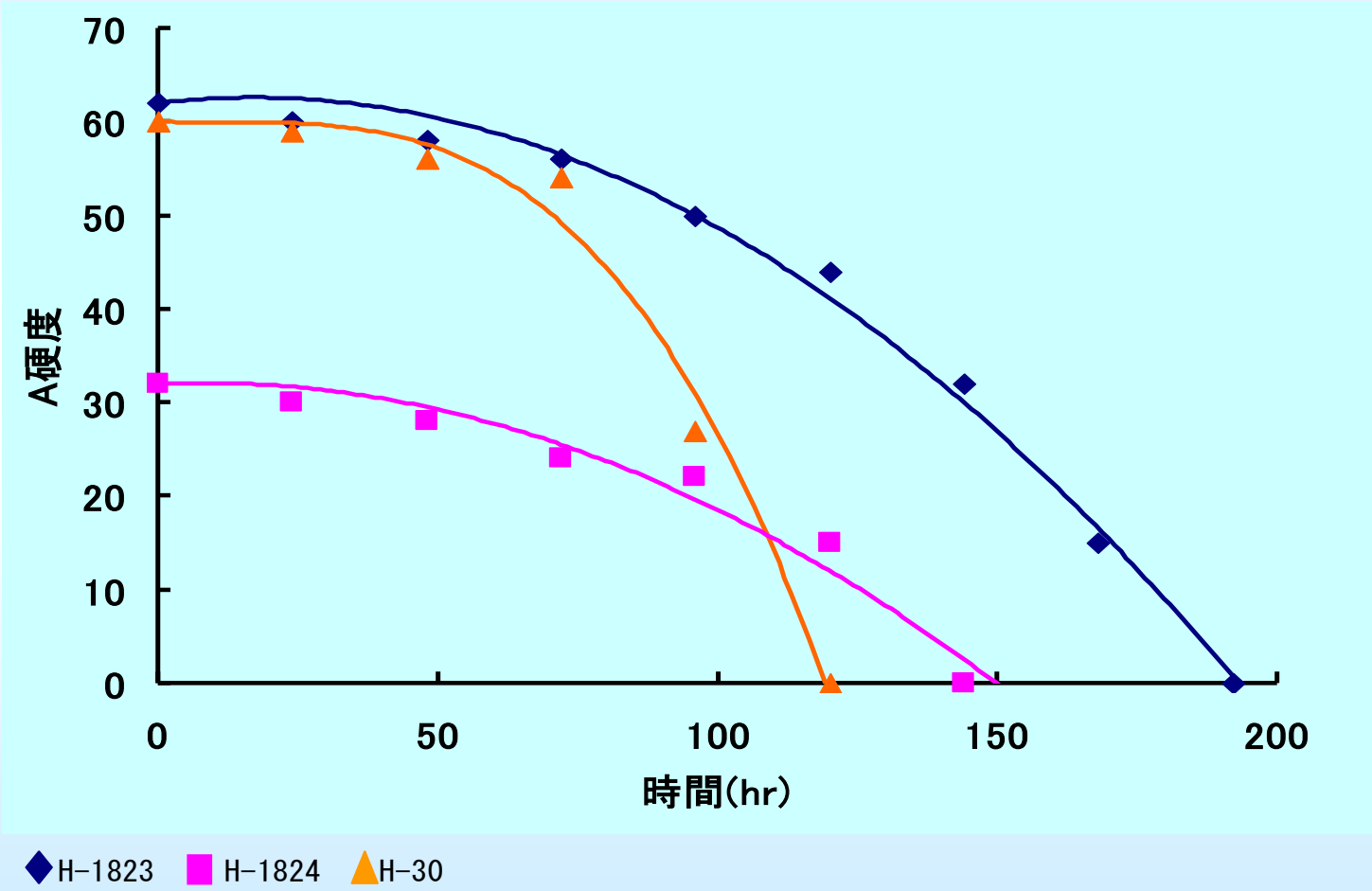



**Castor oil is lower water-absorbing capacity**

reference

# PCT (Presser cooker test)

## (Moisture & Heat resistance acceleration test)



reference

# PU rigid foam (Chemical resistance)

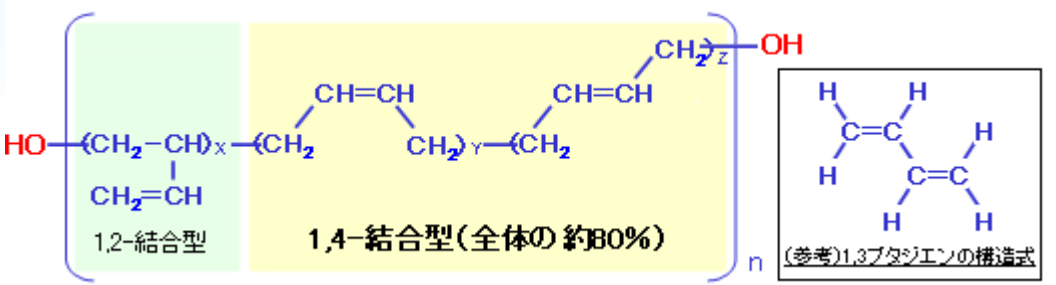
| | | | |
|---|---|---|---|
| Seawater | G | MEK | S |
| Soapy water | G | Acetone | S |
| Benzene | G | Ethyl acetate | S |
| Toluene | G | Styrene monomer | S |
| Xylene | G | Concentrated sulfuric acid | D |
| Gasoline | G | Concentrated nitric acid | D |
| Paraffin oil | G | Concentrated hydrochloric acid | S |
| Methyl chloride | S | Concentrated NaOH aq. solution | G |
| Alcohol | S | Vegetable oil | G |
| Carbon tetrachloride | S | Animal oil | G |

G; Not attacked, S; Swelling, D; Dissolved

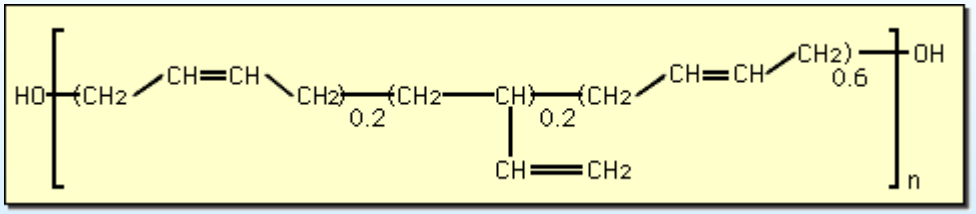
reference

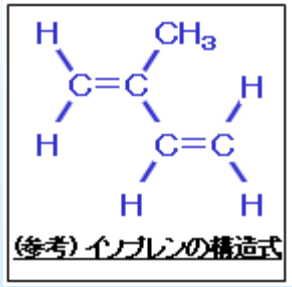
# Hydrocarbon based polyols

## Poly-bd (Polybutadiene polyol)



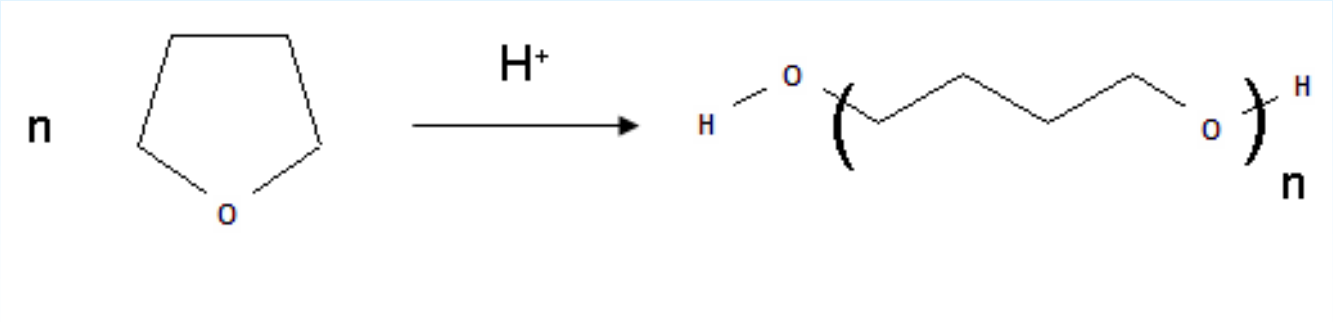

## Polyisoprene polyol)



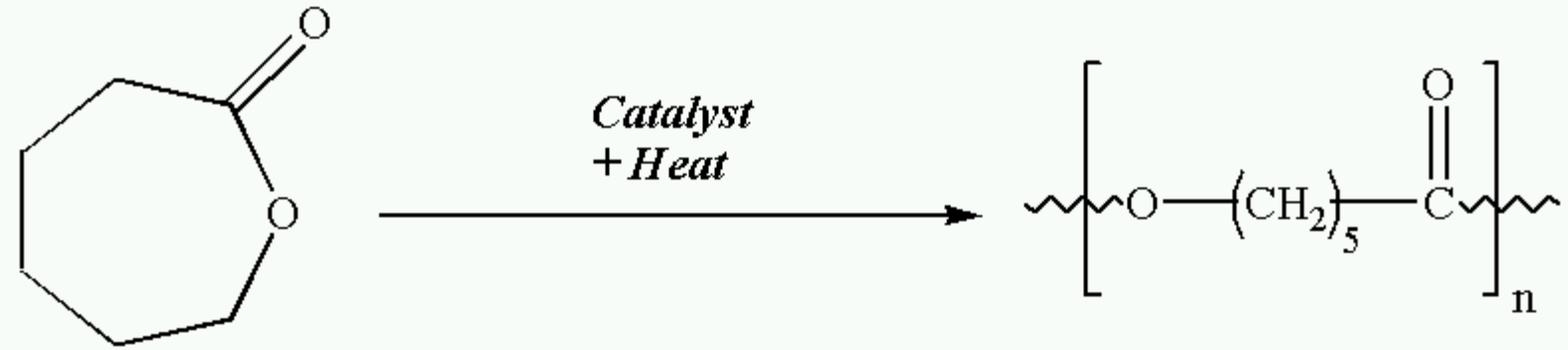



reference

# Chemical structure of PTMG or PCL




THF PTMEG




ε-Caprolactone PolyCaprolactone

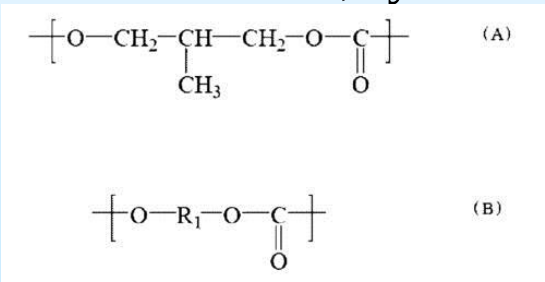
reference

# Characteristic on PCL

In General, PU made from PCD shows excellency over the other PU from other polyol like PTMG, PHA, and PCL, in the following properties such as mechanical properties, hydrolysis resistance, heet stability, chemical resistance, weatherability. In Addition, Asahi Kasei PCDLs have the following superior characteristics compared with other PCDs.

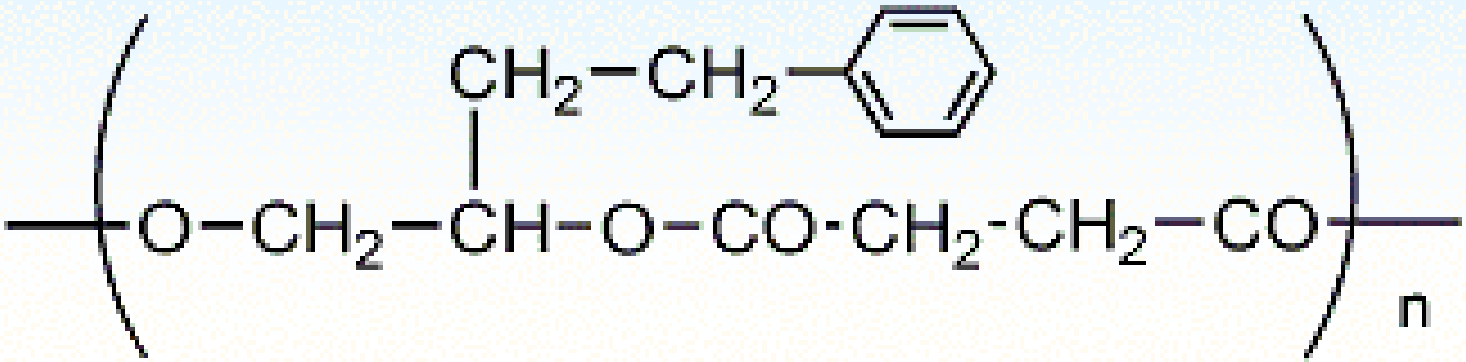
- Easy to handle because of **liquid state** at room temperature.
  T5652, T5651, T5650J, T4672, T4671
- Adds softness to PU and remains **soft** at low temperatures.
  T5652, T5651, T5650J
- Better chemical resistance.
  T4672, T4671, T4692, T4691

Typical applications of PCD are artificial leather, synthetic leather, TPU, pandex, adhesive, paint etc. Among them PCD is the best fitted for areas which require durability. Moreover Asahi Kasei PCDLs have better performance in the application of artificial leather, synthetic leather and spandex which require softness.



reference

# Chemical structure of UP




reference

# DU PONT TYPE FALLING IMPACT TESTER

# Castor Oil (compatibility)

reference

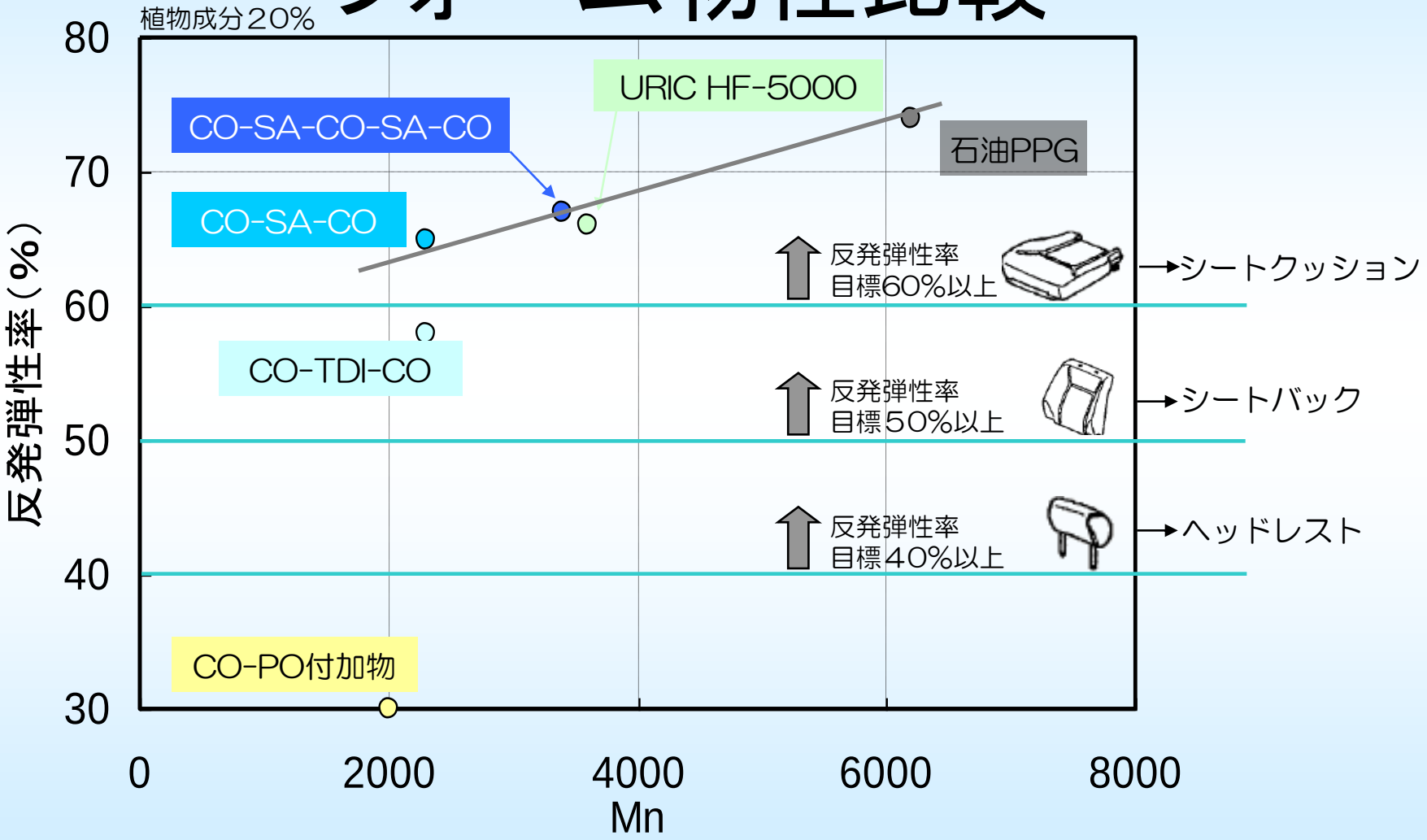
Castor oil/other polyol=1:1

| | 25 ℃ |
|---|---|
| PPG MW3000 | ○ |
| PTMG MW3000 | ○ |
| AA/BG MW1000 | △ |
| AA/DEG MW1000 | ○ |
| Phthalic acid type polyester | × |
| Polycarbonate | △ |
| Polycaprolactone | △ |
| Polybutadiene | × |

○; transparence, △; opacity (haze), ×; separation

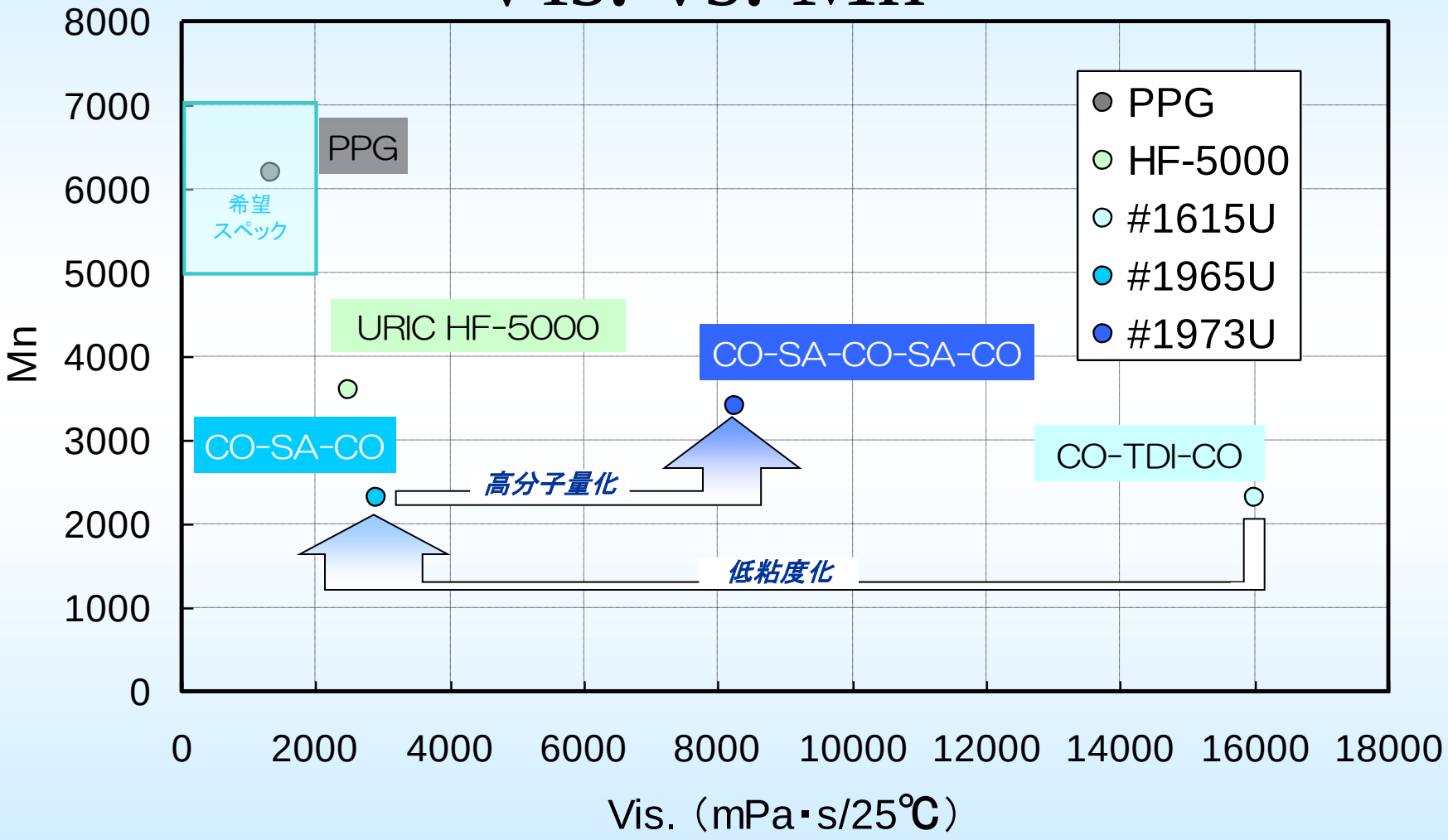
reference

# フォーム物性比較

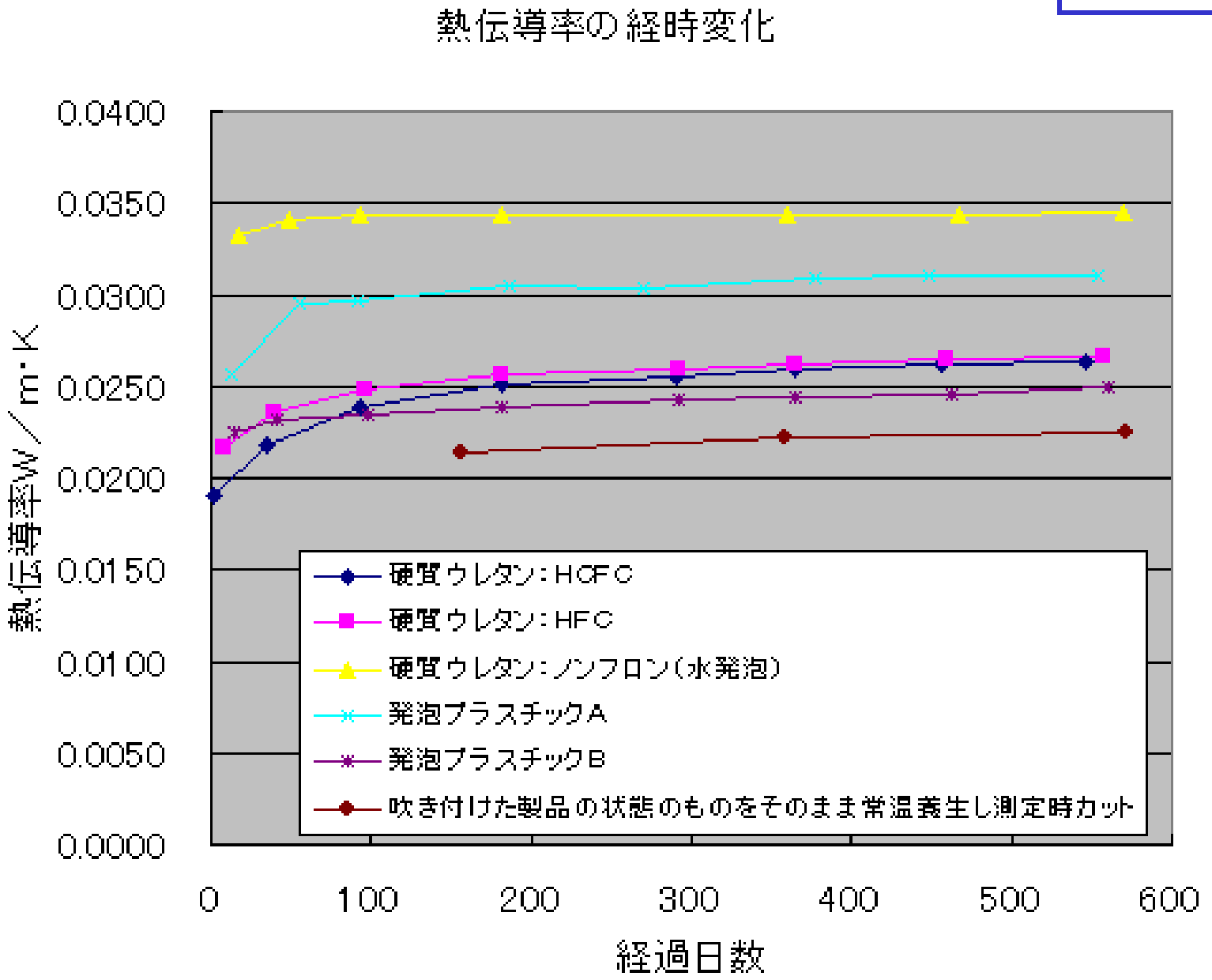


reference

# Vis. vs. Mn

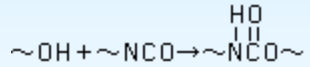


reference

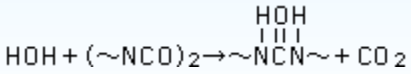

熱伝導率の経時変化
0.0400
0.0350
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
熱伝導率W／m・K
0
100
200
300
400
500
600
経過日数
硬質ウレタン：HCFC
硬質ウレタン：HFC
硬質ウレタン：ノンフロン（水発泡）
発泡プラスチックA
発泡プラスチックB
吹き付けた製品の状態のものをそのまま常温養生し測定時カット

reference

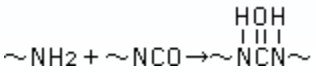
# Main reaction examples of NCO bond



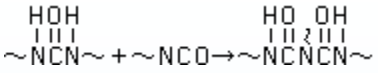
ウレタン結合の生成（鎖延長反応）



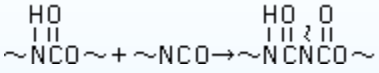
尿素結合と炭酸ガスの生成（発泡反応）



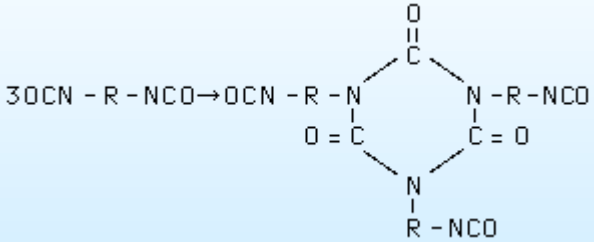
尿素結合の生成（鎖延長反応）



ビュレット結合の生成（架橋反応）



アロファネート結合の生成（架橋反応）



イソシアヌレート結合の生成
（三量化反応）

reference

## ポリウレタン分野別需要動向

（単位：トン）

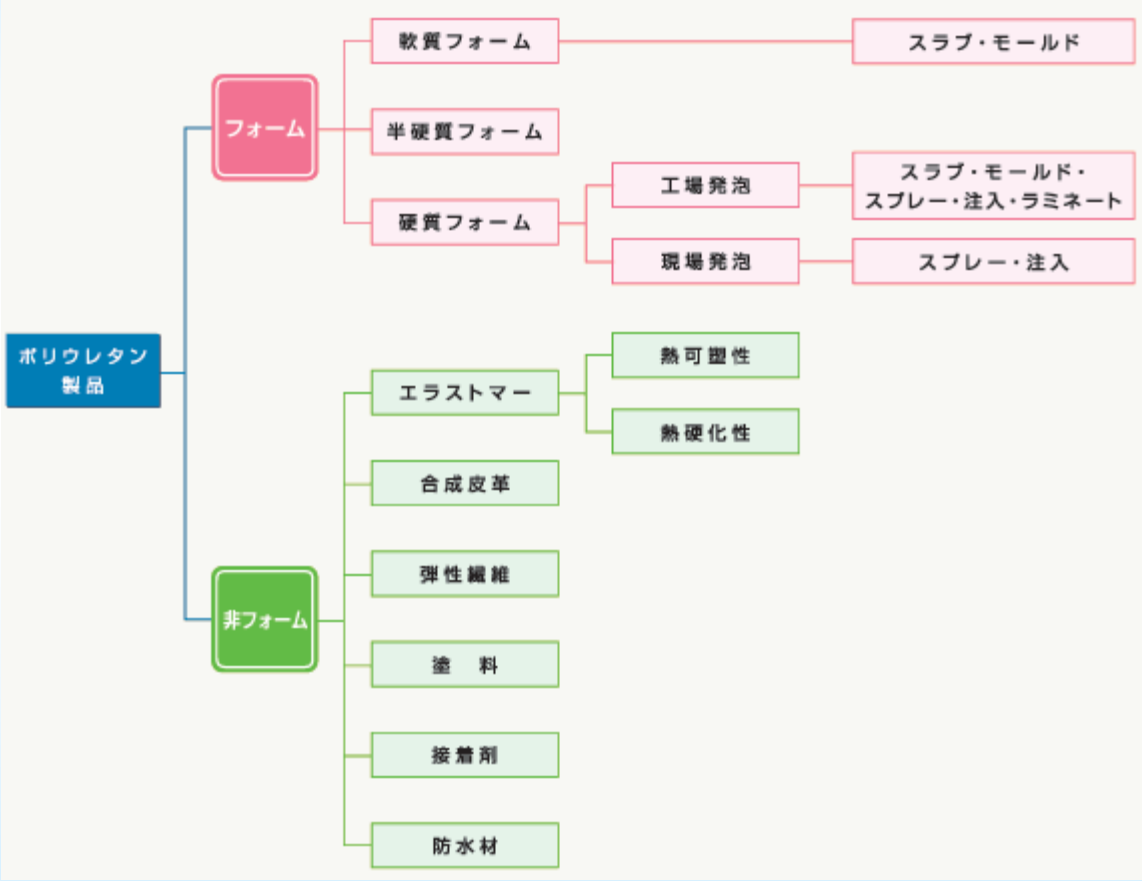
| 種類 | 用途 | 2003年 | 2004年 | 2005年 | 2006年 | 2007年 |
|---|---|---|---|---|---|---|
| 軟質フォーム | 車両 | 109,900 | 110,500 | 108,800 | 109,300 | 109,300 |
| | 寝具 | 10,100 | 10,400 | 10,000 | 9,900 | 9,400 |
| | 家具・インテリア | 7,200 | 7,100 | 7,100 | 6,800 | 6,300 |
| | その他 | 25,800 | 22,400 | 22,100 | 19,900 | 16,200 |
| | 小計 | 153,000 | 150,400 | 148,000 | 145,900 | 141,200 |
| 硬質フォーム | 船舶車両 | 4,800 | 4,800 | 4,800 | 5,800 | 5,400 |
| | 機器用 | 35,600 | 36,100 | 36,500 | 34,700 | 30,900 |
| | 土木・建築 | 36,900 | 36,900 | 37,800 | 40,000 | 37,600 |
| | その他 | 23,600 | 22,800 | 22,400 | 22,900 | 19,200 |
| | 小計 | 100,900 | 100,600 | 101,500 | 103,400 | 93,100 |
| エラストマー | 注型用 | 4,300 | 5,000 | 4,600 | 4,800 | 4,800 |
| | TPU用 | 12,800 | 14,900 | 15,500 | 17,600 | 18,200 |
| | 混合 | 400 | 500 | 500 | 600 | 600 |
| | 小計 | 17,500 | 20,400 | 20,600 | 23,000 | 23,600 |
| 塗料 | | 129,000 | 136,900 | 141,800 | 141,700 | 142,600 |
| 接着剤 | | 60,900 | 59,300 | 52,000 | 56,500 | 61,200 |
| 土木建築塗布 | | 67,400 | 70,600 | 69,500 | 66,300 | 65,900 |
| シーリング材 | | 30,300 | 32,300 | 34,200 | 35,400 | 36,300 |
| レザー・マイクロセルラー | | 21,100 | 21,100 | 21,200 | 21,300 | 21,100 |
| 繊維 | | 26,500 | 26,300 | 26,100 | 26,100 | 25,600 |

（フォームおよび塗料は経済産業省統計生産実績を基礎にして推定。またＲＩＭ成形は含まない。）

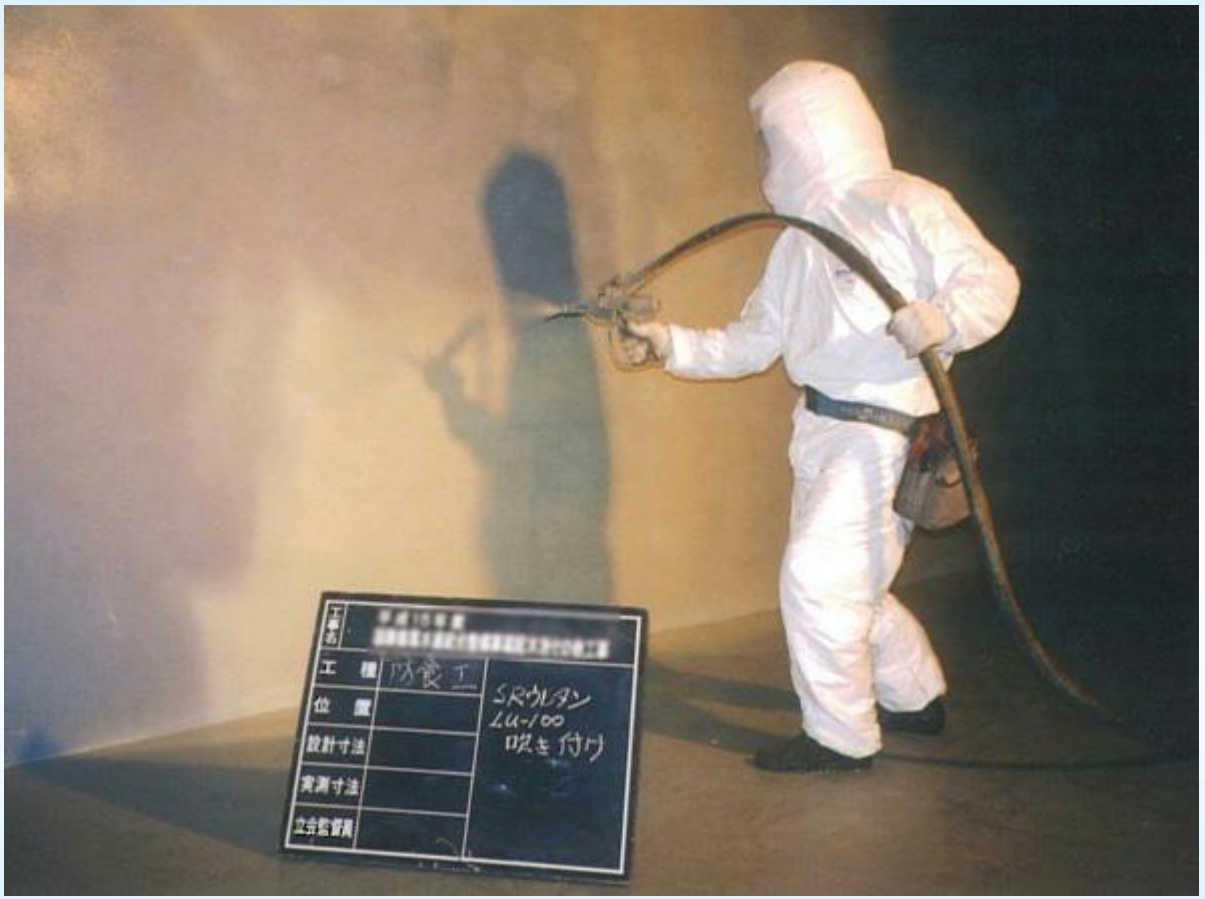
※塗料は溶剤含む。※端数は四捨五入。

reference

# Application of polyurethane

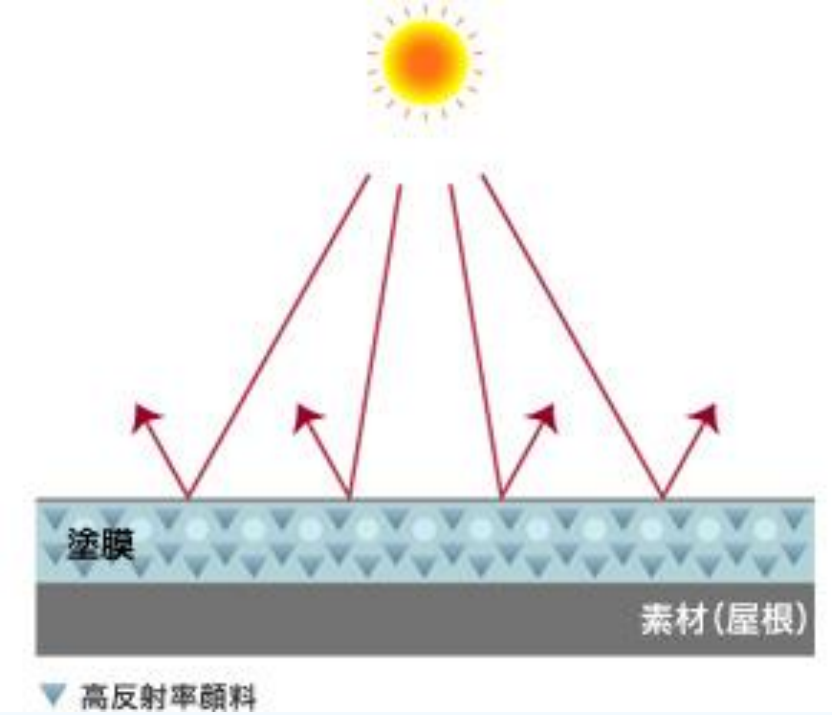


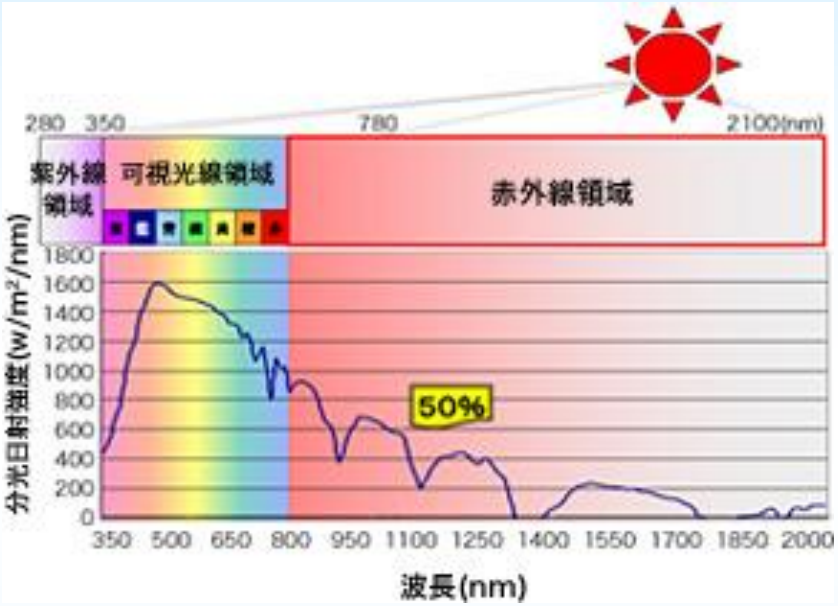
# Solvent-free 2KPU anti-corrosive paints




URIC H-368, H-854, H-870

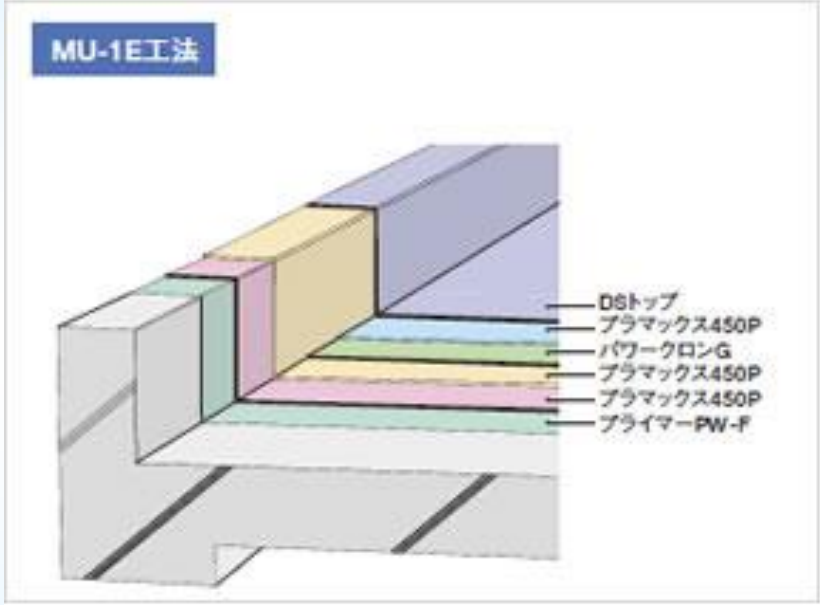
# Mechanism of solar heat-shielding



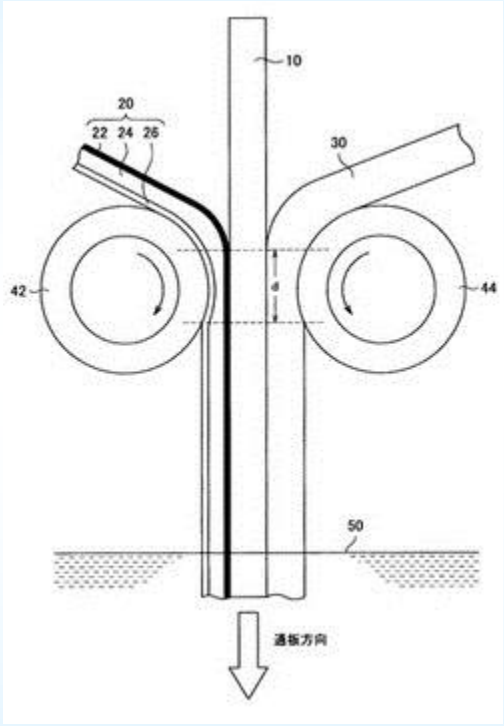



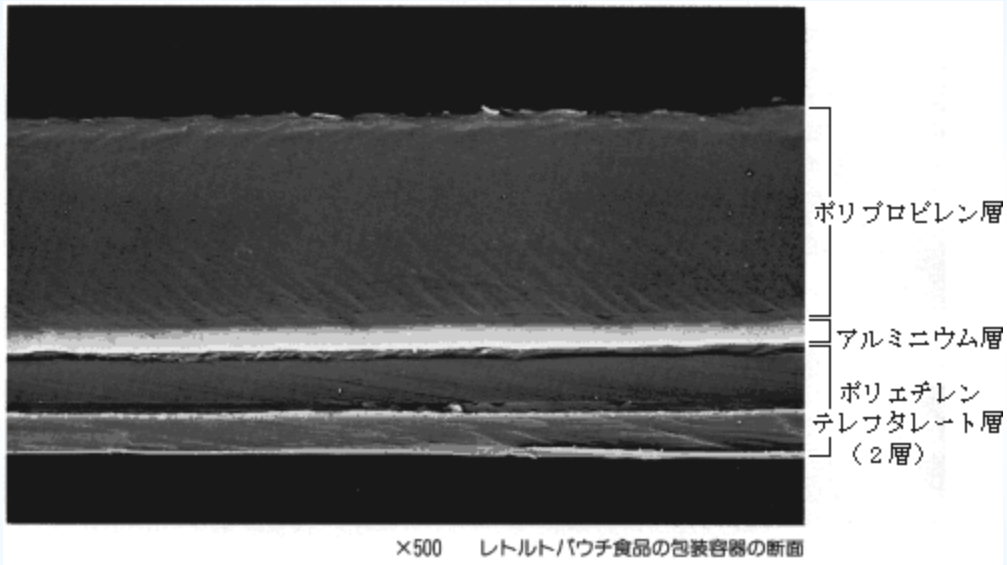

Special modified $TiO_2$ effectively reflects this infrared rays area (780-2100nm) which makes the person feel that it is hot.

# Materials for PU waterproofing




# Retort pouches for food




Thickness ; 0.1 mm (100μm)