

Kuraray Polyols

Polyester Polyols, Polycarbonate Polyols

Kuraray Co., Ltd.



Contacts

Kuraray Co., Ltd.

Otemachi 1-1-3, Chiyoda, Tokyo, 100-8115, JAPAN
PHONE : +81 (0)3 6701 1639, FACSIMILE : +81 (0)3 6701 1646
Web : <http://www.kuraray.co.jp>

Kuraray Europe GmbH

Philipp-Reis-Straße 4, D-65795, Hattersheim am Main, GERMANY
PHONE : +49 (0)69 305 35844, FACSIMILE : +49 (0)69 305 98 35845
e-mail : chemicals@kuraray.eu
Web : <http://www.kuraray.eu>

Kuraray America Inc.

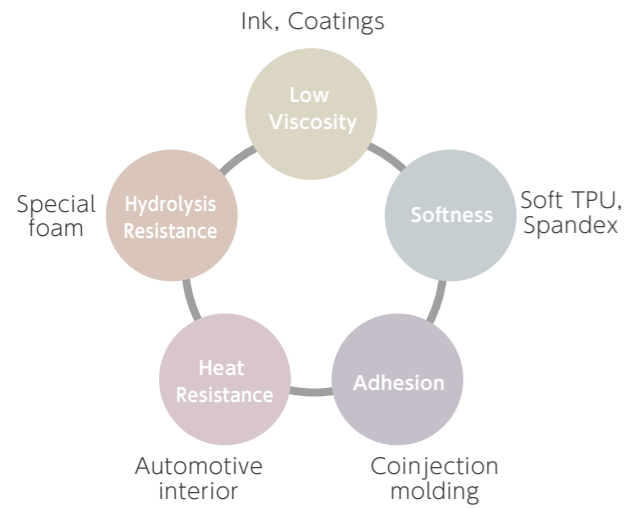
2625 Bay Area Boulevard, Suite 600, Houston, TX 77058-1551, USA
PHONE : +1 (0)713 495 7325, FACSIMILE : +1 (0)713 495 7322
Web : <http://www.kuraray.us.com/>

Kuraray Co., Ltd.
Isoprene chemical division

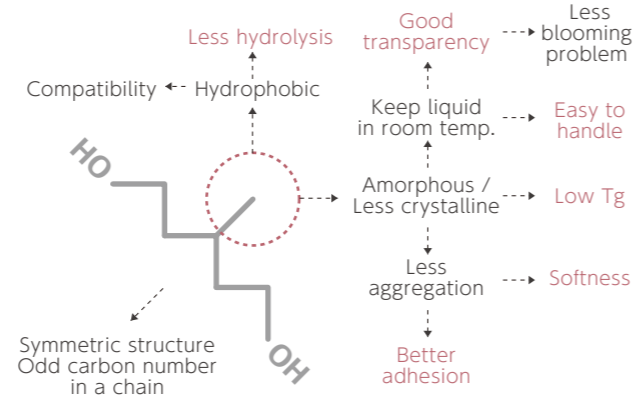
2014.12.①

kuraray

① Advantage of Kuraray's polyols



③ 3-Methyl-1,5-Pentanediol (MPD) Unique diol for unique properties



⑤ Major Application of Kuraray polyols

- Polyurethane resin for :**
- Printing ink
 - Paint
 - Adhesive
 - Shoe sole
 - TPU
 - Synthetic leather
 - Polyurethane fiber (spandex)



⑦ Solubility of the polyols in solvents

polyol / solvent	MeOH			iPrOH			Tol			MEK			EtOAc		
	3/1	2/2	1/3	3/1	2/2	1/3	3/1	2/2	1/3	3/1	2/2	1/3	3/1	2/2	1/3
P-2010	○	○	△	○	△	△	○	○	○	○	○	○	○	○	○
PBA-2000	▲	△	×	▲	△	×	▲	○	○	▲	○	○	▲	○	○
PCL-2000	▲	▲	×	▲	▲	×	▲	○	○	▲	○	○	▲	▲	○
C-2090	△	×	×	△	×	×	○	○	○	○	○	○	○	○	○
PHC-2000	×	×	×	△	×	×	▲	○	○	▲	○	○	▲	○	○

○: homogeneous dissolved
 △: white turbidity (emulsion)
 ▲: partially dissolved
 ×: separated

→ Wider possibility of solvents for your formulation

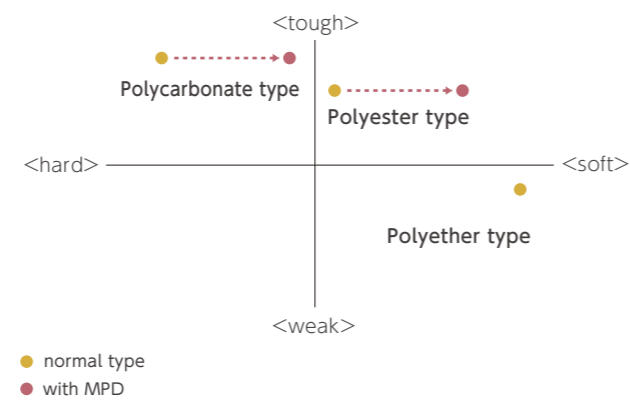
② Kuraray Polyols : all based on MPD*

	P-series (Ester type)	C-series (Carbonate type)
MPD	MPD/Adipic Acid MPD/Terephthalic Acid MPD/Isophthalic Acid MPD/Sebacic Acid MPD/TMP/Adipic Acid	MPD/HD/DEC

* MPD : 3-Methyl-1,5-Pentanediol



④ Kuraray polyols solve problems



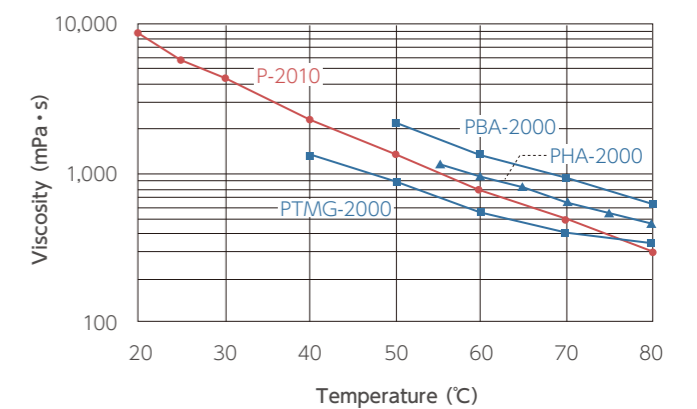
⑥ Case study 1 : Printing ink

<Gravure ink for food package>

- Solubility**
 [dissolved in wide-range solvents]
 Adhesion [better adhesion to plastic films]
 Transparency [keeping colors bright]
 Low viscosity [easy for handling]
 UV resistance [UV light for sterilization]



⑧ Viscosity of polyols



*melting point : PBA-2000→51~53°C
 PHA-2000→53~56°C
 PTMG-2000→31°C
 P2010→-66°C

→ Liquid at low temperature

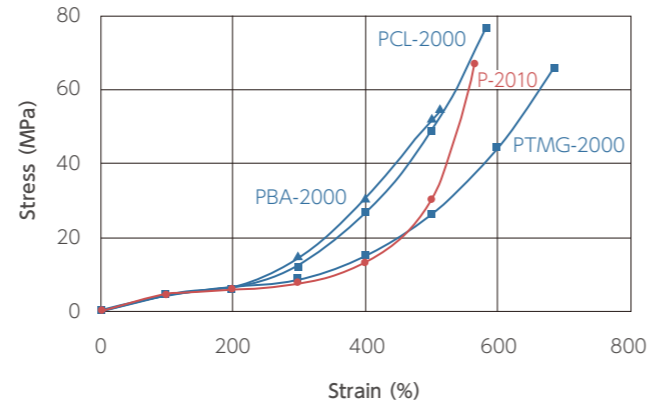
⑨ Viscosity of Pre-polymer

Prepolymer	Temperature(°C)			
	-4	20	30	40
KurarayPolyol P-2010 : TDI= 1:2	Viscous Liquid	35	15	8
PBA-2000 : TDI = 1:2	Solid	Viscous Liquid	Viscous Liquid	Viscous Liquid
PCL-2000 : TDI = 1:2	Solid	Solid	Solid	13

[Pa · s]

→ For your solvent free pre-polymer

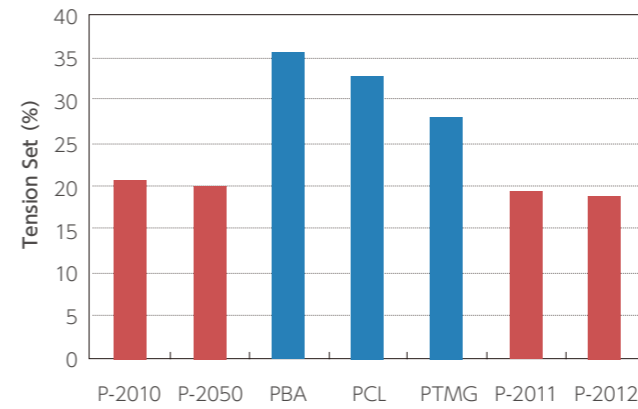
⑪ Stress-Strain Curve (Polyester polyol)



100 μm cast film, Polyol/MDI/BD=1/3/2 (N%=2.9)

→ Elongation with less tension

⑬ Elongation Set



Condition: 23°C, 24hr, 100% elongation, n=3
Polyol/MDI/BD=1/3/2 (molar ratio); Thickness 2mm

→ Better morphological stability

⑩ Case study 2 : TPU

<Thermoplastic polyurethane>

Softness

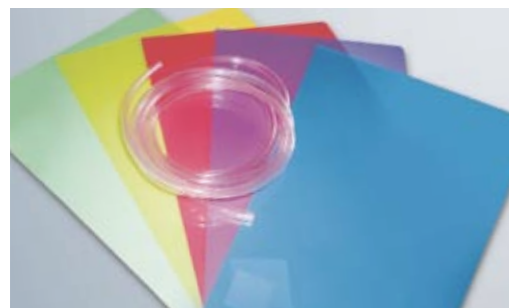
[Soft polyurethane without plasticizer]

Heat resistance [suitable for car interior]

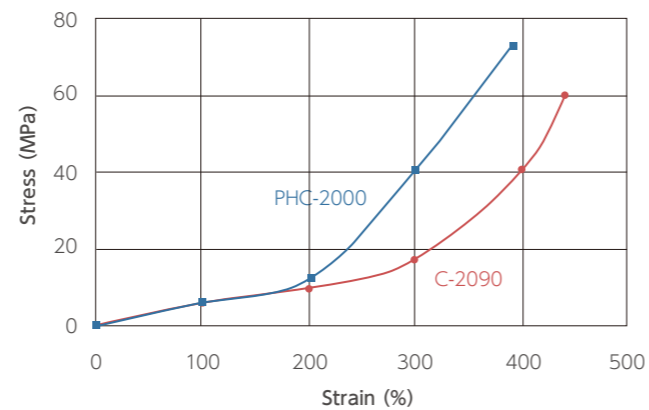
Transparency [keeping your products clear]

Abrasion resistance [good for sportswear]

Low temperature property [Tg is very low]

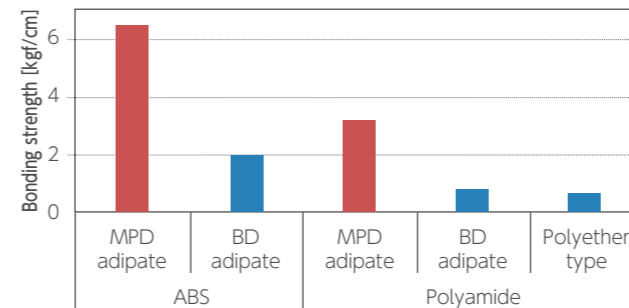


⑫ Stress-Strain Curve (Polycarbonate polyol)



100 μm cast film, Polyol/MDI/BD=1/3/2 (N%=2.9)

⑭ Adhesion property



→ suitable for co-injection molding (double mold)

Test method: 180 degrees peeling test
Shore A hardness of each TPU: 90
Sample preparation: insert molding (laminare structure)

⑮ Case study 3 : Shoe sole

<Shoe sole for protective footwear>

Water resistance

[superior to other polyester polyols]

Softness [shock absorbing]

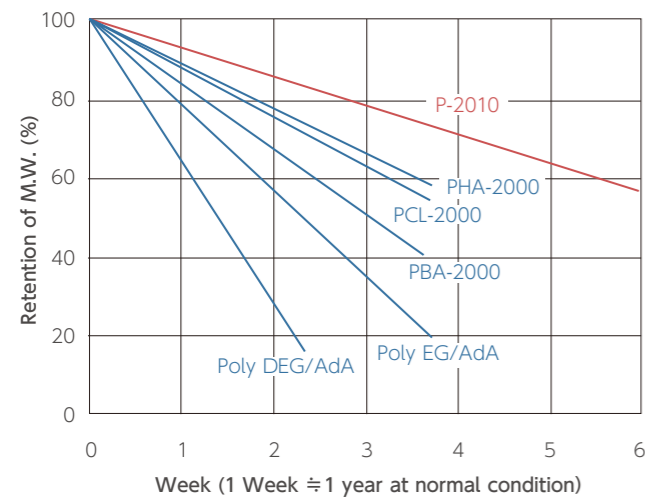
Abrasion resistance [better durability]

Chemical resistance [applicable for industrial use]



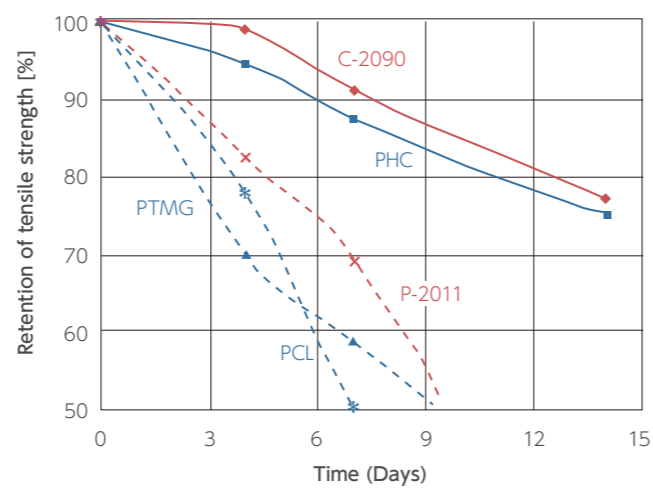
P-2010: MPD adipate
P-2050: MPD sebacate
P-2011: MPD / AdA+TPA
P-2012: MPD / AdA+HPA
C-2090 :MPD/HD carbonate

⑮ Hydrolysis resistance (polyester polyol)



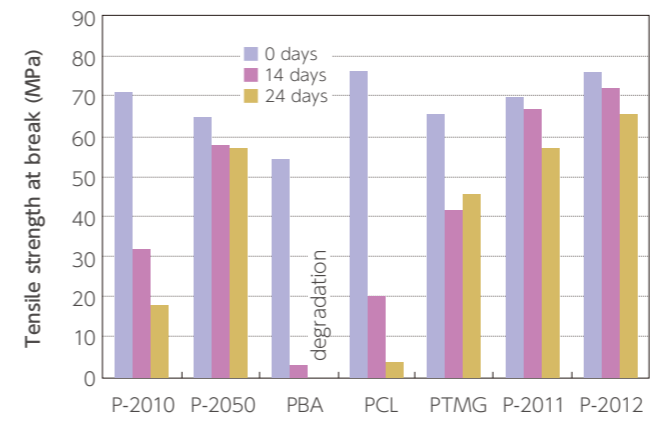
Polyol(MW=2000)/MDI/BD = 1/5/4 (molar ratio)
70°C, 95%R.H.

⑯ Hydrolysis resistance (polycarbonate polyol)



Polyol(MW=2000)/MDI/BD=1/3/2 (molar ratio)
Kept in water at 100°C

⑳ Acid resistance



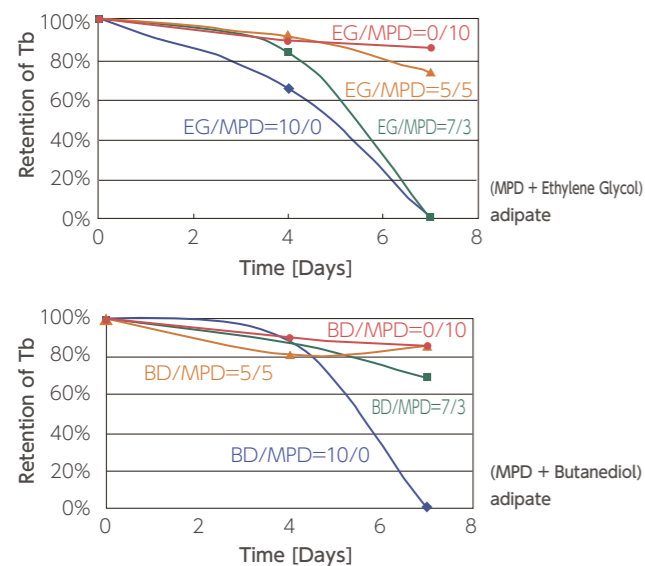
Polyol (MW=2000)/MDI/BD = 1/3/2 (molar ratio)
Kept into 5% H₂SO₄ aq. at 60°C

㉑ Case study 4 : Synthetic leather

<Car seat, Furniture>
Well balance of softness and toughness
[a product with reliability]
Softness [luxurious texture]
Heat resistance [suitable for car interior]
Cold resistance [keeping softness in winter]
Water resistance [easy care]

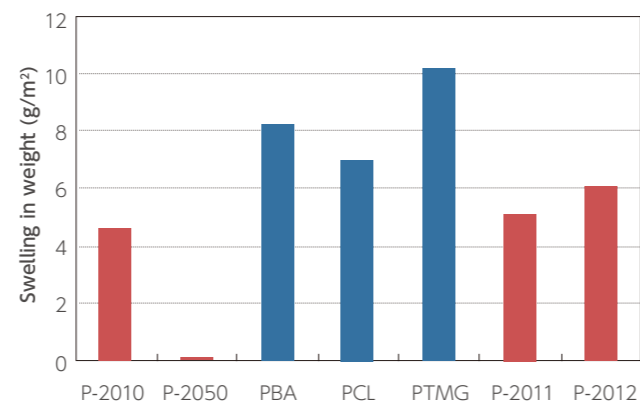


⑰ Hydrolysis resistance (combination)



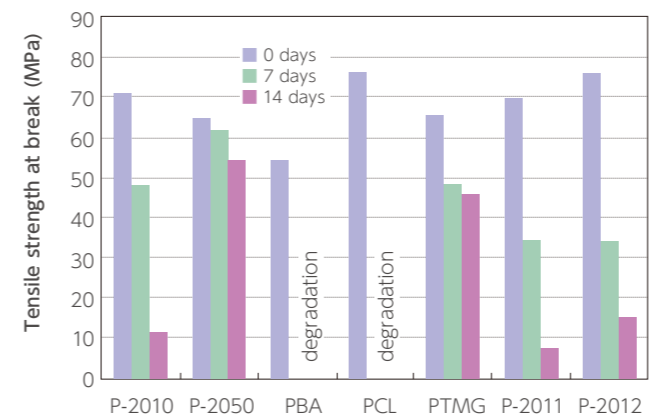
Polyol(MW=2000)/MDI/BD = 1/3/2 Soaked in boiling water (100°C)
100 μm dumbbell-shape film Stress rate: 50cm/min

⑲ Water absorption



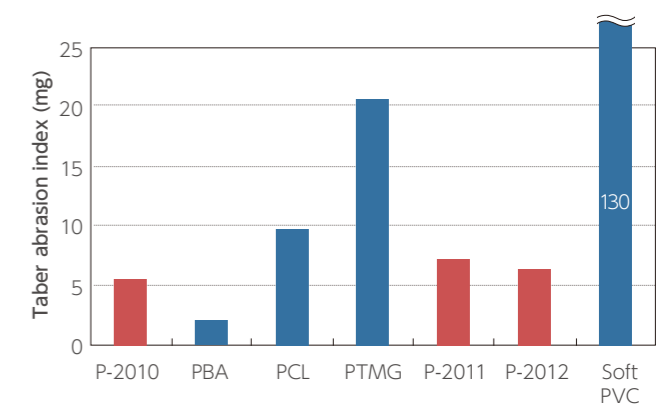
Polyol/MDI/BD = 1/3/2 (molar ratio)
Kept in water for 4days
Sheet of 10×20×1 mm³

㉒ Alkali resistance



Polyol (MW=2000)/MDI/BD = 1/3/2 (molar ratio)
Kept into 5% NaOH aq. at 60°C

㉓ Abrasion resistance (Taber method)



Polyol/MDI/BD = 1/3/2 (molar ratio)
Disk of 120 mm diameter and 2mm thickness
9.8N load, 60rpm, 1000cycles (abrading wheels: H-22)

P-2010: MPD adipate
P-2050: MPD sebacate
P-2011: MPD / AdA+TPA
P-2012: MPD / AdA+IPA
C-2090: MPD/HD carbonate

②④ Flexural fatigue strength

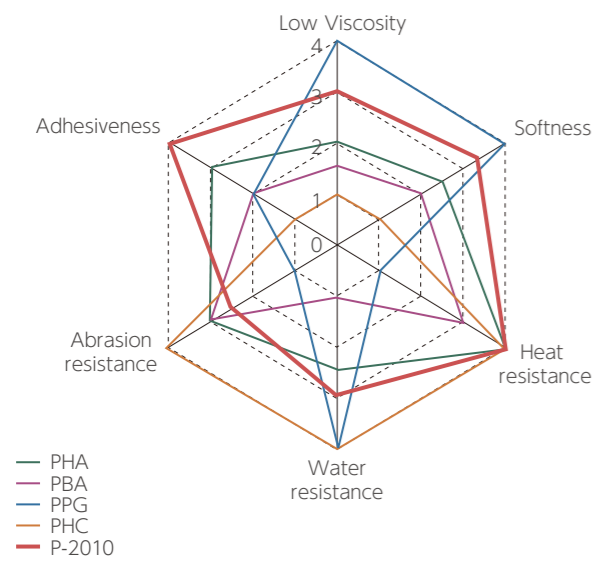
Flex cycles until crack length grows 0.5 ~ 1mm

Polyol	Flex cycle
C-2090	>100,000
PHC-2000	< 6,000

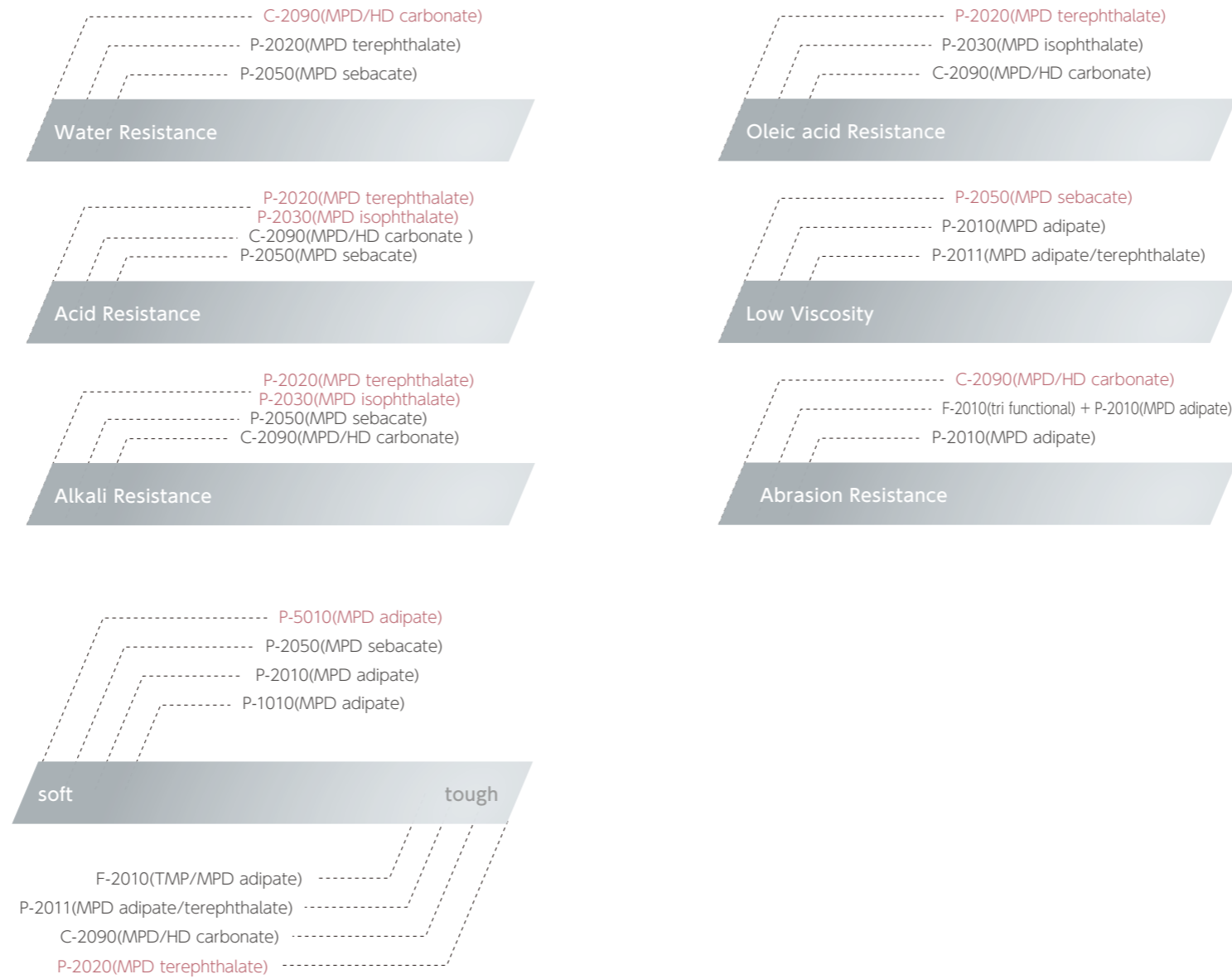
Polyol(MW=2000)/MDI/BD=1/3/2 (molar ratio)
Flex cycle: 300 times per minutes

→ High tolerance against flex fatigue

②⑤ Compare to other polyols



②⑥ Recommended Grade



Product List

<Diols>	CAS Nr.	M.W.	Functional Number	Appearance at 25°C	Viscosity [mPa·s]	Melting point [°C]	NET volume [kg/drum]
MPD (3-Methyl-1,5-Pentanediol)	4457-71-0	118	2	Liquid	173 @20°C	< -50	190
ND (1,9-Nonanediol)	3937-56-2	160	2	White Solid	33 @60°C	46	175

<Polyols>	CAS Nr.	M.W.	Functional Number	Appearance at 25°C	Viscosity [mPa·s] at 25°C	Tg [°C]	NET volume [kg/drum]
-Polyester Polyols-							
MPD adipate							
Kuraray Polyol P-510	39751-34-3	500	2	Liquid	540	-76.7	215
Kuraray Polyol P-1010	39751-34-3	1000	2	Liquid	1,500	-70.6	215
Kuraray Polyol P-2010	39751-34-3	2000	2	Liquid	5,700	-66.6	215
Kuraray Polyol P-3010	39751-34-3	3000	2	Liquid	13,800	-64.9	215
Kuraray Polyol P-4010	39751-34-3	4000	2	Liquid	28,000	-64.4	215
Kuraray Polyol P-5010	39751-34-3	5000	2	Liquid	47,000	-63.8	215
Kuraray Polyol P-6010	39751-34-3	6000	2	Liquid	68,000	-64.3	215
[MPD/TMP] adipate							
Kuraray Polyol F-510	122310-07-0	500	3	Liquid	2,200	-65.5	200
Kuraray Polyol F-1010	122310-07-0	1000	3	Liquid	1,700	-62.5	200
Kuraray Polyol F-2010	122310-07-0	2000	3	Liquid	7,200	-62.7	215
Kuraray Polyol F-3010	122310-07-0	3000	3	Liquid	15,000	-62.7	215
MPD [adipate/terephthalate]							
Kuraray Polyol P-2011	160935-30-8	2000	2	Liquid	40,000	-43.1	215
MPD terephthalate							
Kuraray Polyol P-520	162005-47-2	500	2	Paste	13,300	-51.6	215
Kuraray Polyol P-1020	162005-47-2	1000	2	Wax	8,700 @60°C	-24.7	215
Kuraray Polyol P-2020	162005-47-2	2000	2	Wax	73,000 @60°C	-9.6	215
MPD [adipate/isophthalate]							
Kuraray Polyol P-1012	156638-20-9	1000	2	Liquid	14,000	-51.0	215
Kuraray Polyol P-2012	156638-20-9	2000	2	Liquid	42,000	-42.0	215
MPD isophthalate							
Kuraray Polyol P-530	76962-70-4	500	2	Liquid	26,000	-44.3	215
Kuraray Polyol P-2030	76962-70-4	2000	2	Liquid	105,000 @60°C	-6.7	215
MPD sebacate							
Kuraray Polyol P-2050	26009-52-9	2000	2	Liquid	5,200	-60.9	210
ND adipate							
Kuraray Polyol N-2010	73019-30-4	2000	2	Wax	1,000 @60°C	-15.2	200
-Polycarbonate Polyols- [MPD/1,6-HD]							
Kuraray Polyol C-590	140936-35-2	500	2	Liquid	170 @60°C	-70.2	215
Kuraray Polyol C-1090	140936-35-2	1000	2	Liquid	1,800 @60°C	-53.2	215
Kuraray Polyol C-2090	140936-35-2	2000	2	Liquid	4,600 @60°C	-45.3	215
Kuraray Polyol C-3090	140936-35-2	3000	2	Liquid	15,700 @60°C	-42.0	215



Registration

	REACH (EU)	TSCA (US)	ENCS (JP)	IECSC (CN)	ECN (TW)	ECL (KR)	NDSL (CA)	EFSA (EU)
MPD	○ *1	○	○	○	○	○	○	○ *3
ND	○ *2	○	○	○	○	○	○	—
P-xx10	Polymer	○	○	○	○	○	○	○ *4
P-xx11	Polymer	○	○	○	○	○	—	○ *4
P-xx12	Polymer	○	○	○	○	—	—	○ *4
P-xx20	Polymer	○	○	○	○	—	—	○ *4
P-xx30	Polymer	—	○	○	○	—	—	○ *4
P-xx50	Polymer	—	○	○	○	—	—	○ *4
F-xx10	Polymer	○	○	○	○	○	—	○ *4
N-2010	Polymer	—	○	○	○	○	—	—
C-xx90	Polymer	○	○	○	○	○	—	—

*1 : Registered by Kuraray. Kuraray Europe GmbH is appointed as OR.

*2 : Pre-registered by Kuraray Europe GmbH as an importer

*3 : SML = 0.05 mg/kg

*4 : All monomers are listed on EFSA positive list

To the best of our knowledge, information contained herein is accurate. It is the sole responsibility of the customer to determine whether the product is appropriate and suitable for customer's specific use. Specific end use may require approval by appropriate regulatory agencies. All chemicals may present unknown health hazards and should be used with caution. Although certain hazards may be described in this publication, we cannot guarantee that these are the only hazards that exist. Kuraray makes no warranties, express or implied, regarding products on any information contained here in. Kuraray disclaims any liability for infringement of any patent by reason of customer's use of any Kuraray products in combination with other materials or in any process.

Reference

Abbreviations

MPD: 3-Methyl-1,5-Pentanediol
 ND: 1,9-Nonanediol
 AdA: Adipic Acid
 TPA: Terephthalic Acid
 IPA: Isophthalic Acid
 SA: Sebacic Acid
 TMP: Trimethylol Propane
 HD: 1,6-Hexanediol
 BD: 1,4-Butanediol
 EG: Ethylene Glycol
 DEG: Diethylene Glycol
 PBA: Poly Butanediol Adipate
 PCL: Polycaprolactone
 PHA: Poly Hexanediol Adipate
 PHC: Poly Hexanediol Carbonate
 PTMG: Poly Tetramethylene ether Glycol
 MDI: 4,4'-Diphenylmethane Diisocyanate