Showa Denko America Inc
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Karenz MT™ PE1

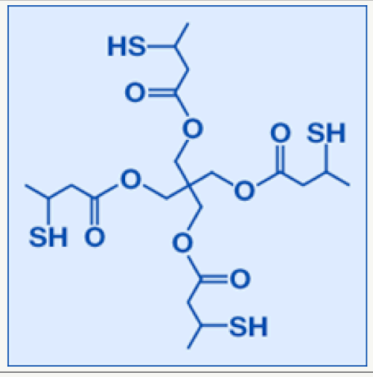
Overview

To increase the speed of UV-curing resins, the amount of polymerization initiators is increased. In the case of epoxy resins, the temperature is increased. However, when multifunctional-Thiol*-based Karenz MT™ PE1 is used, curing speeds are substantially improved. Karenz improves adhesiveness and elongation, as well as reduces the amount of energy used for production and processing.

The use of Karenz MT™ PE1 in UV-curing resins helps reduce the amount of UV irradiation and polymerization initiators, which restrict the coloring of the product. In the case of epoxy resins, it is possible to cure at low temperatures and increase the curing rate compared with the use of conventional amine-based curing agents*. Furthermore, compared with conventional Thiol-based curing agents, Karenz MT™ PE1 has lower levels of odor.

UV-curing resins: A photo-curing resin that changes its properties following irradiation of ultraviolet rays. It is used as a coating material and as photoresist in the production of electronic circuits.
Multifunctional-thiol: Compounds whose molecule contains two or more groups of hydrogenated sulfur (-SH).
Amine-based curing agents: Curing agents whose molecule contains amino groups (-NH2), reacting with epoxy resins at room temperature for curing.

Properties

Product name	Karenz MT™ PE1
Structure	
Chemical Name	Pentaerythritol tetrakis (3-mercaptobutylate)
CAS No.	31775-89-0
M.W.	544.8
Appearance	colorless or yellow liquid
Density	1.19 (30°C)
Refractive Index	1.523
Viscosity	1200mPa·s (24°C)
Flash Point	with no flammability

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HANDLING AND STORAGE

Please read our MSDS before using Karenz MT™

Handling

Take measures against static electricity and wear conductive clothes and shoes. Handle the product where adequate local exhaust ventilation is provided. Wear protective glasses, gloves and mask. Wash hands with water after handling.

Storage

Store the product in a dry, cool, and dark place. Do not allow high temperature objects, sparks or flame in the vicinity of the product. Use a closed container.

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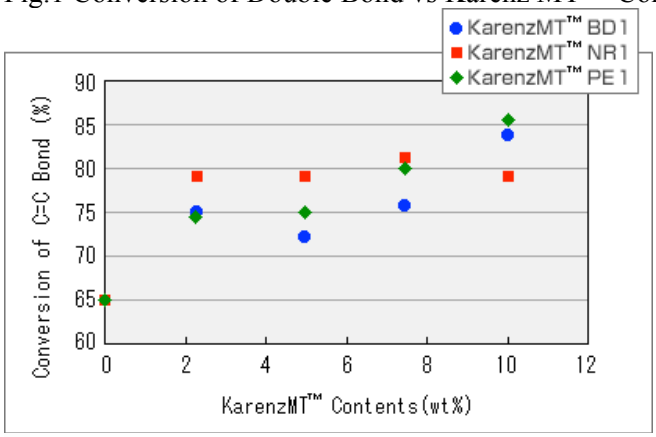
Karenz UV Agent

Curing

Curing（1）

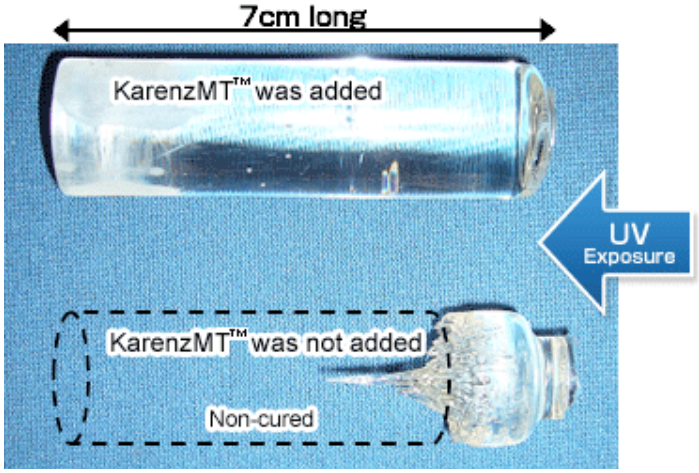
We observed an increase in C=C double bonds correlating to the increase in Karenz added.

Fig.1 Conversion of Double Bond vs Karenz MT™ Contents



Monomer	BPDA (bisphenol A type diacrylate)
Karenz MT™	BD1、NR1、PE1
Initiator	IRGACURE™ 184 2wt%
Exposure Dose	800mJ/cm2

Curing（2）



Monomer	BPDA
Karenz MT™	PE1 2wt%
Initiator	IRGACURE™ 184 2wt%

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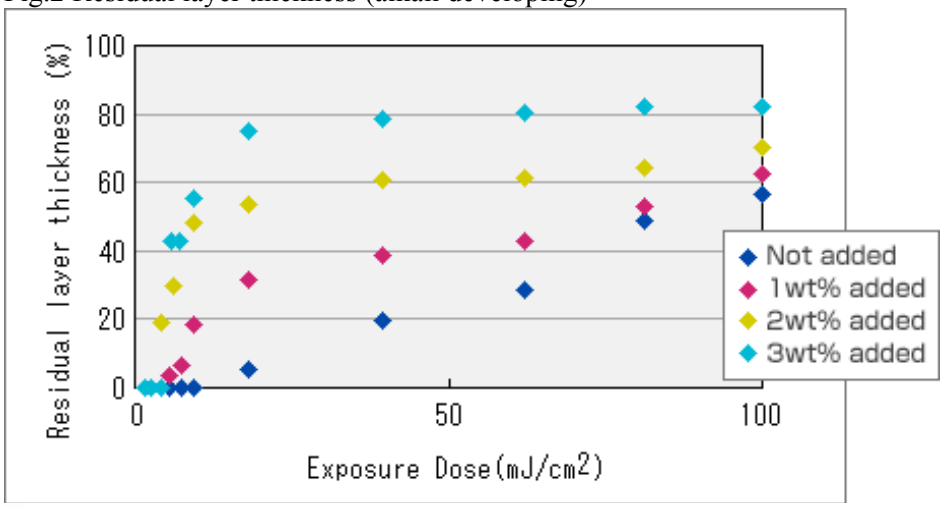
Curing（3）

Using Karenz MT™ improved layer development.

Fig.2 Residual layer thickness (alkali developing)

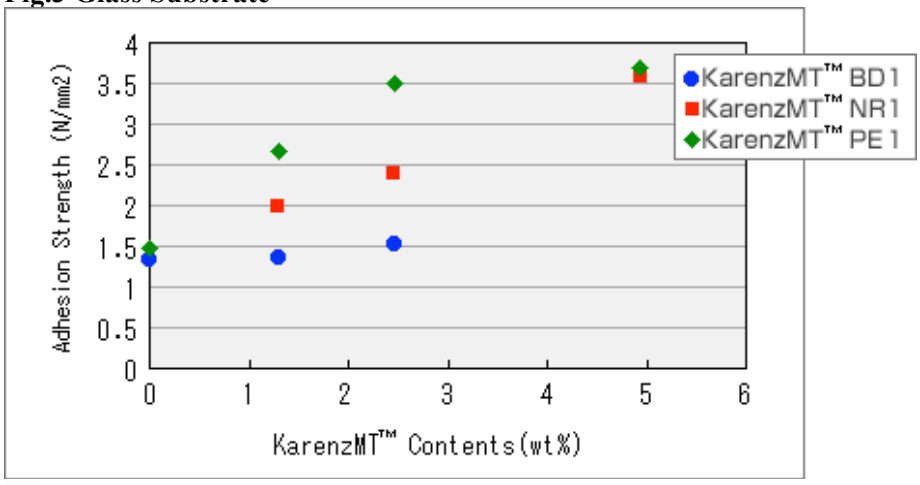


Monomer	(Green pigment and acrylic polymer) dispersion･epoxyacrylate
Karenz MT™	PE1

Adhesion

Adding Karenz MT™ improved adhesion strength.

Fig.3 Glass Substrate



Monomer	BPDA
Karenz MT™	BD1, NR1, PE1
Initiator	IRGACURE™ 184 2wt%
Exposure Dose	500mJ/cm2

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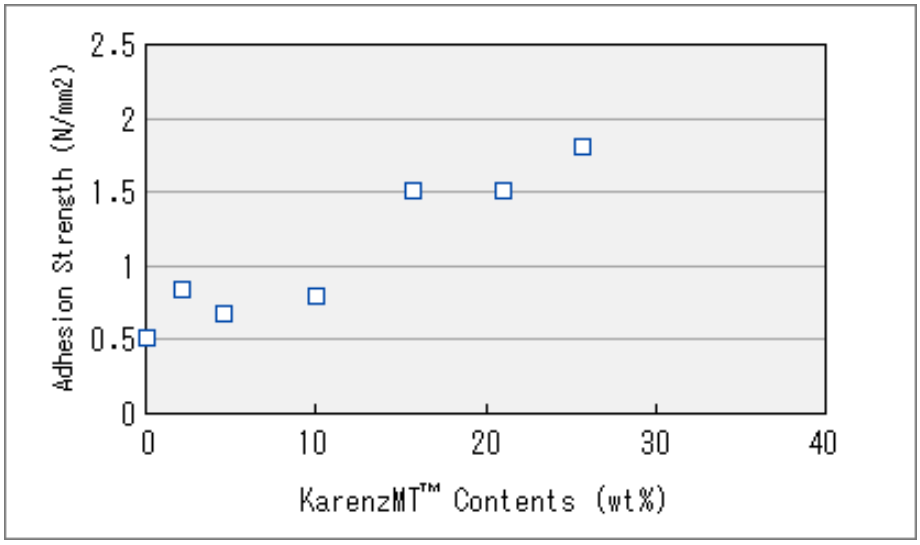
Fig.4 Plastic Substrate (polyethylene terephthalate)

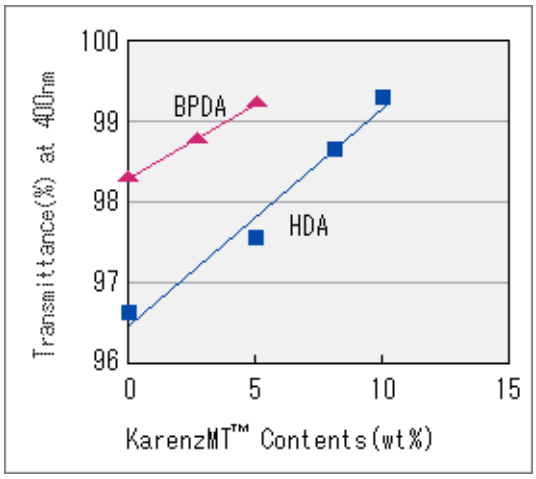


Monomer	BPDA
Karenz MT™	PE1
Initiator	IRGACURE™ 184 2wt%
Exposure Dose	500mJ/cm2

Transparency

As Karenz MT™ quantity increased, transparency increased.

Fig.5 Influence of Karenz MTR Contents on Transparency



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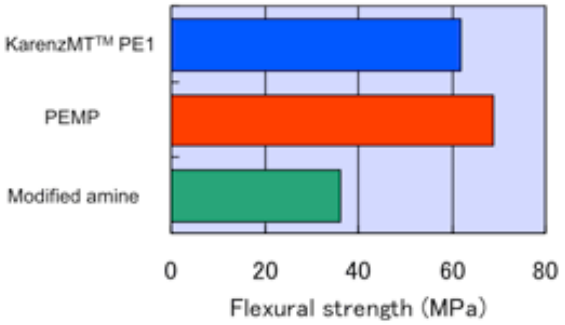
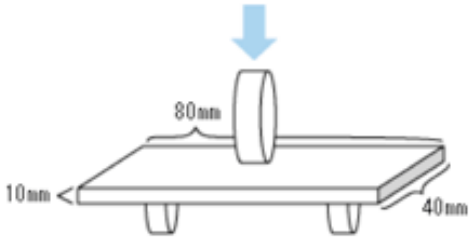
Monomer	BPDA, HDA(hexanediacrylate)
Karenz MT™	BD1
Initiator	IRGACURE™ 184 2wt%
Exposure Dose	500mJ/cm2
Film Thickness	100μm

Shelf-life

Karenz MT™ was stable for over 2 weeks at 40℃.





Monomer	DPHA (dipentaerythritolhexaacrylate)
Karenz MT™	BD1、NR1、PE1 2wt%
Comparative Thiol	PEMP
Temperature	40°C

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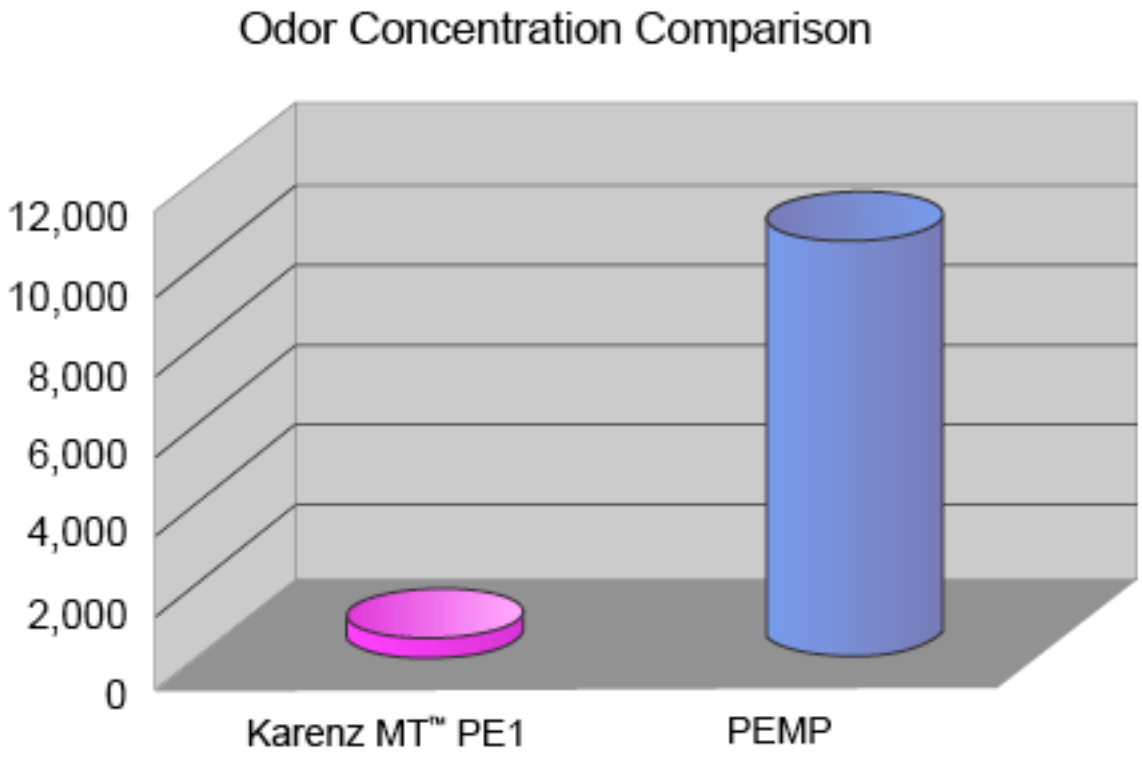
Odor



Measurement: Examined by FF-2A (SHIMADZU CORPORATION)
Odor Concentration: The lowest dilution multiple, odor cannot be sensed.

Karenz MT™ PE1, Tetra-functional Primary Thiol (PEMP), and degenerated amine were compared as epoxy curing agents.

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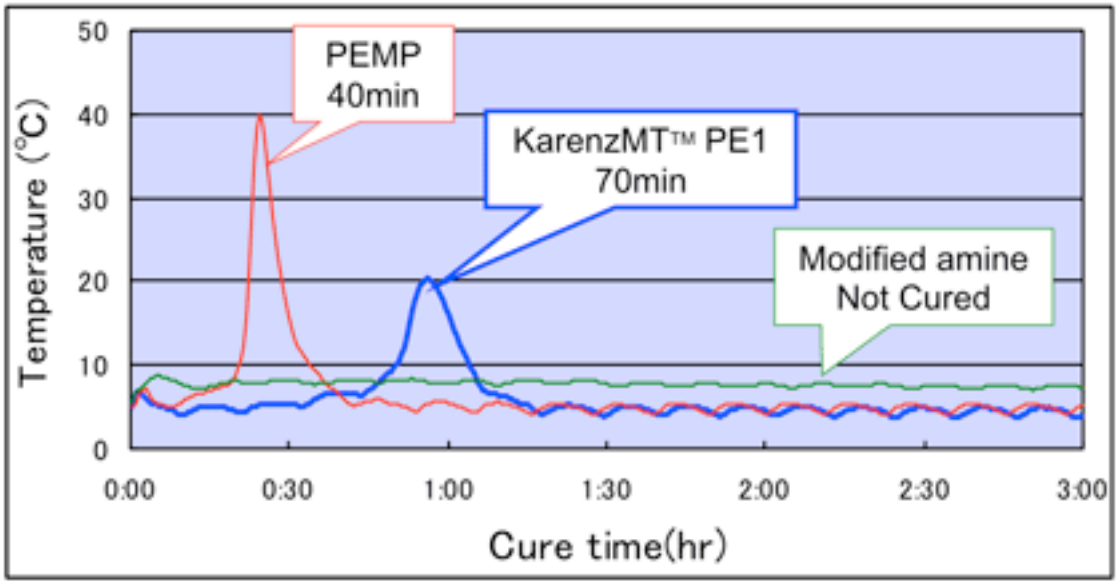
Advantages for Epoxy Curing Agent

Curing

Curing Speed at Low Temperature (5℃)



Epoxy blended with Karenz MT™ PE1 cured at 5℃, and its hardness was same at 25℃.

Curing Temperature (°C)	Curing Time(hour)	Hardness(Shore D)
Room Temperature	24	75
5°C	24	78

Room Temperature	Bisphenol A based type
C.A.	Karenz MT™ PE1
	Primary Thiol (PEMP)
	Degenerated amine
Accelerator	TAP (2,4,6-tris (dimethylamino) -phenol)
Composition	Epoxy / Thiol / TAP = 100 / 70 / 10
	Epoxy / D-amine = 100 / 80

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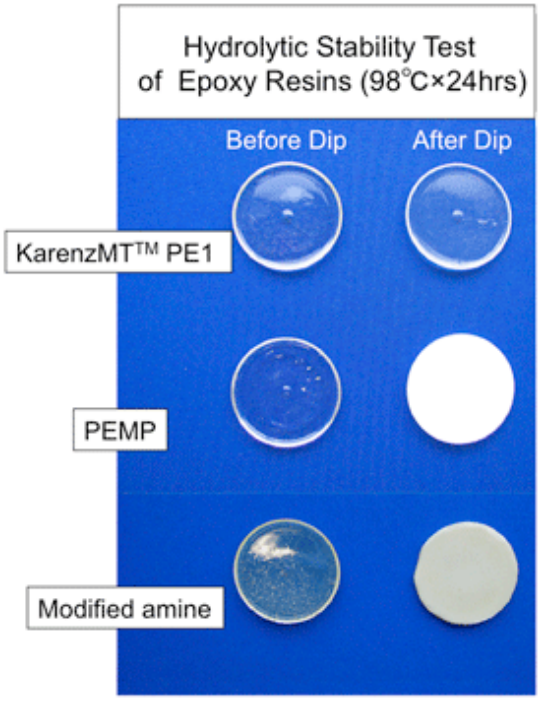
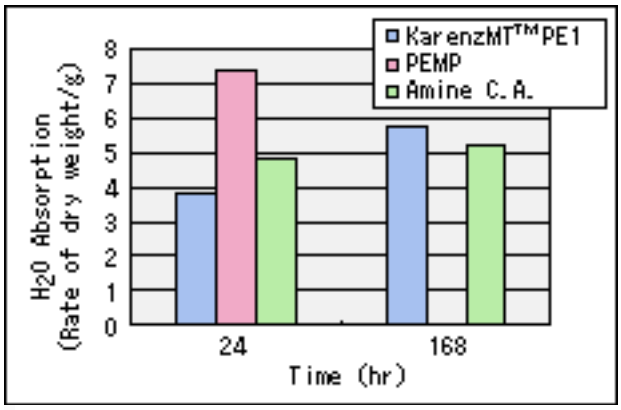
Hydrolytic Stability



According to our test results, Karenz MT™ PE1 had good Hydrolytic stability. Karenz MT™ PE1 resin was stable after dipping it in hot water, while the primary Thiol resin and degenerated amine resin lost transparency.



Test Method	JIS K7114
Epoxy Resin	Phenol nobolac type
C.A.	Karenz MT™ PE1
	Primary Thiol (PEMP)
	Degenerated amine
Accelerator	
Composition	Epoxy / Thiol / DMBA = 100 / 70 /3.5
	Epoxy / D-amine = 100 / 80

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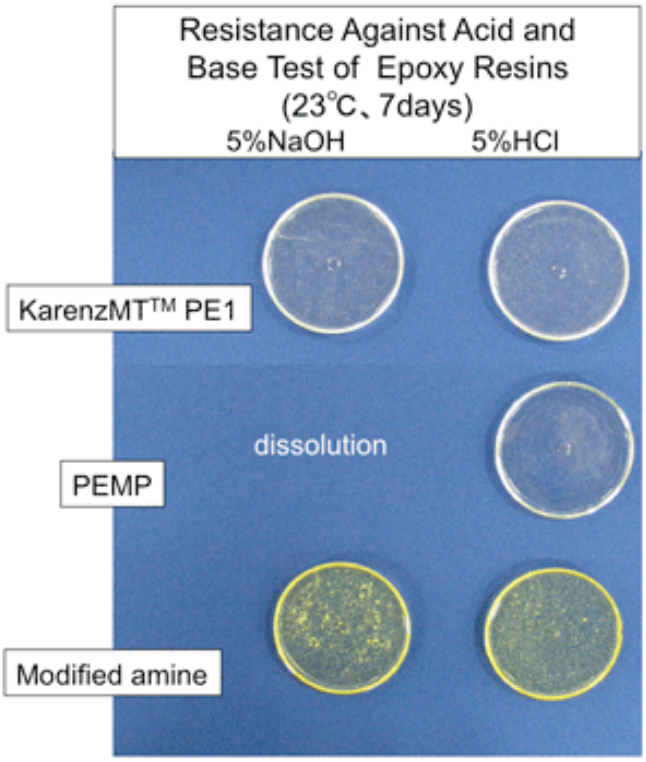
Resistance Against Acids and Bases



Karenz MT™ PE1 resin showed good resistance against acids and bases.

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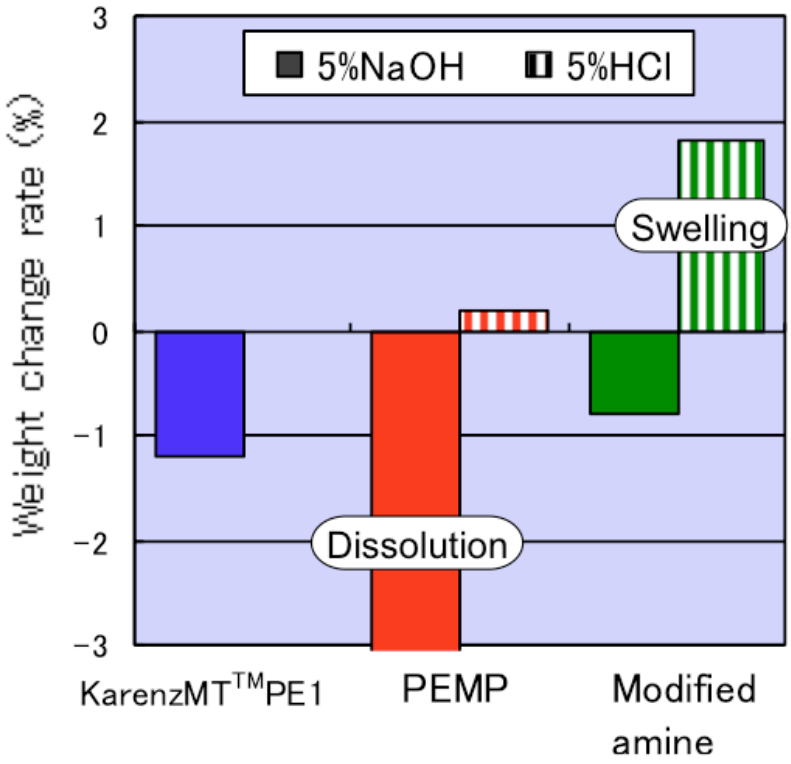
Test Method	JIS K7114
Epoxy Resin	Bisphenol A based type
C.A.	Karenz MT™ PE1
	Primary Thiol (PEMP)
	Degenerated amine
Accelerator	TAP
Composition	Epoxy / Thiol / TAP = 100 / 70 /10
	Epoxy / D-amine = 100 / 80



Weather Resistance

Sunshine Weather Meter Test
Karenz MT™ PE1 resin didn't become yellow after our weather meter test.

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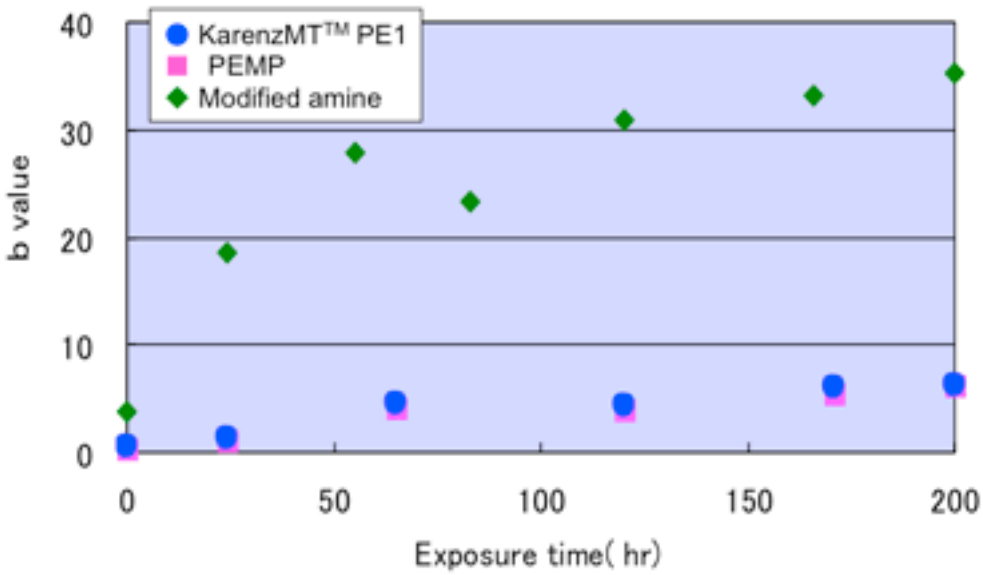
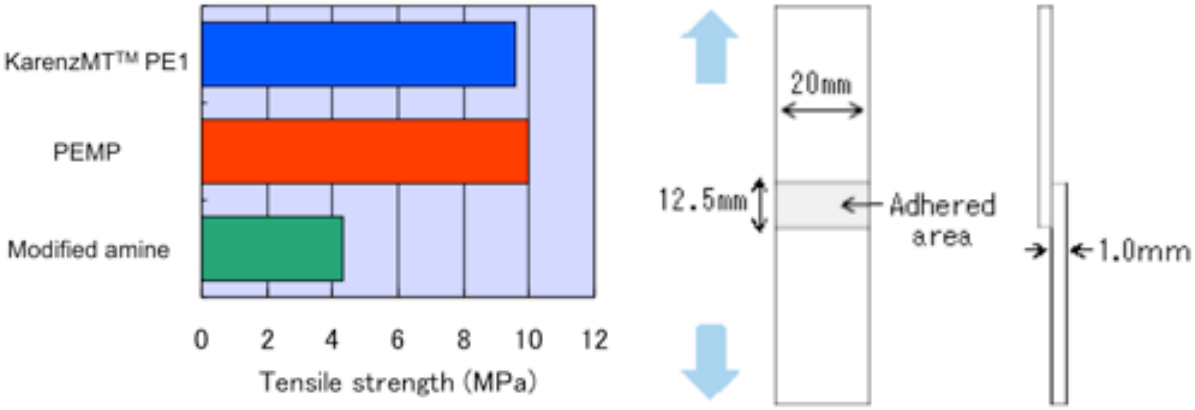


Epoxy Resin	Bisphenol A based type
C.A.	Karenz MT™ PE1
	Primary Thiol (PEMP)
	Degenerated amine
Composition	Epoxy / Thiol / TAP = 100 / 70
	Epoxy / D-amine = 100 / 80
Curing Method	Thermal cure without accelerator
Exposure Condition	Illumination : 255W/m2
	Temperature 63°C
	Rainfall : 18min./200min.

Adhesion

Karenz MT™ PE1 resin showed good resistance against acids and bases.



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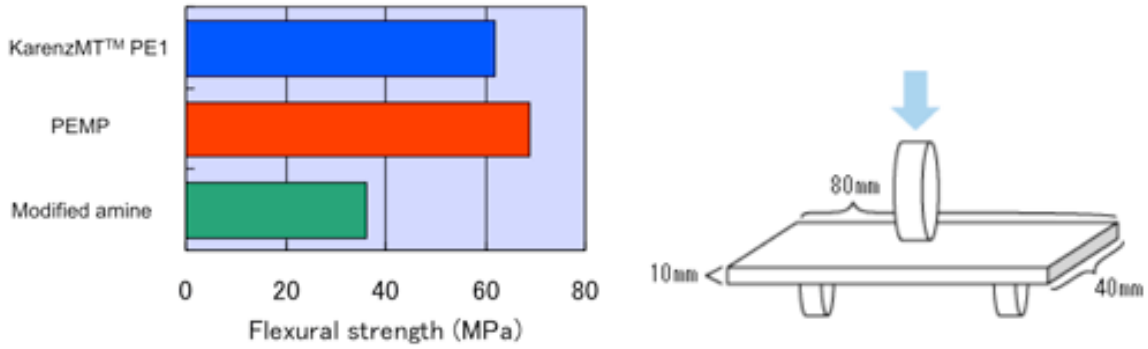
Test Method	JIS K6850
Epoxy Resin	Bisphenol A based type
C.A.	Karenz MT™ PE1
	Primary Thiol (PEMP)
	Degenerated amine
Accelerator	TAP
Composition	Epoxy / Thiol / TAP = 100 / 70 /10
	Epoxy / D-amine = 100 / 80

Flexibility

Flexure Test
Karenz MT™ resin showed good flexibility and toughness compared to degenerated amine resin.



Test Method	JIS K6481
Epoxy Resin	Bisphenol A based type
C.A.	Karenz MT™ PE1
	Primary Thiol (PEMP)
	Degenerated amine
Accelerator	TAP
Composition	Epoxy / Thiol / TAP = 100 / 70 /10
	Epoxy / D-amine = 100 / 80

* The information contained herein is based upon data considered, and is true and accurate. However, SHOWA DENKO K.K. accepts no responsibility or risk which may result from the handling and use of products or for infringement of any patent.

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