DAICEL
DAICEL CORPORATION

Sustainable Value Together

Functional Materials

ε-Caprolactone and Derivatives

Cycloaliphatic Epoxides / Other Epoxides

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Introduction

Daicel Corporation is a manufacturer of various organic functional products among their wide available product line. In this catalog, we would like to introduce peracetic acid derivatives such as ε-caprolactone, its oligomers, polymers, epoxy compounds.

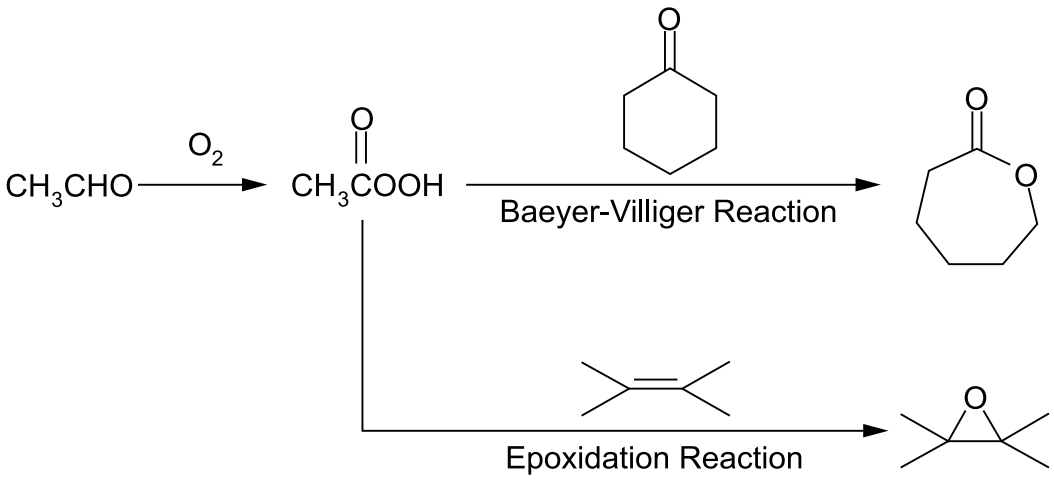
These products are widely used in the field of polyurethane, coatings, additives for plastics, electronics, resins, etc.

This catalog outlines these products presented by the Organic Chemical Products Company. Technical data sheets for each product are also available.

In addition, we will prepare various lab-samples upon your requests.
Please feel free and contact us with inquiries about our products.

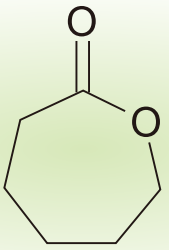
We are looking forward to serving you.

Oxidation by Peracetic acid



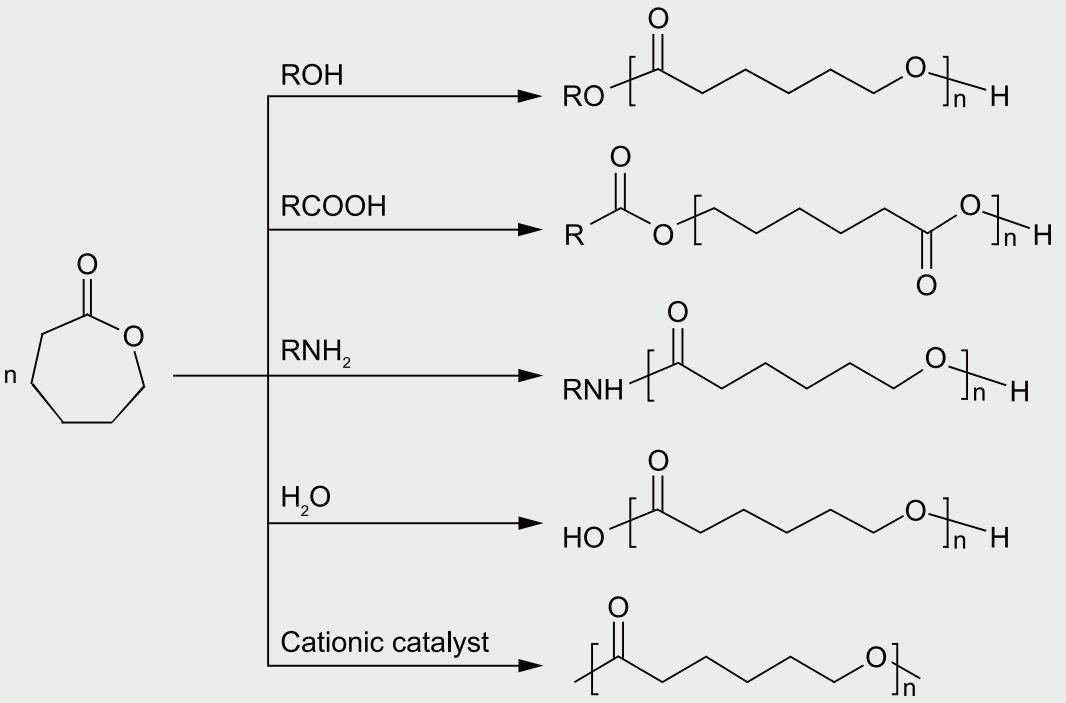
1) PLACCEL M : ε-Caprolactone monomer

PLACCEL M is a 7 membered-lactone(ε -caprolactone) with such physical properties as shown in the table below. With its excellent chemical reactivity, various kinds of resins and organic compounds can be modified with PLACCEL M to improve compatibility, solubility, flexibility, and reactivity.



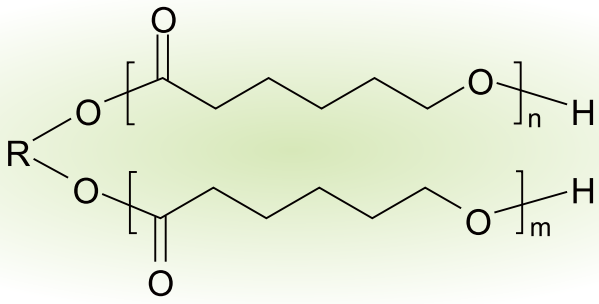
Product	Molecular weight	Appearance (r.t.)	Specific gravity (20/4 ℃)	Specific gravity of vapor	Boiling point (℃)	Vapor pressure (mmHg/20℃)	Viscosity (mPa·s/20 ℃)	Flash point (℃)
M	114.14	Liquid	1.0693	4.01	237.1	0.02	6.6	118

Reaction of PLACCEL M



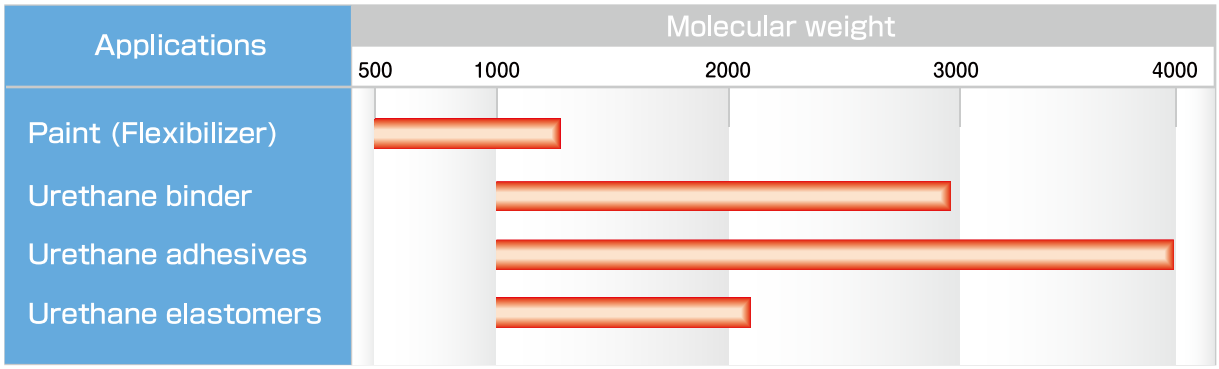
2) PLACCEL 200 series : Polycaprolactone diols

PLACCEL 200 series are polycaprolactone diols.
Various kinds of molecular weight are available as listed in the table below.
They have more excellent UV-resistance and heat resistance than polyether diols, and a higher water resistance than adipate-based polyesterdiols.



Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/75℃)
205	530	Paste	10	213.3	0.08	0.005	30-40	40
205U	530	Liquid	10	211.9	0.10	0.007	N/A	310/25℃
205UT	530	Liquid	10	212.2	0.05	0.009	N/A	303/25℃
205H	530	Liquid	20	213.4	0.10	0.008	N/A	880/25℃
208	830	Wax	10	137.5	0.11	0.007	35-45	90
210	1000	Wax	10	112.8	0.09	0.005	46-48	120
210CP	1000	Paste	10	112.8	0.16	0.006	31-33	80
210B	1020	Wax	10	109.0	0.07	0.004	N/A	143/60℃
212	1250	Wax	15	90.8	0.09	0.004	40-52	175
212CP	1250	Wax	10	90.2	0.14	0.009	37-40	115
212UA	1250	Wax	10	89.0	0.03	0.003	N/A	181/60℃
220	2000	Wax	15	56.7	0.06	0.003	45-55	370
220CPB	2000	Wax	10	57.2	0.16	0.006	40-50	230
220CPT	2000	Wax	10	56.6	0.02	0.006	N/A	245
220UA	2000	Wax	10	55.7	0.09	0.006	N/A	245
230	3000	Wax	15	37.6	0.07	0.005	55-58	850
240	4000	Wax	20	28.5	0.07	0.006	48-58	1550

Applications



3) PLACCEL N series : Polycaprolactone diols with narrow molecular weight distribution

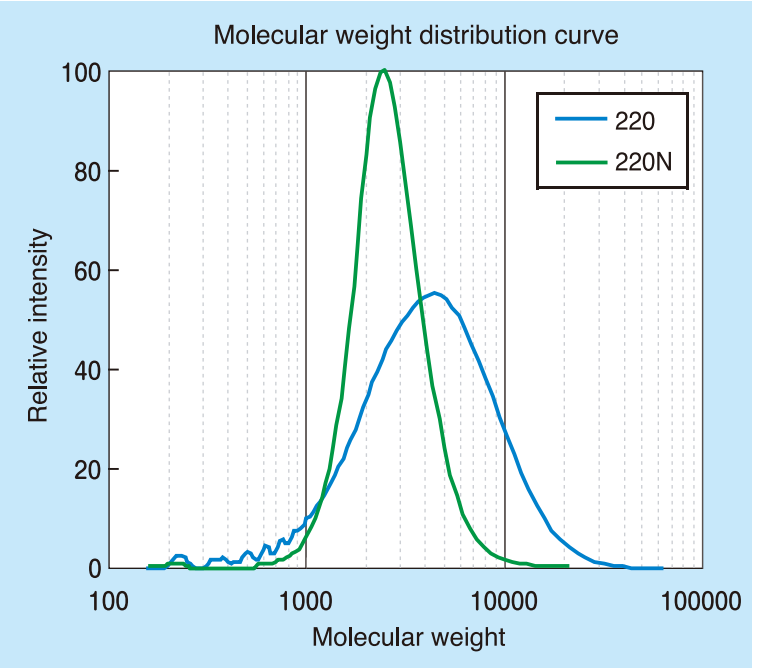
PLACCEL N is characterized for its narrow molecular weight distribution. Polyurethane elastomers made from PLACCEL 210N or 220N show excellent abrasion resistance and compression permanent set resistance.

The recommended applications of these polyurethane elastomers are solid tires, rollers, scratching blades of toner for copy machines.

Because of their low content of low molecule oligomer unit, the so-called “blooming” is not likely to occur.

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Moisture Content (wt%)	Melting point (℃)	Viscosity (mPa·s/75℃)
210N	1000	Wax	10	113.2	0.13	0.004	32-37	85
220N	2000	Wax	10	56.1	0.10	0.004	48-51	240
230N	3000	Wax	10	37.1	0.13	0.005	52-54	490

Product	Molecular weight distribution (*Mw*/*Mn*)
210N	1.34
210	1.88
220N	1.24
220	2.00

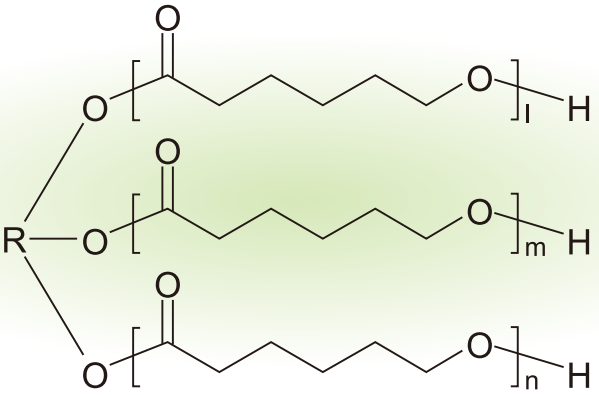


4) PLACCEL 300 series : Polycaprolactone triols

PLACCEL 300 series are polycaprolactone triols terminated with three hydroxyl groups in each molecular.

Flexibility can be given to various coating resins by using PLACCEL 300 series.

They can also be used as raw materials for urethane foam to obtain excellent physical properties at lower temperature.

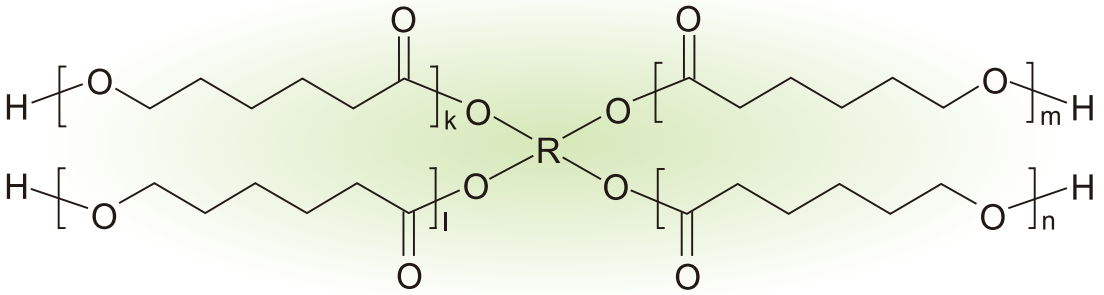


Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/25℃)
303	310	Liquid	15	541.3	0.50	0.015	N/A	1770
305	550	Liquid	10	305.6	0.50	0.015	N/A	1280
305T	550	Liquid	15	304.9	0.03	0.029	N/A	1320
308	850	Paste or Liquid	10	195.3	0.38	0.010	20-30	1400
309	900	Paste or Liquid	10	187.3	0.20	0.012	N/A	1450
312	1250	Wax	10	136.1	0.38	0.008	33-37	150/75℃
320	2000	Wax	15	85.4	0.29	0.007	40-45	280/75℃

5) PLACCEL 400 series : Polycaprolactone tetraols

PLACCEL 410 is a polycaprolactone tetraol.

It can be used as a urethane resin cross-linking agent and raw material of the coating.



Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/60℃)
410	1030	Liquid	15	217.8	0.56	0.011	N/A	270

6) PLACCEL L series : Liquid polycaprolactone oligomers

Liquid polycaprolactone diols are widely applied in many fields because of their easy handling, superior compatibility with various kinds of resins and excellent solubility.

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (%)	Melting point (℃)	Viscosity (mPa·s/25℃)
L212AL	1250	Liquid	15	90.2	0.17	0.006	14	3165
L220AL	2000	Liquid	10	56.8	0.20	0.005	14	8430
L320AL	2000	Liquid	10	83.4	0.45	0.009	17-20	10830

7) PLACCEL E series: Highly hydrolytic resistant polyols

Daicel developed highly hydrolytic resistant polyols.
Liquid diols with improved hydrolytic stability can be widely applied in such fields as urethane adhesive, gravure ink binder, polyurethane elastomer and plasticizer for paint and epoxy-resin.

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/75℃)
220EB	2000	Liquid	20	56.8	0.24	0.005	N/A	750
220EC	2000	Liquid	45	56.5	0.02	0.004	N/A	1055

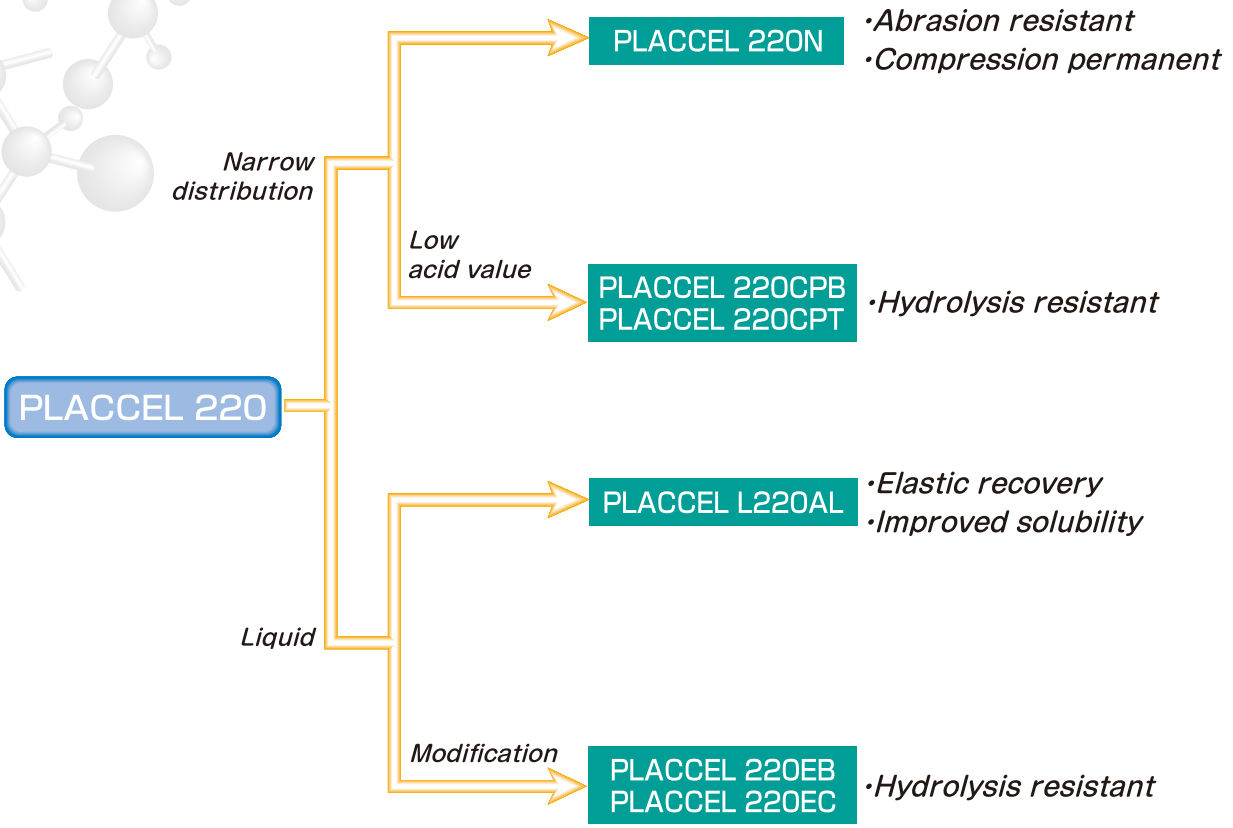
8) PLACCEL T2205, P3403: Caprolactone-modified polyether polyols

PLACCEL T2205 is polytetramethylene glycol(PTMG) modified with ε-caprolactone. Polyurethane elastomers made with this polyether-ester diols and isocyanates show excellent properties at low temperature and superior durability.

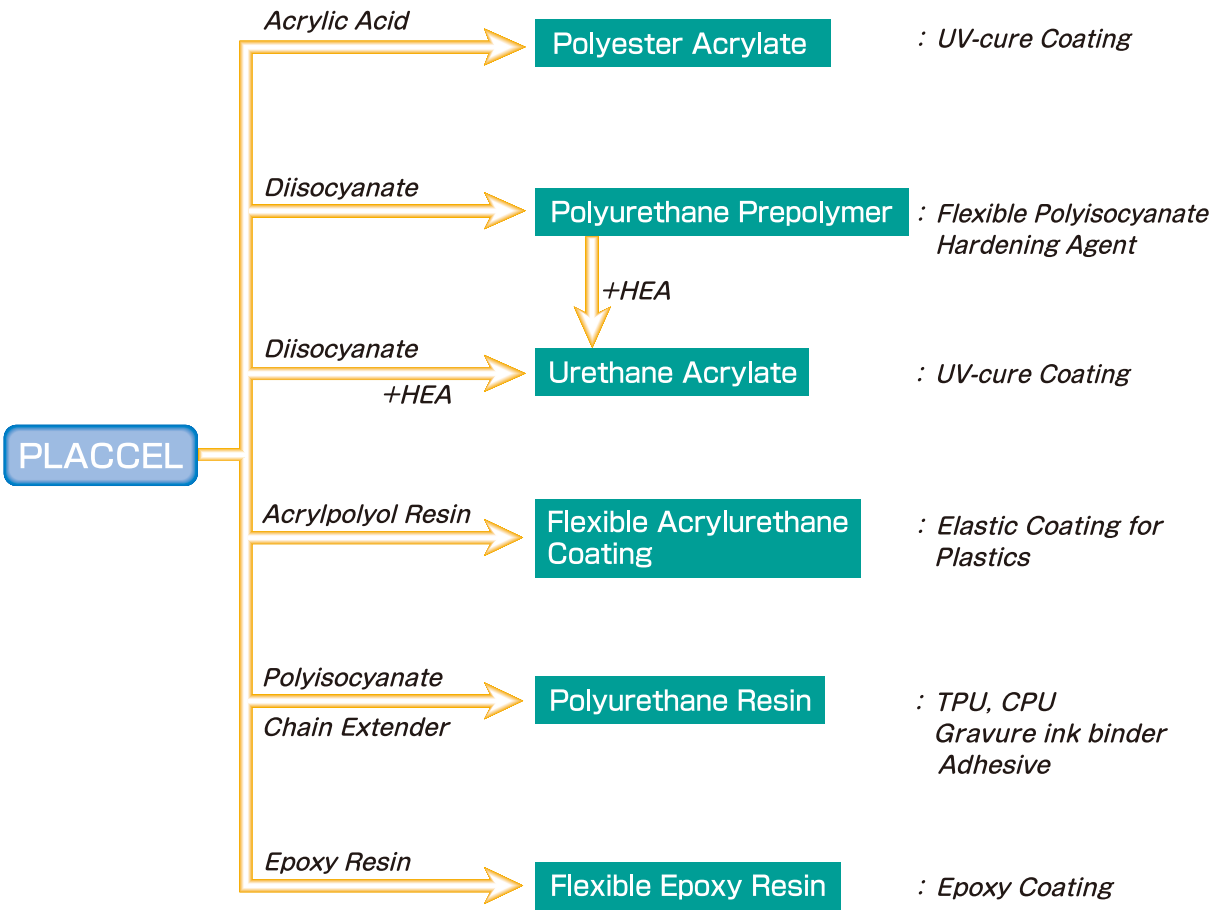
PLACCEL P3403 is a polypropylene glycol(PPG) modified with ε-caprolactone. By modifying polypropylene glycol with ε-caprolactone, it is possible to improve the dispersion of reactivity.

Product	Molecular weight	Functional number	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/75℃)
T2205	2000	2	Wax	20	54.3	0.04	0.019	N/A	220
P3403	4000	3	Liquid	25	42.4	0.26	0.008	N/A	140

Polycaprolactonediols family with MW of 2000

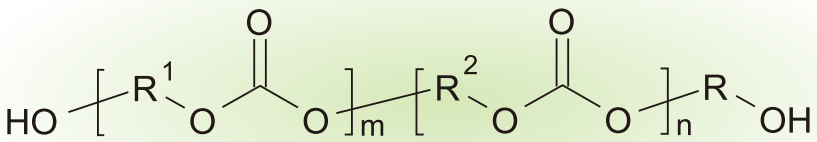


Applications



9) PLACCEL CD series : Polycarbonate diols

Polycarbonate diols can also be used in polyurethane applications.
They are characterized by its superior heat and moisture resistance than polyester diols and polyether diols.



$R = R^1$ or R^2

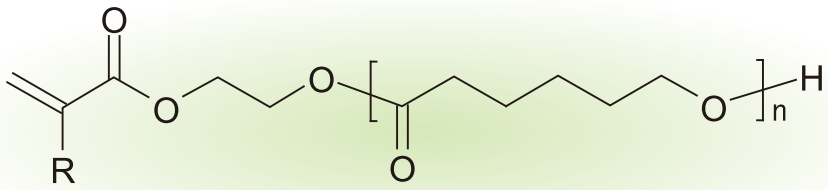
Polycarbonate diols

- **Conventional type** : *High crystallization*
- **Liquid type (PL)** : *Low modulus*

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/75℃)
CD210	1000	Wax	20	111.5	0.02	0.004	40-48	415
CD220	2000	Wax	10	55.7	0.03	0.004	47-53	2590
CD205PL	500	Liquid	10	230.6	0.05	0.005	N/A	1400/25℃
CD220PL	2000	Liquid	10	57.6	0.03	0.006	N/A	4615/60℃

10) PLACCEL F series : Caprolactone-modified (meth)acrylates

PLACCEL F series are macro monomers with a (meth)acrylic double bond. They have both of a radical polymerizable (meth)acrylic double bond and a primary hydroxyl group which is highly reactive with hardening agents such as isocyanates and/or melamines.



R= H, PLACCEL FA ; Acrylate derivative

R= CH_3 , PLACCEL FM ; Methacrylate derivative

PLACCEL FA series (acrylate)

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g) *3	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/ 25℃)	MEHQ (ppm)
FA1	230	Liquid	20	244	3.51	0.020	N/A	30	5000
FA1DDM	230	Liquid	15	244	3.48	0.021	-24	32	500
FA2D	344	Liquid	15	163	2.50	0.010	-12	78	500
FA5	686	Wax	25	81.8	0.94	0.009	N/A	130/40℃	5000
FA10L *1	1258	Liquid *2	35	31	0.67	0.007	N/A	48	5000

*1: 30% Toluene solution. *2: It may be crystallized at low temperature. *3: Calculated value.

PLACCEL FM series (methacrylate)

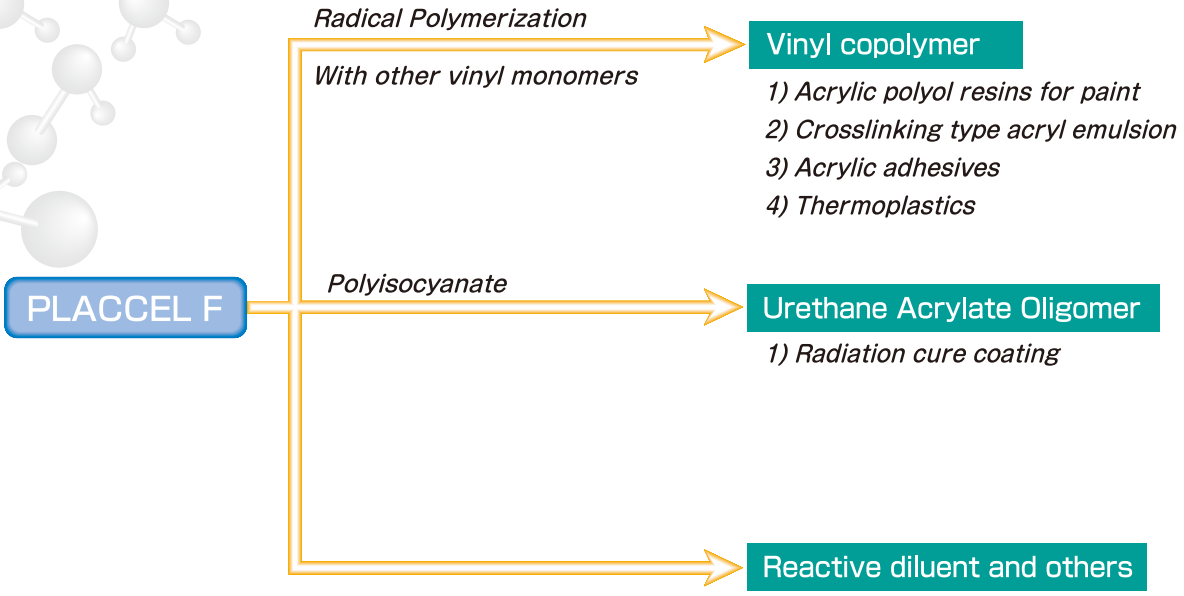
Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/ 25℃)	MEHQ (ppm)
FM1	244	Liquid	25	224.3	3.41	0.018	N/A	30	5000
FM1D	244	Liquid	15	226.3	3.54	0.017	N/A	31	500
FM2D	358	Liquid	20	154.5	2.44	0.009	N/A	72	500
FM3	473	Paste	45	116.2	1.95	0.009	N/A	130	1000
FM4	586	Paste	45	93.6	1.59	0.008	N/A	200	500
FM5	701	Wax	40	78.2	1.36	0.006	21	121/40℃	500
FM6	814	Wax	30	67.8	1.02	0.006	N/A	163/40℃	500

Relation between Tg and additional mol number of CLM

Additional mol number of CLM (n)	1	2	3	4	5
Product name	FA1	FA2	FA3	FA4	FA5
Tg of homopolymer (℃)	-28	-40	-46	-51	-53

Product name	FM1	FM2	FM3	FM4	FM5
Tg of homopolymer (℃)	-8	-28	-37	-43	-47

Applications



Characteristics

Primary hydroxyl groups in acrylpolyol resins were introduced by a copolymerization of the PLACCEL F series. These are located at the end of a flexible polycaprolactone chain or are far from the main chain of structure.

Consequently, acrylic polyol resins are easily allowed to react with melamine or such hardening agent as polyisocyanates to complete crosslinking.

This results in elastic and strong coating films.

Improved properties by copolymerization with PLACCEL F series

Scratch resistance, hardness, elasticity, abrasion resistance, flexibility at low temperature, adhesion, workability.

Remarks

Beside the products listed on this brochure, other kinds of special types of PLACCEL FM, FA are available: For example reducing the content of stabilizer, diluted with solvents to be easily handled, and modified with more caprolactones (FM-6, 7, ...10).

Please contact us about them.

11) PLACCEL HEMAC : Hydroxyl functioned carbonate methacrylates

HEMAC is a hydroxyl functioned carbonate methacrylates developed by Daicel. It has a radical polymerizable methacrylic double bond and a highly reactive primary hydroxyl group in the molecule.
In addition, HEMAC is highly water resistant and heat resistant because of its carbonate bond.

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	Acid value (KOHmg/g)	Water (wt%)	Melting point (℃)	Viscosity (mPa·s/25 ℃)
HEMAC1	260	Liquid	70	0.12	0.032	N/A	105

Characteristics

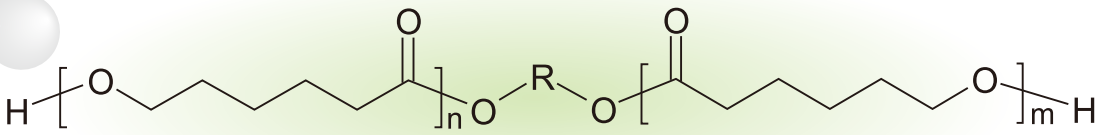
- Radical polymerizable
- Containing a primary hydroxyl group
- Higher water resistance

Applications

- Acrylic resins for coating
- Acrylic emulsion
- Acrylic adhesives
- Monomer for radiation curable coating

12) PLACCEL H series : Thermoplastic high molecular weight polycaprolactones

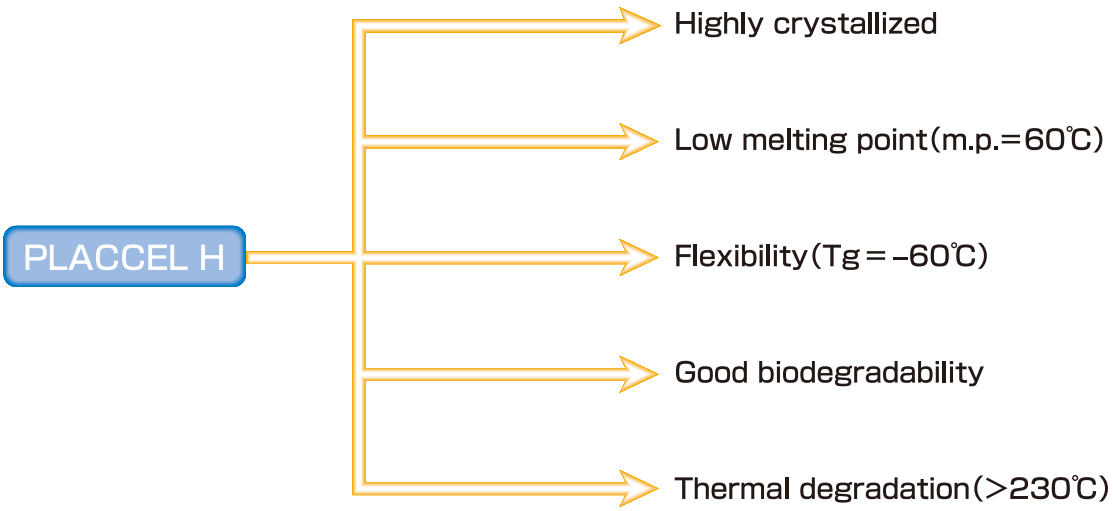
PLACCEL H1P is highly crystallized thermoplastic aliphatic polyester resin with a melting point of 60 °C.



Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Viscosity *1 (mPa·s/25 ℃)	Melting point (℃)	Tg (℃)
H1P	10000	Granular	25	12.3	0.18	N/A	770	60	-60

*1: 50% Solution of xylene was used for analysis.

Characteristics



Applications

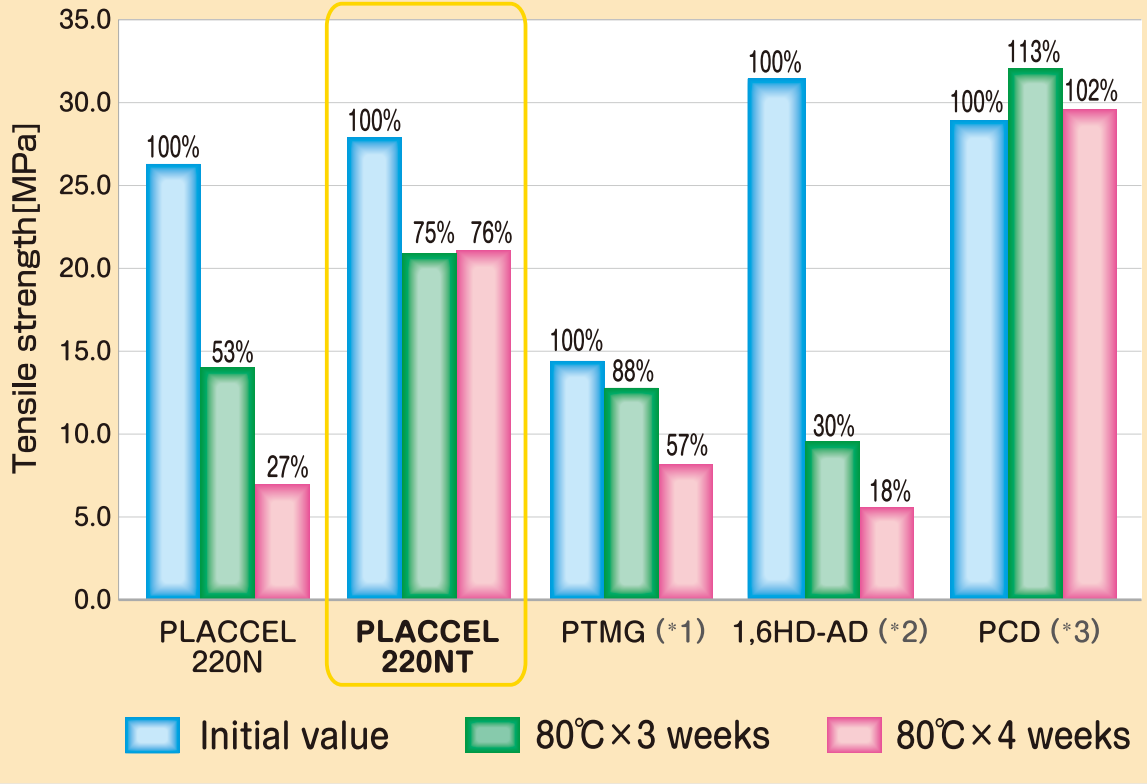
- Plastic materials moldable with hot air or hot water
- Medical materials
- Additives for plastics to improve its mechanical properties including impact resistance
- Binders for ceramics and for metal molding
- Biodegradable plastics
- Hot melt adhesives, thermal transfer printing inks
- Flowing agent for engineering plastics

13) Highly Hydrolysis Resistant series:(Development grade)

PLACCEL T-series are possible to synthesizing higher hydrolysis resistant products compared with standard grade of PLACCEL.

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Viscosity (mPa·s)
204HGT	400	Liquid	8	278.1	0.03	0.02	225/25℃
207HGT	750	Paste	8	149.6	0.02	0.01	461/25℃
210CPT	1000	Wax	13	112.7	0.02	0.01	141/60℃
220NT	2000	Wax	15	55.9	0.01	0.00	237/75℃
220BT	2000	Wax	10	55.4	0.03	0.00	440/60℃
330NT	3000	Wax	30	56.0	0.02	0.01	623/60℃

Hydrolysis resistance evaluation of TPU made from different polyols



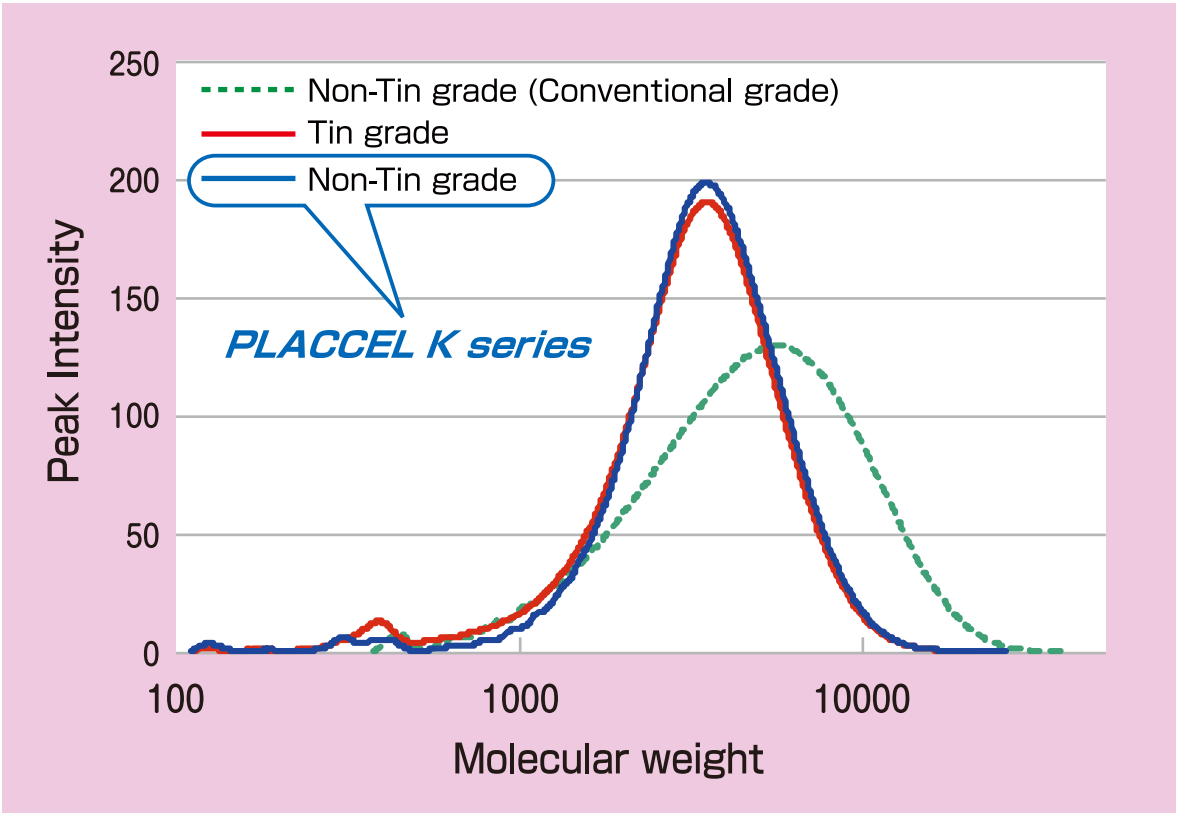
Composition : Polyol / BDO / MDI = 1.0 / 2.5 / 3.5, NCO / OH = 1.005
Method : Test pieces were soaked in water at 80℃ and tensile tests were conducted.
(*1) PTMG : Polytetramethylene glycol,
(*2) 1,6HD-AD : 1,6Hexanediol adipate,
(*3) PCD : Polycarbonate diol

14) Eco-Friendly series:(Development grade)

PLACCEL K-series are characterized by non-tin and narrow molecular weight distribution.

Product	Molecular weight	Appearance (r.t.)	Color (Pt-Co Units)	OH value (KOHmg/g)	Acid value (KOHmg/g)	Water (wt%)	Viscosity (mPa·s)
205UK	530	Liquid	19	213.5	0.13	0.02	286/25℃
220NK	2000	Wax	14	56.7	0.12	0.01	224/75℃
220CPK	2000	Wax	16	56.6	0.02	0.02	234/75℃
FA2K	344	Liquid	20	161.3	2.34	0.01	89/25℃

Molecular Weight Distribution of PLACCEL



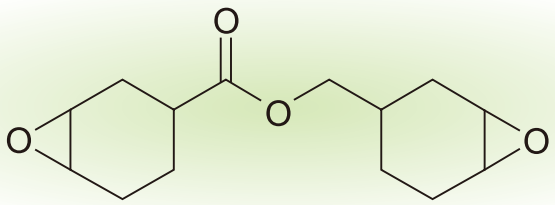
Cycloaliphatic Epoxides

Cycloaliphatic epoxides can be synthesized by the epoxidation reaction with peracetic acid. Compared to the epoxy resin of bisphenol A glycidyl ether type, cycloaliphatic epoxides have extremely low chlorine content and also characteristics of the cure reactivity and physical properties of the cured product in order to have no benzene ring and an internal epoxy group attached to alicyclic skeleton directly.

1) CELLOXIDE 2021P : Cycloaliphatic diepoxide

CELLOXIDE 2021P can be easily cured by heat with acid anhydrides or phenol type curing agents.

It is also possible to cure by heat or ultraviolet light when using a cationic catalyst. Since it has a high heat resistance, electrical insulation and excellent transparency, the cured product can be used in electrical insulating varnish, sealant applications and composite.



Product	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Acid value (KOHmg/g)	Water (wt%)	Viscosity (mPa·s/25 ℃)
CELLOXIDE 2021P	Liquid	10	130	0.08	0.006	240

Characteristics

- *Cured product having excellent properties*
  (heat resistance, weather resistance, transparency, electrical insulating, arc resistance, tracking resistance)
- *Very low maximum chlorine content*
- *Low-viscosity liquid at room temperature*

Applications

- *Composite materials (FRP, mica tape)*
- *Electrical insulating materials*
  (electrical insulating varnish, resin insulator, GIS)
- *Electronic materials (semiconductor sealing, LED sealing, underfill)*
- *Materials for cationic curing resin*
  (clear coating, ink, adhesive, stereolithography)
- *Stabilizer (acid scavenger for oil and synthetic resin insulation)*

2) CELLOXIDE 8010 : Cycloaliphatic diepoxide

CELLOXIDE 8010 is cycloaliphatic epoxy resin that improves the characteristics of CELLOXIDE 2021P. Tg of the acid anhydride cured product is 250 °C or more, and Tg of the thermal cationic cured product is 350 °C or more.
CELLOXIDE 8010 is a low viscosity liquid.
Curing speed of CELLOXIDE 8010 is fast and the cured product is excellent in hardness and transparency.

Product	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Acid value (KOHmg/g)	Water (wt%)	Viscosity (mPa·s/25 °C)
CELLOXIDE 8010	Liquid *1	5	100	0.04	0.005	64

*1 : It may be crystallized at low temperature.

Characteristics

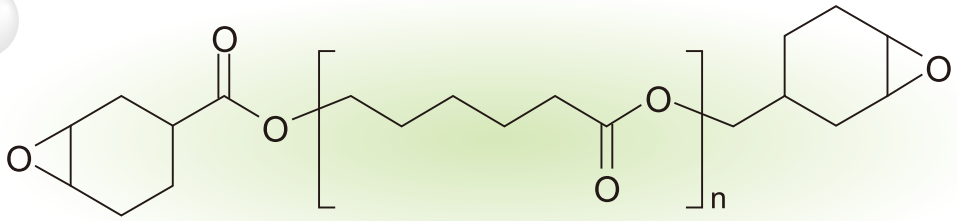
- *High Tg*
- *Fast-curing*
- *Excellent properties of cured products (heat resistance, transparency, high hardness)*
- *Very low maximum chlorine content*
- *Low-viscosity liquid at room temperature*

Applications

- *Composite materials (FRP)*
- *Electronic materials (semiconductor sealing, LED sealing, underfill)*
- *Materials for cationic curing resin (clear coating, ink, adhesive, stereolithography)*
- *Stabilizer (acid scavenger for oil and synthetic resin insulation)*

3) CELLOXIDE 2081 : Flexible cycloaliphatic diepoxide

CELLOXIDE 2081 is cycloaliphatic epoxy resin with excellent flexibility.
It can be used in applications such as electrical insulating varnish and semiconductor sealant cast which require flexibility. When it is blended into other epoxy resins, it is also possible to impart flexibility.



n = 1 (average)

Product	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Acid value (KOHmg/g)	Viscosity (mPa·s/45 ℃)
CELLOXIDE 2081	Liquid	30	200	0.25	96

Characteristics

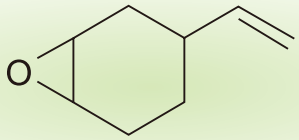
- *Possible to impart flexibility*
- *Cured product having excellent properties*
  (heat resistance, weather resistance, transparency, electrical insulating, arc resistance, tracking resistance)
- *Very low maximum chlorine content*
- *Low-viscosity liquid at room temperature*

Applications

- *Composite materials (FRP, mica tape)*
- *Electrical insulating materials*
  (electrical insulating varnish, resin insulator, GIS)
- *Electronic materials (semiconductor sealing, LED sealing, underfill)*
- *Materials for cationic curing resin*
  (clear coating, ink, adhesive, stereolithography)
- *Stabilizer (acid scavenger for oil and synthetic resin insulation)*

4) CELLOXIDE 2000 : Vinylcyclohexene monoepoxide

CELLOXIDE 2000 is a cycloaliphatic epoxy resin containing a vinyl group. This product has almost no difunctional epoxy (vinylcyclohexene diepoxide) which is highly toxic byproduct. For example, it is possible to synthesize derivatives containing a cycloaliphatic epoxy through the hydrosilylation with vinyl group.



Product	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Acid value (KOHmg/g)	Water (wt%)	Viscosity (mPa·s/25 ℃)
CELLOXIDE 2000	Liquid	5	126	0.02	0.008	2

Characteristics

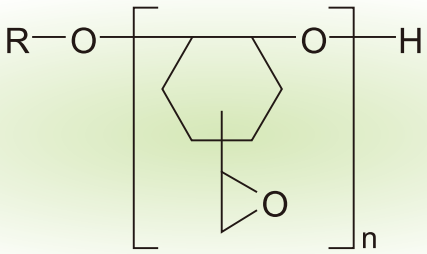
- *Vinyl group-containing*
- *Low-viscosity liquid at room temperature*
- *Very low maximum chlorine content*

Applications

- *Silane coupling agents*
- *Reactive diluent*
- *Stabilizer (acid scavenger for oil and synthetic resin insulation)*

5) EHPE 3150 : Multi-functional cycloaliphatic epoxy resins

EHPE3150 is multi-functional cycloaliphatic epoxy resin.
This resin is a solid epoxy resin having cyclohexane skeleton and terminal epoxy group.
In addition, there is also EHPE3150CE which is a liquid type diluted with cycloaliphatic epoxy.



Product	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Acid value (KOHmg/g)	Water (wt%)	Softening point (℃)	Viscosity (mPa·s/ 25 ℃)
EHPE 3150	Solid (flake)	20 *1	177	0.08	0.015	75	N/A
EHPE 3150CE	Liquid	55	150	0.08	0.026	N/A	44400

*1:25% Solution of acetone was used for analysis.

Characteristics

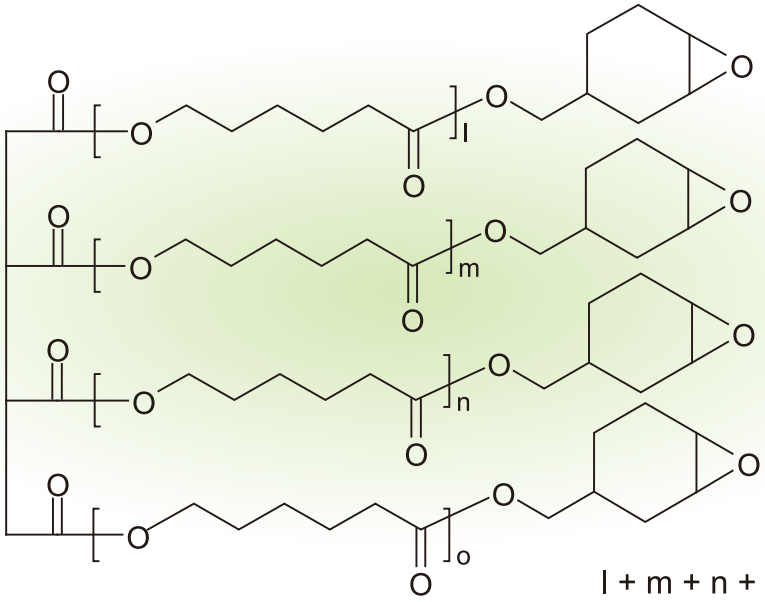
- *Cured product having excellent properties*
  (heat resistance, weather resistance, transparency, electrical insulating, arc resistance, tracking resistance)
- *Very low maximum chlorine content*

Applications

- *Composite materials (FRP)*
- *Electrical insulating materials*
  (electrical insulating varnish, resin insulator, GIS)
- *Electronic materials*
  (semiconductor sealing, LED sealing, underfill, printed wired board)
- *Optoelectronics*
- *Optical components (MEMS)*
- *Curing agent for powder coatings (automotive paint), etc.*
- *Sizing agent of fiber*

6) EPOLEAD GT401 : Tetra-functional cycloaliphatic epoxide

EPOLEAD GT401 is a tetra-functional cycloaliphatic epoxide.
EPOLEAD GT401 is liquid and has high curing rate.
The cured product has excellent toughness, flexibility and high Tg
because EPOLEAD GT401 has four epoxy groups and flexible structure.



l + m + n + o = 1 (average)

Product	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Acid value (KOHmg/g)	Viscosity (mPa·s/70 ℃)
EPOLEAD GT401	Liquid	60	220	0.27	2280

Characteristics

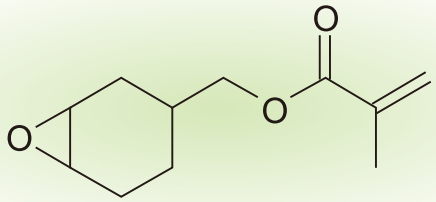
- *Excellent properties of cured products*
  (flexibility heat resistance, weather resistance, transparency)
- *Possible to impart toughness*
- *High reactivity*
- *Very low maximum chlorine content*

Applications

- *Composite materials (FRP)*
- *Electrical insulating materials*
  (electrical insulating varnish, resin insulator, GIS)
- *Electronic materials (semiconductor sealing, LED sealing, underfill)*
- *Materials for cationic curing resin*
  (clear coating, ink, adhesive, stereolithography)
- *Stabilizer (acid scavenger for oil and synthetic resin insulation)*

1) CYCLOMER M100 : Methacrylate containing cycloaliphatic epoxy group

CYCLOMER M100 is methacrylate compound including the cycloaliphatic epoxy group. Compared with glycidyl methacrylate(GMA), CYCLOMER M100 is hard to gel when it is copolymerized with (meth)acrylic acid. It has also good cationic reactivity. The methacrylate group of CYCLOMER M100 can deploy the cycloaliphatic epoxide group in the side chain of polymers by radical copolymerization with a radical polymerizable vinyl monomer such as styrene, methacrylate and ethylene. By the reaction of the cycloaliphatic epoxy group with various functional groups including an active hydrogen, the methacrylate group can be introduced into the monomer or copolymer. The stability of the cycloaliphatic epoxy group of CYCLOMER M100 is high in water. Therefore, it is suitable for the introduction of epoxy groups to the aqueous resin.



Product	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Water (wt%)	Viscosity (mPa·s/25 ℃)	MEHQ (ppm)
CYCLOMER M100	Liquid	40	205	0.025	9	400

Characteristics

- *High stability(stability in water, polymerization stability, mechanical stability)*
- *Very low maximum chlorine content*
- *Low-viscosity liquid at room temperature*

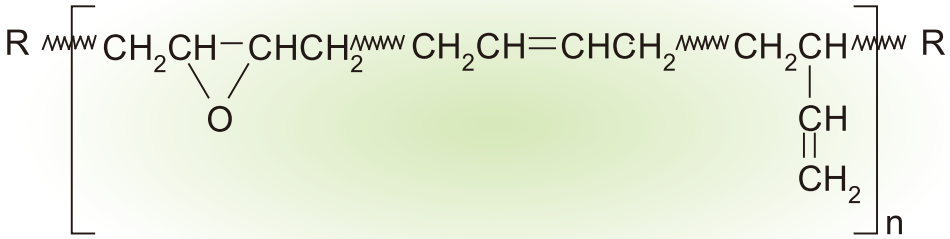
Applications

- *Photo resist resin raw materials*
- *Composite materials (FRP)*
- *Modifier for resins (plastics)*
- *Electrical insulating materials*
  (electrical insulating varnish, resin insulator, GIS)
- *Electronic materials (semiconductor sealing, LED sealing, underfill)*
- *Materials for cationic curing resin*
  (clear coating, ink, adhesive, stereolithography)

2) EPOLEAD PB series : Epoxidized polybutadienes

EPOLEAD PB series is epoxidized polybutadiene which gives a coating film having a rubber elasticity by using various curing agents such as phenol resin, acid anhydrides, polyamines and cationic catalyst. EPOLEAD PB series, which has a lower epoxy equivalent than conventional epoxidized polybutadienes, is characterized by being excellent in compatibility with bisphenol A glycidyl ether type and cresol novolac type epoxy resins and it can impart to the coated rubber elasticity.

EPOLEAD PB3600, which has a hydroxyl group at the terminal and also has a hydroxyl group in the molecule, is characterized by having high polarity and a relatively high viscosity. EPOLEAD PB4700 is characterized by having a lower viscosity and a lower epoxy equivalent than EPOLEAD PB3600.



Product	R	*Mn*	Appearance (r.t.)	Color (Pt-Co Units)	Epoxy equivalent (g/eq)	Acid value (KOHmg/g)	Water (wt%)	Viscosity (mPa·s/45 ℃)
EPOLEAD PB3600	OH	5400	Liquid	30	193	0.06	0.008	29000
EPOLEAD PB4700	H	3100	Liquid	15	165	0.07	0.018	6300

Characteristics

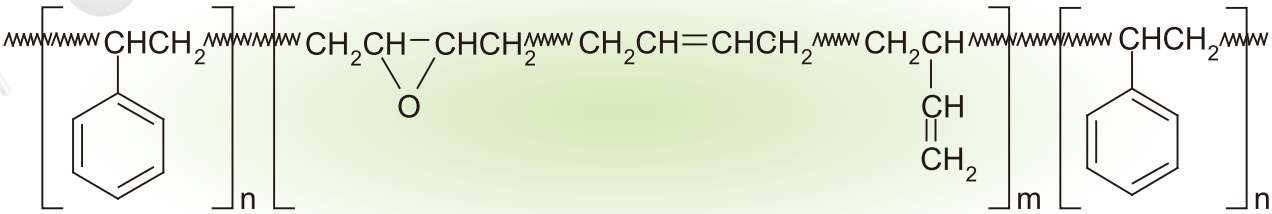
- *Excellent properties of cured products (rubber elasticity, transparency, shock resistance, flex resistance)*
- *Excellent in compatibility with epoxy resins*
- *Low epoxy equivalent (Compared to conventional products)*

Applications

- *Materials for cationic curing resin (clear coating, ink, adhesive, stereolithography)*
- *Can coating (phenol resin curing)*
- *Cation electrodeposition paint, water-based paint (amine curing)*
- *Semiconductor sealing material (acid anhydride curing)*
- *Printed circuit board material*

3)EPOFRIEND series : Epoxidized thermoplastic elastomers

EPOFRIEND are thermoplastic elastomers with epoxy groups in the polymer chain. Epoxy groups of EPOFRIEND are as much reactive as those of other epoxy resins with epoxy hardeners such as amines, acid anhydrides, and so on.
Reactivity with the cationic catalyst of EPOFRIEND is also high.



Product	Appearance (r.t.)	Epoxy equivalent (g/eq)	Hardness (JIS A) *1	MFR (g/10min) *2	Specific gravity *3	Polystyrene unit (wt%)	Tensile Properties *1		
							300% strength (MPa)	Strength at break (MPa)	Elongation at break (%)
EPOFRIEND AT501	Pellet	1055	76	7	0.968	40	3.7	27	830
EPOFRIEND CT310	Pellet	2125	80	5	0.96	40	4.4	29	770

*1: JIS K 6301 *2:ASTM D1238, 190℃, 2.16kg *3:ASTM D297

Characteristics

- *Rubber-like elasticity with thermoplasticity*
- *Compatibility with a variety of resins and plastics*
- *Cross-linking reactivity that comes from epoxy groups*
- *Excellent bonding to a diversity of materials*

Applications

Resin modifier

- ·Modifier of processing and impact resistance — Polyester / Ionomer
- ·Compatibilizer agent — Polyester / Polycarbonate alloy; Polyester / Polyolefin alloy; Styrene resin / Polycarbonate alloy; Polyolefin / Acrylic resin alloy
- ·Modifier of processing and impact resistance — Polyolefin
- ·Compatibilizer agent — Thermoplastic elastomers

Adhesives and coating

- ·Alternative rubber-based adhesive, hot melt adhesive
- ·Improved toughness of epoxy adhesive
- ·Improve the flexibility of epoxy coatings

Conclusion

As indicated on our introduction, this catalog presents you with the peracetic acid derivatives that our company manufactures.

We understand the demand for some unique applications other than the ones stated.

In this case, please feel free to contact us so that we can assist you with them.

It should be noted that properties and physical property values shown in this technical data are representative values and are not guaranteed values.

In addition, please refer to our SDS (safety data sheet) for information on the handling of each product.

Moreover, the written content of this catalog is created based on the information and data which can be presently obtained, and may be revised with new information at any given time.

DAICEL CORPORATION

Organic Chemical Products Company, Performance Products Marketing Group

TOKYO OFFICE
JR SHINAGAWA EAST BLDG.,
2-18-1 KONAN, MINATO-KU, TOKYO, 108-8230, JAPAN
TEL : +81-(0)3-6711-8211
FAX : +81-(0)3-6711-8218

OSAKA OFFICE
GRAND FRONT OSAKA TOWER-B,
3-1 OFUKA-CHO, KITA-KU, OSAKA, 530-0011, JAPAN
TEL : +81-(0)6-7639-7201
FAX : +81-(0)6-7639-7208

URL http://www.daicel.com/yuuki/

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