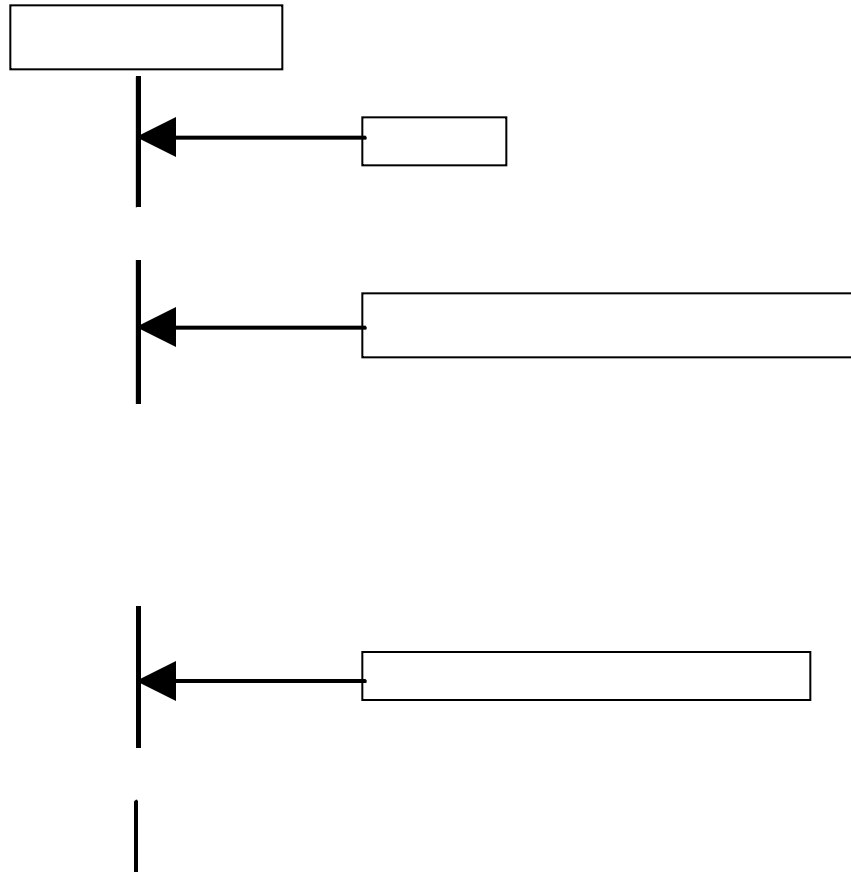


AJICURE

PRODUCT	Structure type	Particle size	Melting point (°C) (softening point)	Recommended usage *		Special feature
		av. (micron)		as hardener	as accelerator	
PN-23	Amine adduct	10-12	100-105	15-25	1-5	Low temp. rapid cure. Accelerator for DICY.
PN-H	Amine adduct	11-13	120-125	15-25	1-5	Modified PN-23 for longer pot life.
PN-31	Amine adduct	10-12	115-120	15-25	1-5	Modified PN-23 for longer pot life.
PN-40	Amine adduct	10-12	105-110	15-25	1-5	Modified PN-23 for longer pot life.
PN-23J	Amine adduct	2-4	100-105	15-25	1-5	Micropulverized PN-23. Faster cure.
PN-31J	Amine adduct	2-4	115-120	15-25	1-5	Micropulverized PN-31. Faster cure.
PN-40J	Amine adduct	2-4	105-110	15-25	1-5	Good transparency and gloss.
MY-24	Amine adduct	8-10	115-120	15-25	1-5	Good adhesion. Accelerator for acidanhydride
MY-H	Amine adduct	8-10	125-130	15-25	1-5	Modified MY-24 for longer pot life.
MY-HK	Amine adduct	2-4	125-130	15-25	1-5	Micropulverized MY-H
AH-203	Amine adduct	10-12	115-120	15-25	1-5	Modified MY-24. Faster cure.
AH-300	complex	-15	100-115	15-25	1-5	Modified PN-23. Lower price type of PN-23.
AH-154	DICY complex	-15	200-210	9	-	Accelerated DICY.
AH-162	DICY complex	-15	200-210	11	-	Accelerated DICY. Long pot life.
VDH	Diylidrazide	100mesh pass >98%	120	41	-	Colorless transparent cured product Can be used as a crosslinking agent for acylic
VDH-J	Diylidrazide	2-4	120	41	-	Micropulverized VDH

* Recommended usage : with a liquid epoxy resin having an epoxy equivalent weight of 190

Recommended method to disperse AJICURE



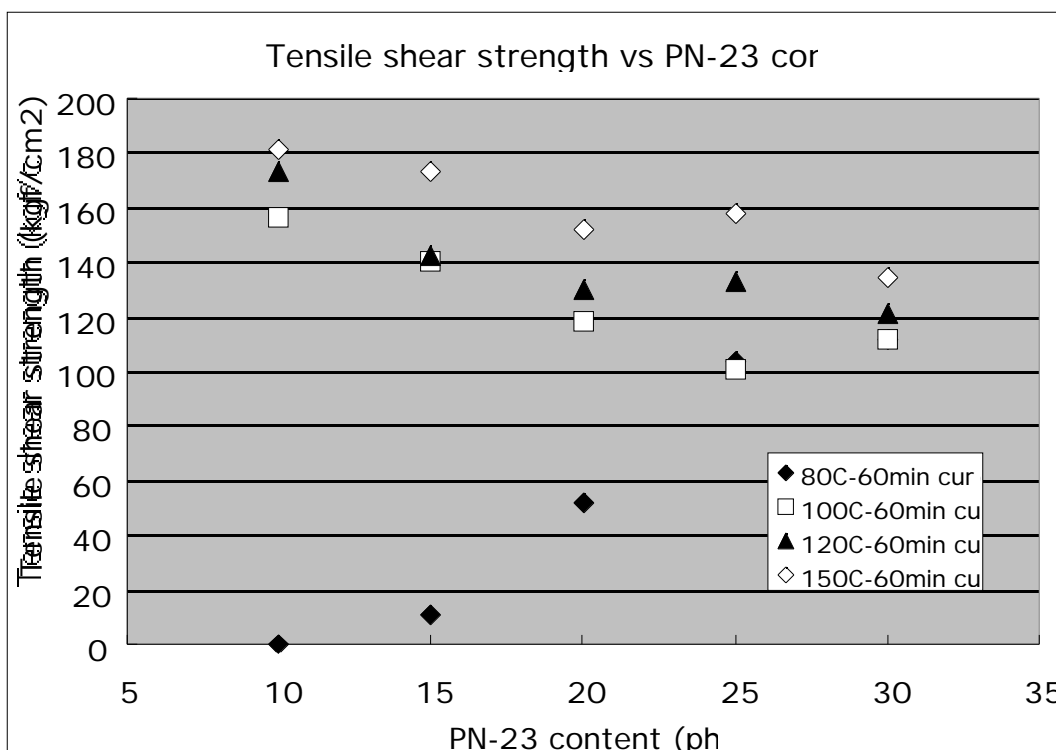
AJICURE PN-23 : Shear strength

Formulation

Bisphenol A epoxy(eew 190) : 100
 AJICURE PN-23 : 10-30
 Fumed silica (Aerosil 200) : 1 (parts)

Table 1. Typical properties of AJICURE PN-23 formulations

AJICURE PN-23 (phr)		10phr	15phr	20phr	25phr	30phr
Gel Time (min)	80°C	27.7	18.8	16.5	13.2	10.1
	100°C	6.1	4.8	4.3	4.2	3.7
	120°C	3.0	2.7	2.4	2.2	2.0
	150°C	2.0	1.7	1.6	1.4	1.4
Tg (°C)	120°C-30min cure	58	134	-	126	-
	120°C-60min cure	79	138	-	129	-
	150°C-30min cure	59	121	-	115	-
Shear strength (kgf/cm ²)	80°C-60min cure	not cure	11	52	104	112
	100°C-60min cure	156	140	118	101	112
	120°C-60min cure	173	142	130	133	121
	150°C-60min cure	181	173	152	158	134
	180°C-60min cure	181	171	152	150	134



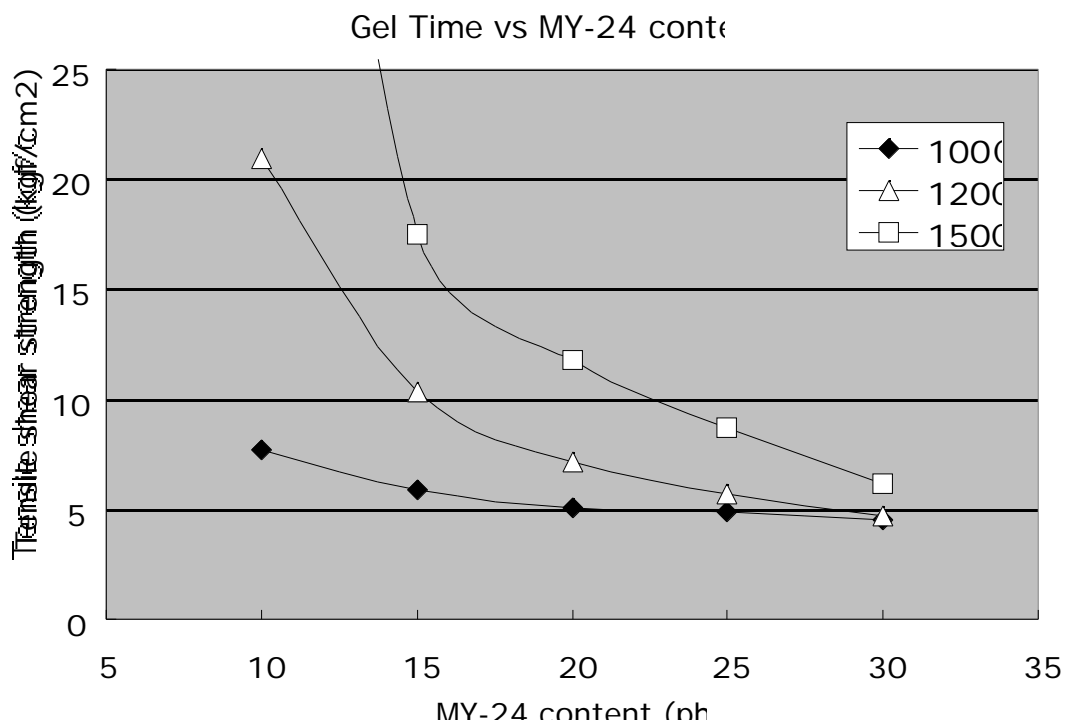
AJICURE MY-24 : Reactivity

Formulation

Bisphenol A epoxy(eew 190) : 100
 AJICURE MY-24 : 10-30
 Fumed silica (Aerosil 200) : 1 (parts)

Table 1. Typical properties of AJICURE MY-24 formulations

AJICURE MY-24 (phr)		10phr	15phr	20phr	25phr	30phr
Gel Time (min)	80°C	>60	>60	>60	>60	>60
	100°C	7.7	5.9	5.1	4.9	4.5
	120°C	20.9	10.3	7.2	5.7	4.7
	150°C	>30	17.5	11.8	8.7	6.2
Tg (°C)	100°C-30min cure	-	-	70	-	-
	100°C-60min cure	-	-	90	-	-
	120°C-30min cure	-	-	85	-	-
	120°C-60min cure	-	-	100	-	-
Shear strength (kgf/cm ²)	100°C-60min cure	57	156	193	229	236
	120°C-60min cure	226	233	229	243	229
	150°C-60min cure	230	287	284	268	247
	180°C-60min cure	223	261	269	258	264



AJICURE MY-24 : Shear strength

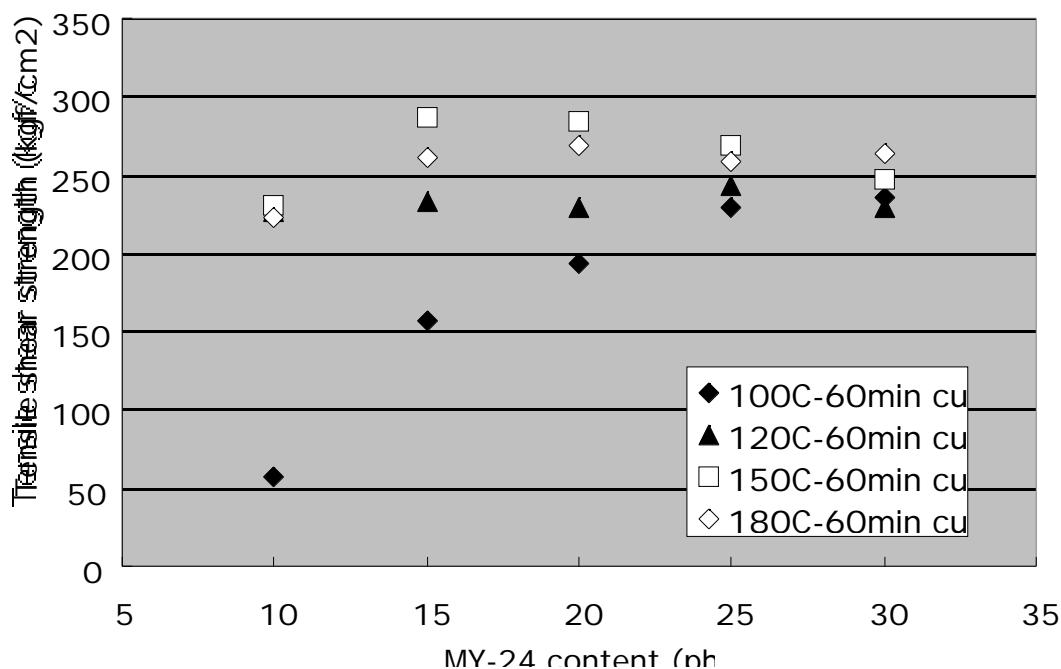
Formulation

Bisphenol A epoxy(eew 190) : 100
 AJICURE MY-24 : 10-30
 Fumed silica (Aerosil 200) : 1 (parts)

Table 1. Typical properties of AJICURE MY-24 formulations

AJICURE MY-24 (phr)		10phr	15phr	20phr	25phr	30phr
Gel Time (min)	80°C	>60	>60	>60	>60	>60
	100°C	7.7	5.9	5.1	4.9	4.5
	120°C	20.9	10.3	7.2	5.7	4.7
	150°C	>30	17.5	11.8	8.7	6.2
Tg (°C)	100°C-30min cure	-	-	70	-	-
	100°C-60min cure	-	-	90	-	-
	120°C-30min cure	-	-	85	-	-
	120°C-60min cure	-	-	100	-	-
Shear strength (kgf/cm ²)	100°C-60min cure	57	156	193	229	236
	120°C-60min cure	226	233	229	243	229
	150°C-60min cure	230	287	284	268	247
	180°C-60min cure	223	261	269	258	264

Tensile shear strength vs MY-24 co

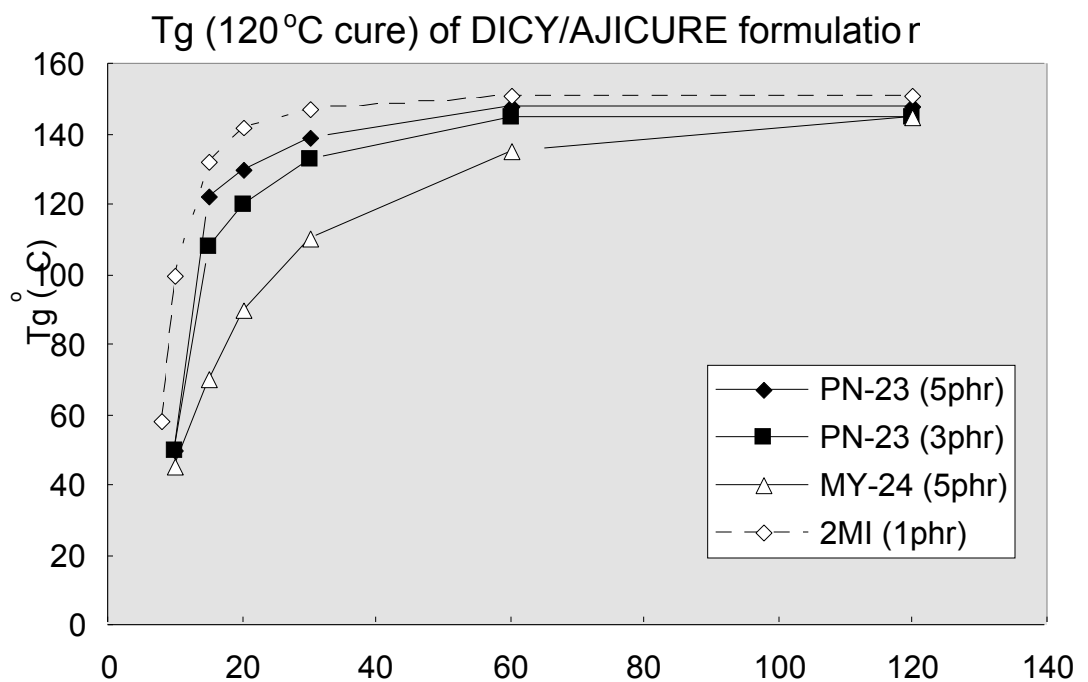
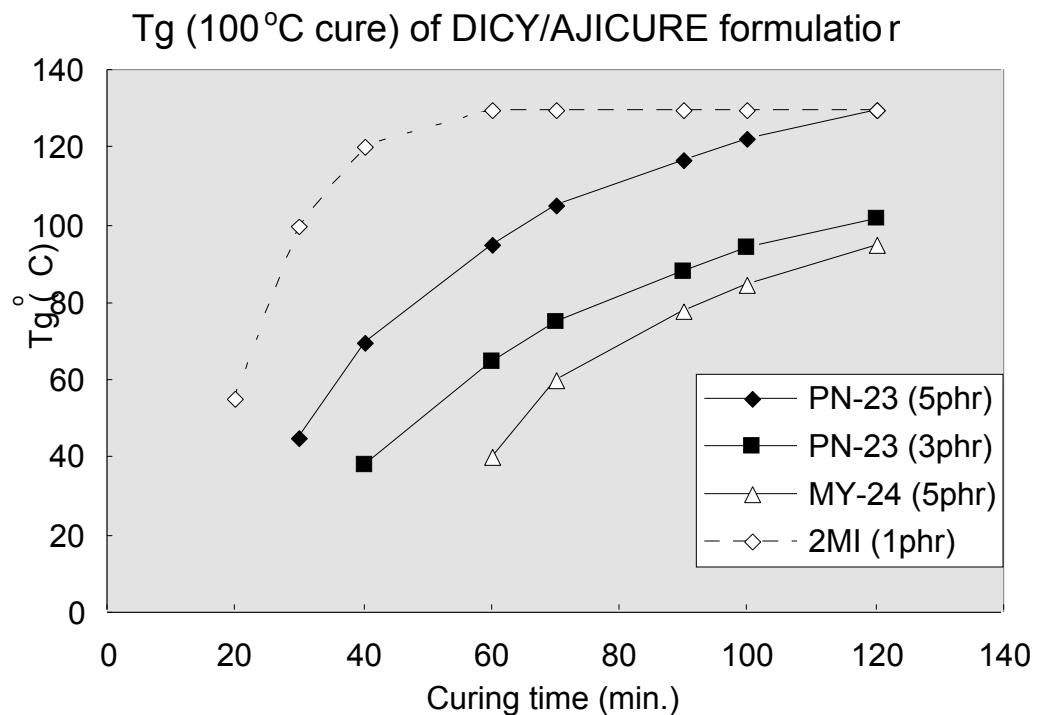


Tg of DICY/AJICURE formulation

Formulation

Epoxy resin 100 (Bisphenol A epoxy:eew190)
Dicyandiamide 8
Accelerator 1-5

Tg : measured by
TMA



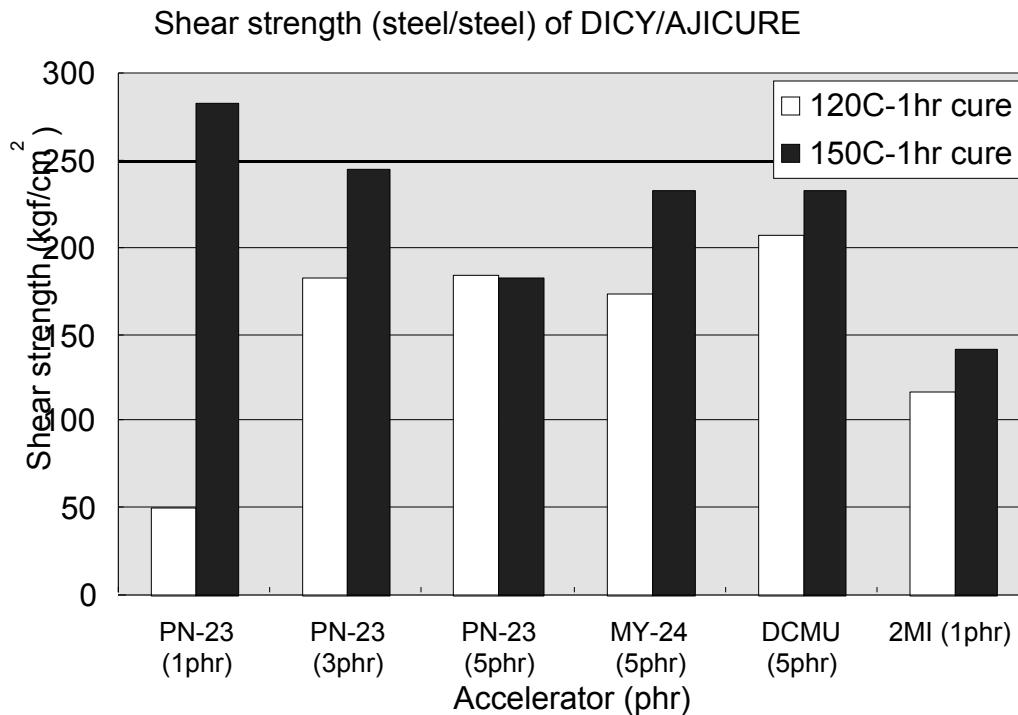
Shear strength of DICY/AJICURE formulation

DICY with small amount of AJICURE PN-23 as an accelerator provides higher shear strength than DCMU or 2MI as an accelerator.

DCMU: 3-(3,4-dichlorophenyl)-1,1-dimethylurea
2MI : 2-methylimidazole

Formulation

Epoxy resin 100 (Bisphenol A epoxy:eew190)
Dicyandiamide 8
Accelerator 1-5



Water uptake of DICY/AJICURE formulation

DICY with small amount of AJICURE PN-23 as an accelerator provides much lower water-uptake than 2MI as an accelerator.

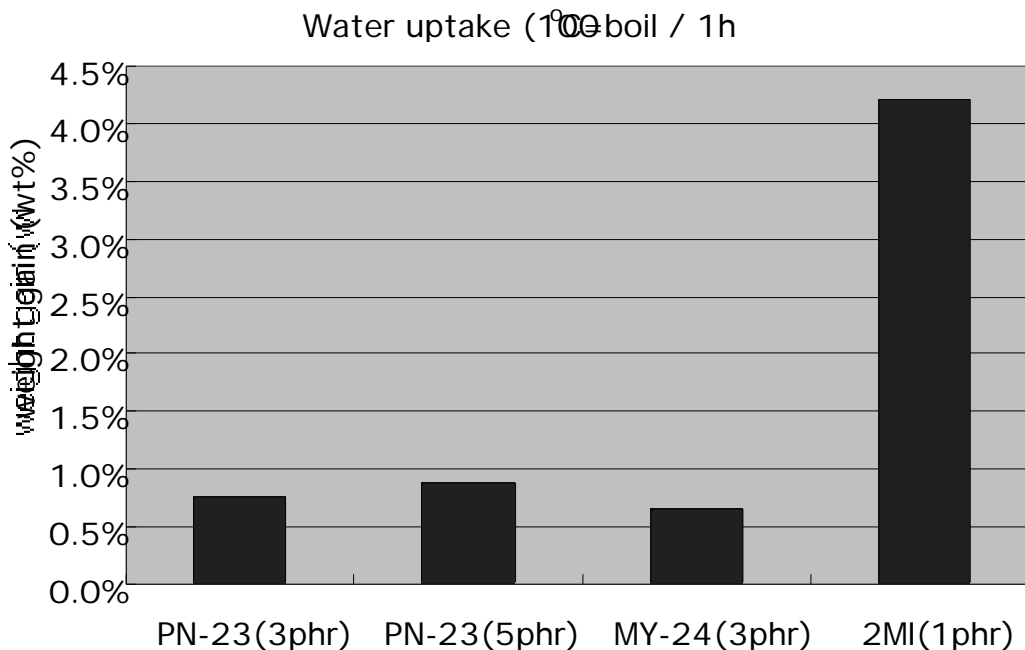
2MI :2-methylimidazole

Formulation

Epoxy resin 100 (Bisphenol A epoxy:eeW190)
Dicyandiamide 8
Accelerator 1-5

Cure condition

120°C-60min



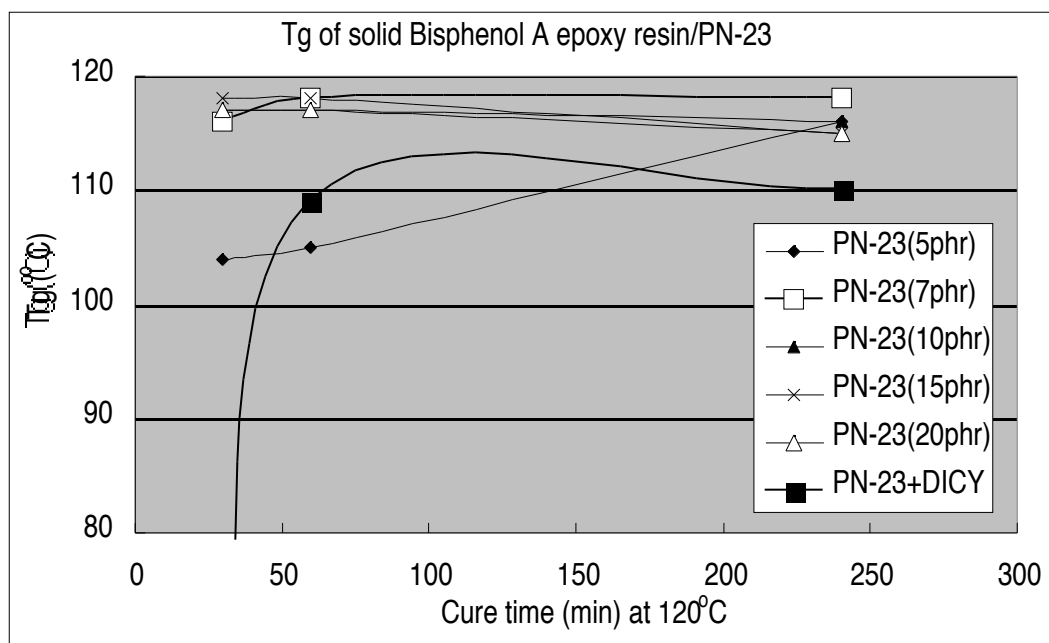
PN-23 for solid bisphenol A epoxy resin

AJICURE PN-23' usage level to solid bisphenol A type epoxy resin(ew 450) is about 7-10phr.

Table.1: Properties of solid bisphenol A epoxy resin and AJICURE PN-23 formulations

Formulation			1	2	3	4	5	6
Solid bisphenol A epoxy (ew450)			100	100	100	100	100	100
AJICURE PN-23			5	7	10	15	20	4
DICY			-	-	-	-	-	4
DSC	on-set temp.	(°C)	101	97	95	93	92	93
	peak temp.	(°C)	141	139	137	135	133	146
	exotherm	(cal/g)	20.0	22.6	22.3	22.7	24.3	21.8
Tg	120°C-30min cure	(°C)	104	116	117	118	117	57
	120°C-60min cure	(°C)	105	118	117	118	117	109
	120°C-120min cure	(°C)	115	ND	ND	ND	ND	110
	120°C-240min cure	(°C)	116	118	116	115	115	110

Solid epoxy resin and AJICURE PN-23 was mixed through dry-blend method.



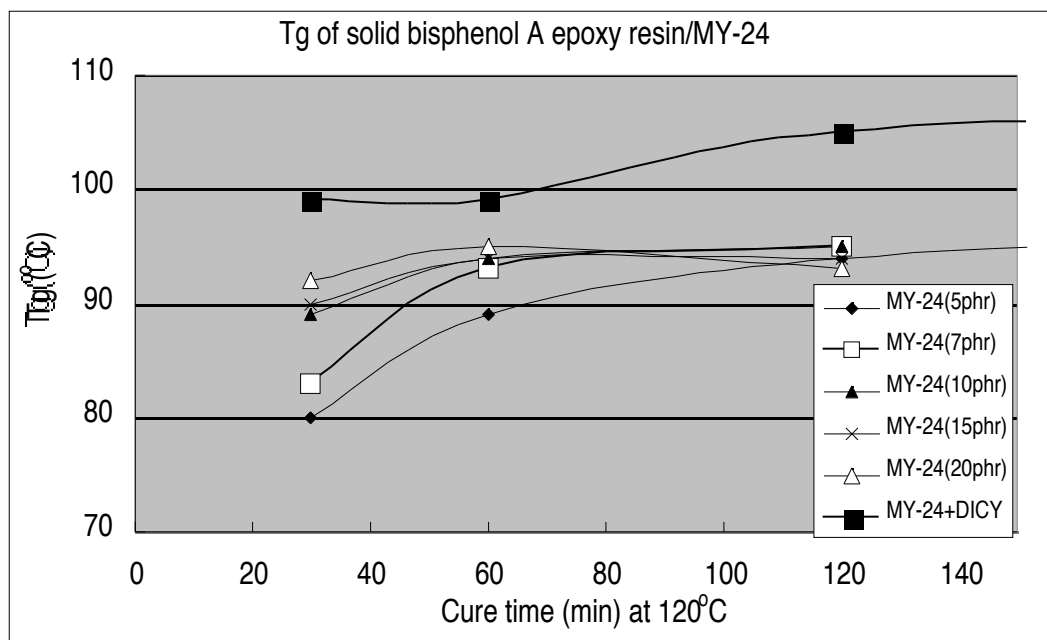
MY-24 for solid bisphenol A epoxy resin

AJICURE MY-24's usage level to solid bisphenol A type epoxy resin(eew 450) is about 7-10phr.

Table.1: Properties of solid bisphenol A epoxy resin and AJICURE MY-24 formulations

Formulation			1	2	3	4	5	6
Solid bisphenol A epoxy (eew450)			100	100	100	100	100	100
AJICURE MY-24			5	7	10	15	20	4
DICY			-	-	-	-	-	4
DSC	on-set temp.	(°C)	104	103	105	93	93	111
	peak temp.	(°C)	137	137	136	134	134	148
	exotherm	(cal/g)	5.6	6.6	6.5	10.4	10.2	17.0
Tg	120°C-30min cure	(°C)	80	83	89	90	92	99
	120°C-60min cure	(°C)	89	93	94	94	95	99
	120°C-120min cure	(°C)	94	95	95	94	93	105
	120°C-240min cure	(°C)	97	ND	ND	ND	ND	107

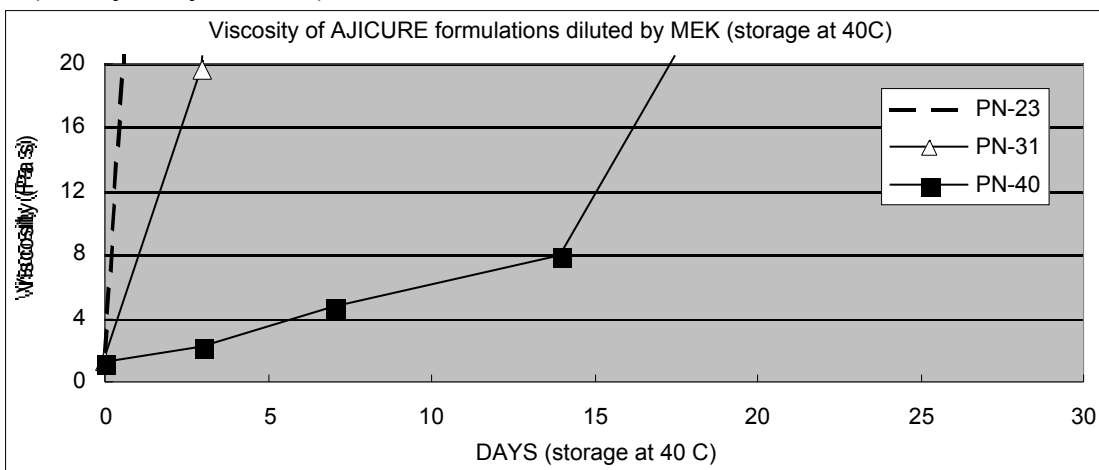
Solid epoxy resin and AJICURE MY-24 was mixed through dry-blend method.



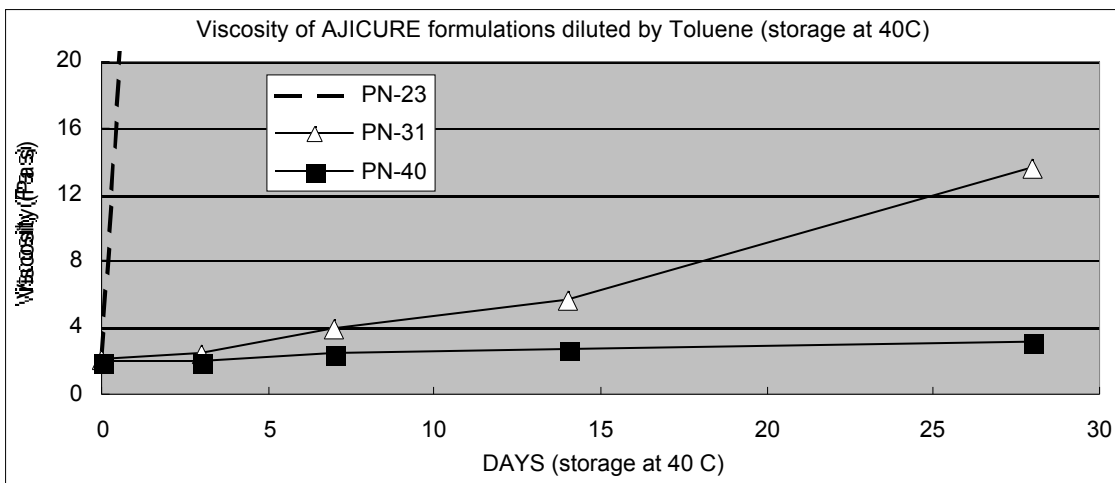
AJICURE PN-series formulation with various solvents

AJICURE PN-40 formulation can be diluted by various solvents without viscosity increase.
AJICURE PN-40 has excellent pot life even when it is used with solvent compared with PN-23.

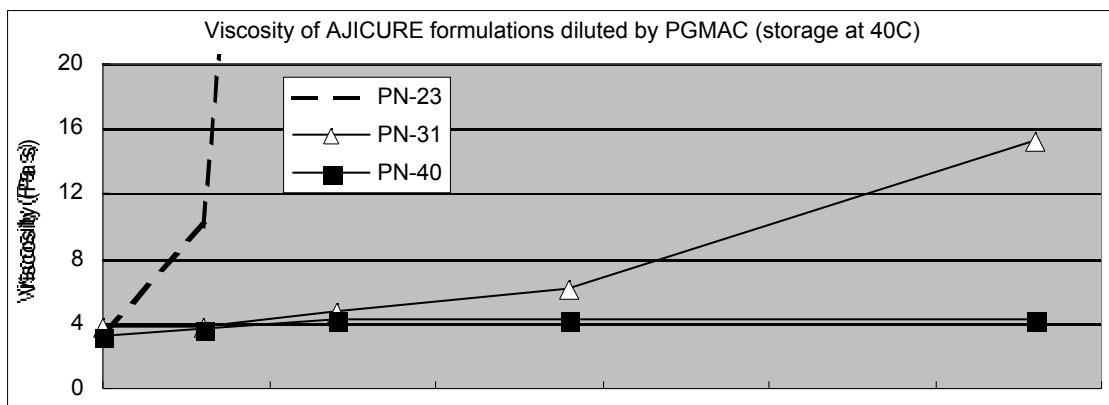
MEK (Methyl ethyl ketone)



Toluene



PGMAC (Propyleneglycol monomethylether acetate)



Ajicure PN-31, PN-40 or PN-40J has much better pot life in bisphenol F epoxy resin / diluents system than Ajicure PN-23 or PN-H.

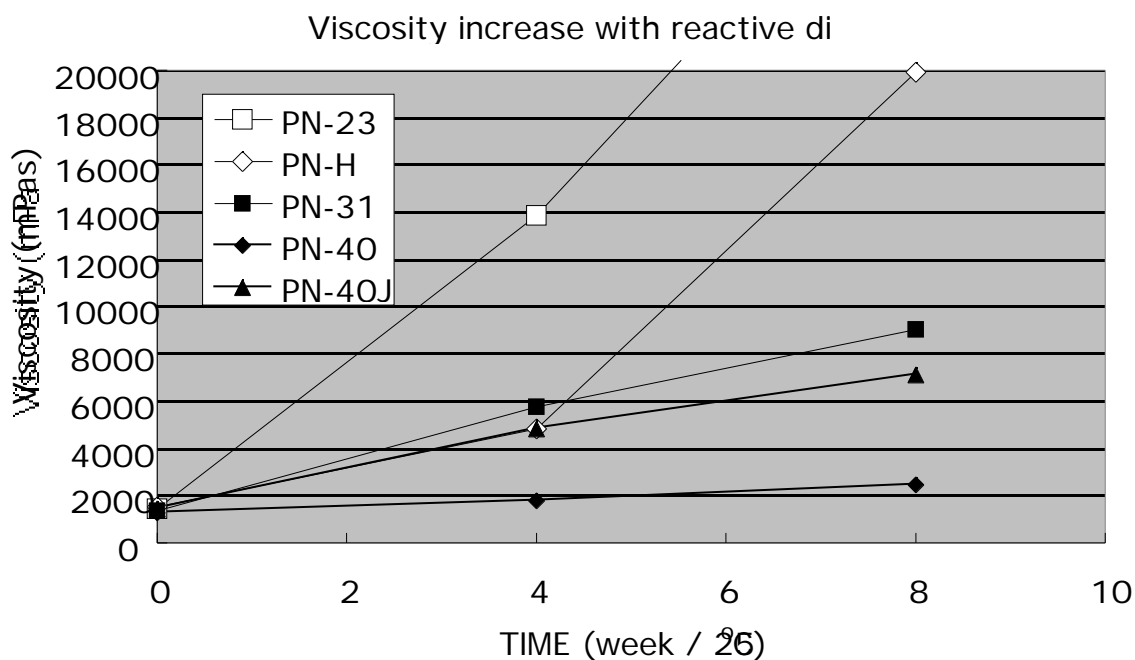
<Formulation>

Epon 807	80
1,6-hexandiol diglycidylether	20
Ajicure	20
Aerosil 200	2

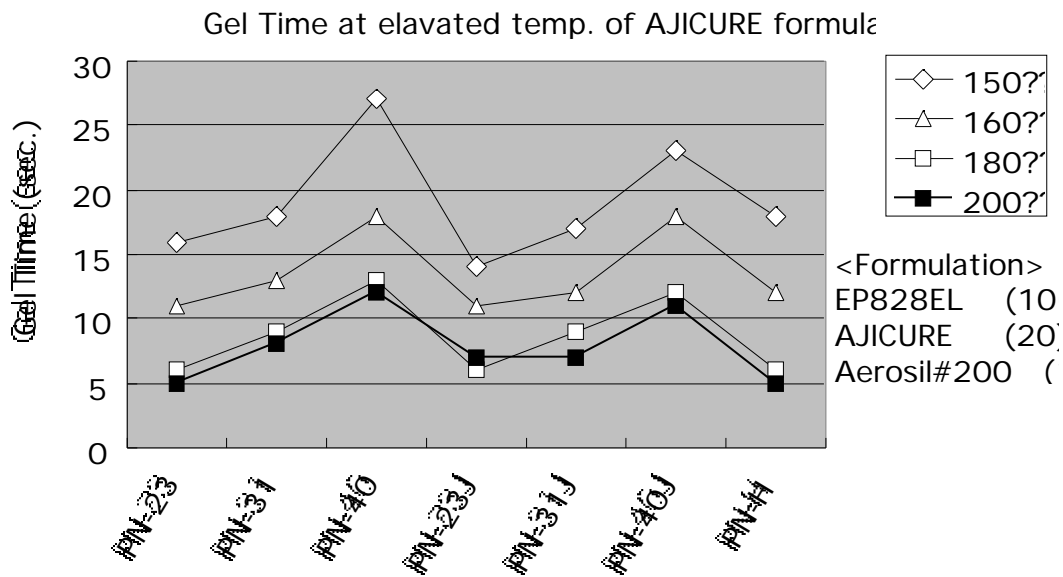
Epon807 is equivalent to Epon862.

Table 1. Bisphenol F epoxy / 1,6-hexanedioldiglycidylether formulations

Ajicure		PN-31	PN-40	PN-40J	PN-23	PN-H
Particle size av. (micron)			10-12	2-3	10-12	
Gel Time (min)	100 °C	3.9	4.2	4.1	4.2	4.2
	120 °C	2.2	2.5	2.3	2.1	2.3
	150 °C	1.5	1.7	1.6	1.4	1.5
Initial Viscosity (mPas)		1332	1292	1418	1445	1554
Viscosity Increase ratio	after 4D @40 °C	gel	8.5	34.4	cure	cure
Viscosity Increase ratio	after 4W @25 °C	4.3	1.4	3.4	9.6	3.1
Viscosity Increase ratio	after 8W @25 °C	6.8	1.9	5.0	21.5	12.8



Gel Time at 150 - 200°C of AJICURE PN-series 1



* Gel Time was measured by hot plate method.

AJICURE PN-23 or PN-23J cures fastest at elevated temp. of all AJICUREs.

Rapid cure at high temperature formulations

- Bisphenol F epoxy resin formulation with AJICURE PN-23 cures faster than bisphenol A epoxy resin formulation.
- Combination of AJICURE PN-23 and dicyandiamide(DICY) is good for rapid cure at high temperature.
- AJICURE PN-23J can cure faster than PN-23.

Table 1.PN-23 formulation for rapid cure at high temperature 1

Run No.	1	2	3	4	5	6	
EP807	100	30	50	50	50	50	
EP604	-	70	50	50	50	50	
AJICURE PN-23J	20	20	20	10	5	-	
AJICURE PN-23	-	-	-	-	-	20	
Aerosil#200	1	1	1	1	1	1	
Gel time (sec.)	150°C	19	14	14	53	>400	23
	180°C	7	7	6	45	>400	8
Initial viscosity (P)	170	1328	654	410	334	560	

EP807 is equivalent to Epon862.

Table 2.PN-23 formulation for rapid cure at high temperature 2

Run No.	4	5	7	8	
EP807	50	50	50	50	
EP604	50	50	50	50	
AJICURE PN-23J	10	5	10	5	
AJICURE PN-23	-	-	-	-	
Aerosil#200	1	1	1	1	
DICY-7	-	-	5	5	
Gel time (sec.)	150°C	53	>400	40	69
	180°C	45	>400	12	19
Initial viscosity (P)	410	334	508	400	

Ajicure PN-31 and PN-31J are amine-epoxy adduct type latent epoxy curing agents and accelerators. Ajicure PN-31J is a micro-grounded type of Ajicure PN-31. These products are very good accelerators for epoxy/dicyandiamide(DICY) system and also very good latent curing agents for epoxy resin. One component epoxy/Ajicure PN-31 or PN-31J formulations show rapid cure and very long pot life and provide high Tg when cured.

One component DICY cured adhesive accelerated with Ajicure PN-40 or PN-40J show rapid cure and very long pot life and provide high shear strength.

.....

We have 3 kinds of Ajicure PN-series; Ajicure PN-23, PN-40 and PN-31. The differences between them are mainly curing speed and stabilities, which are described below;

Curing speed : *Fast* Ajicure PN-23 > PN-31 > PN-40
Pot life : *Long* Ajicure PN-40 > PN-31 > PN-23

Ajicure PN-23 is very stable in bisphenol A epoxy resin formulations. But in bisphenol F formulations or formulations with diluents Ajicure PN-23 shows shorter pot life. In comparison with Ajicure PN-23 **Ajicure PN-31 shows better pot life even in bisphenol F epoxy.**

.....

Table 1. Typical properties

	AJICURE PN-31	AJICURE PN-31J
Appearance	pale yellow powder	pale yellow powder
Particle size av.	10 micron	3 micron
Softening point (°C)	110-120	110-120

- RAPID CURE at LOW TEMPERATURE (80°C)
- LONG POT LIFE
–Long pot life during storage at 60 °C
- HIGH Tg
- GOOD ACCELERATOR of DICY

Table 2. Properties of Bis-F epoxy formulations

		PN-31	PN-31J	PN-23
Formulation	Epon 807	100	100	100
	Ajicure PN-31	20	-	-
	Ajicure PN-31J	-	20	-
	Ajicure PN-23	-	-	20
	Aerosil 200	2	2	2
Gel Time (min)	80 °C	13.6	12.1	13.1
	100 °C	3.9	4.8	4.0
	120 °C	2.1	2.0	2.1
	150 °C	1.3	1.5	1.3
Tg (°C)	[80 °C-60min cure]	105	105	105
	[120 °C-30min cure]	135	130	135
Initial Viscosity (Ps)		90	92	90
Viscosity Increase ratio after 1W @40 °C		1.4	2.6	2.8
Viscosity Increase ratio after 4W @40 °C		2.2	no data	24.1

Epon807 is equivalent to Epon862.

Table 3. Properties of Bis-A epoxy formulations

		PN-23J	PN-31J	PN-23	PN-31
Formulation	Epon 828	100	100	100	100
	Ajicure PN-23J	20	-	-	-
	Ajicure PN-31J	-	20	-	-
	Ajicure PN-23	-	-	20	-
	Ajicure PN-31	-	-	-	20
	Aerosil 200	1	1	1	1
Gel Time (min)	80 °C	9.4	14.8	19.8	>30
	100 °C	3.4	4.6	4.2	4.6
	120 °C	2.2	2.5	2.2	2.3
	150 °C	1.4	1.4	1.2	1.2
Tg (°C)	[100 °C-30min cure]	no data	no data	125	120
	[120 °C-30min cure]	no data	no data	135	140
Initial Viscosity (Ps)		290	294	290	290
Viscosity Increase ratio after 4W @40 °C		4.0	3.0	1.5	1.2
Viscosity Increase ratio after 24hr @60 °C		no data	no data	6.6	2.1
Viscosity Increase ratio after 3hr @70 °C		no data	no data	cure	1.8
Viscosity Increase ratio after 8hr @70 °C		no data	no data	-	5.5

Ajicure PN-31 is an excellent accelerator for DICY.

Table 4. Properties of Bis-F epoxy / DICY formulations

		PN-31	PN-23
Formulation	Epon 807	100	100
	DICY	8	8
	Ajicure PN-31	5	-
	Ajicure PN-23	-	5
	Aerosil 200	1	1
Gel Time (min)	100 °C	13.0	12.9
	110 °C	4.5	4.4
	120 °C	2.9	3.0
	150 °C	1.3	1.4
Tg (°C)	[120 °C-0.5hr+150 °C-1hr cure]	138	135
Initial Viscosity (Ps)		52	54
Viscosity Increase ratio after 1W @40 °C		1.2	1.5
Viscosity Increase ratio after 4W @40 °C		1.6	8.0

Epon807 is equivalent to Epon862.

Ajicure PN-23J is a micro-grounded type of Ajicure PN-23.

Ajicure PN-23J is the fastest curing agent of all Ajicures. However Ajicure PN-23J is so fine particle that its pot life formulated with epoxy resins is relatively short.

We have 3 kinds of Ajicure PN-series; Ajicure PN-23, PN-40 and PN-31. The differences between them are mainly curing speed and stabilities, which are described below;

Curing speed : *Fast* Ajicure PN-23 > PN-31 > PN-40

Pot life : *Long* Ajicure PN-40 > PN-31 > PN-23

Table 1. Typical properties

	AJICURE PN-23	AJICURE PN-23J
Appearance	pale yellow powder	pale yellow powder
Particle size av.	10 micron	3 micron
Softening point (°C)	95-105	95-105
Curing condition	80°C/60min ~ (Bis A epoxy)	80°C/30min ~ (Bis A epoxy)

Table 2. Properties of Bis-A epoxy formulations

		PN-23J	PN-23
Particle size av. (micron)		3	10
Formulation	Epon 828	100	100
	PN-23J	20	-
	PN-23	-	20
	Aerosil 200	1	1
Gel Time (min)	80 °C	9.4	19.8
	100 °C	3.4	4.2
	120 °C	2.2	2.2
	150 °C	1.4	1.2
Tg (°C)	[100 °C-30min cure]	no data	125
	[120 °C-30min cure]	no data	135
Initial Viscosity (Ps)		290	291
Viscosity Increase ratio after 1W @40 °C		1.7	1.0
Viscosity Increase ratio after 4W @40 °C		4.0	1.5
Viscosity Increase ratio after 8W @40 °C		1.6	1.6