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Gaskamine 240

Improvement of Curing Performance under Low Temperature Condition

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1. Advantages of Gaskamine 240

Gaskamine 240 has a variety of advantages as an epoxy hardener.

1. **Low Viscosity**
2. Long Pot life and **Fast Drying Performance** in warm atmosphere
3. **Excellent Appearance (as a coating film)**
4. Good Chemical Resistance (as a coating film and a cast sheet)
5. High Bond Strength

MGC shows you the formulation to keep the above advantages even under a low temperature condition.

2. Properties of epoxy compound and Gaskamine 240

2-1 Properties of Gaskamine 240

Table 1. Typical properties of Gaskamine 240

	Gaskamine 240 (G-240)
Properties	
Color (Gardner)	<1
Viscosity (mPa・s/ 25°C)	**66**
Amine value	403
AHEW	103

2-2 Properties of epoxy compound

Table 2. Properties of epoxy compound

	Ep801
Commercial name	Epikote 801
Manufacturer	Japan Epoxy Resins Co.,Ltd.
Properties	
Color (Gardner)	0.2
Viscosity (mPa・s/ 25°C)	1100
EEW	216

3. Curing performance at 5°C without any additives

Performance of G-240: Excellent Appearance (as a coating film)
Good water spotting resistance

Table 3. Properties of coating film cured with Gaskamine 240 at 5°C

Hardener	G-240
Composition	
Ep801 (g)	100
Hardener (g)	48
Curing condition	5°C (80%RH)
RCI drying time (hr: min)	
Set-to-touch	11:15
Dust free	>24:00
Dry through	>24:00
Appearance (7days)	
Gloss/ Clarity/ Leveling	**Ex/ Ex/ Ex**
Dryness	
1day/ 2days/ 7days	P/ Ex/ Ex
Water spotting resistance	
1day/ 2days/ 7days	F/ **Ex**/ **Ex**
Pencil hardness	
1day/ 4days/ 7days	<6B/ HB/ HB

Appearance: evaluated visually
Ex: Excellent G: Good
F: Fair P: Poor

Dryness: evaluated with finger
Ex: Dry G: Slightly sticky
F: Sticky P: Severe sticky

Water spotting resistance:

After curing the coating film at 5°C for 1 day, 2 days and 7 days, water with 10 mm in diameter is placed on the coating film and covered by glass cup. After 24 hours, water on the coating film is wiped up and the condition of the coating film is evaluated visually.

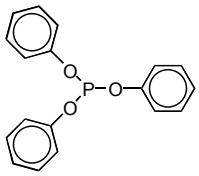
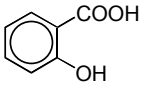
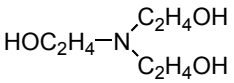
Ex: No visual changes G: Slightly lower gloss or clarity
F: Slight surface whitening P: Whitening

4. Properties of accelerators

Essential performance of accelerator…

Improve curing performance
Improve water spotting resistance
Keep excellent Appearance

Table 4. Typical properties of accelerators

accelerator	Triphenyl phosphite (TPP)	Salicylic acid	Triethanolamine (TEA)
Manufacturer	TOKYO CHEMICAL INDUSTRY CO.,LTD.	Wako Pure Chemical Industries, Ltd.	KANTO CHEMICAL CO, INC.
Properties Structure			
Molecular weight	310.3	138.1	149.2
Specific gravity d^{20}_4	1.184	—	1.124
Melting point (℃)	22-24	158-161	18-21
Boiling point (℃)	360	211/20mm	190-193/5mm
Flash point (℃)	218	—	185

5. Curing performance at 5°C with each of accelerators

5-1 Comparison among accelerators

Result: Salicylic acid improves curing performance and water spotting resistance best.

Table 5. Properties of Gaskamine 240 containing accelerators

Hardener No.	G240-1	G240-2	G240-3	G-240
Formulation (wt%)				
G-240	95	95	95	100
TPP	5			
Salicylic acid		5		
TEA			5	
Properties				
Viscosity (mPa･s/ 25°C)	69	171	97	66
AHEW	108	108	108	103
Stability (5°C/ 3months)	Clear	Clear	Clear	-

Table 6. Properties of coating film cured with Gaskamine 240 containing accelerators

Hardener No.	G240-1	G240-2	G240-3	G-240
Composition				
Ep801 (g)	100	100	100	100
Hardener (g)	50	50	50	48
Curing condition	5°C (80%RH)			
RCI drying time (hr: min)				
Set-to-touch	8:45	8:15	7:15	11:15
Dust free	>24:00	**22:45**	>24:00	>24:00
Dry through	>24:00	>24:00	>24:00	>24:00
Appearance (7 days)				
Gloss/ Clarity/ Leveling	Ex/ Ex/ Ex	Ex/ Ex/ Ex	Ex/ F/ Ex	Ex/ Ex/ Ex
Dryness				
16hrs/ 1day/ 2days/ 7days	P/ F/ Ex/ Ex	**F**/ **Ex**/ Ex/ Ex	P/ F/ Ex/ Ex	P/ P/ Ex/ Ex
Water spotting resistance				
16hrs/ 1day/ 2days/ 7days	P/ F/ Ex/ Ex	**F**/ **G**/ Ex/ Ex	P/ P/ F/ G	P/ F/ Ex/ Ex
Pencil hardness				
1day/ 4days/ 7days	<6B/ HB/ H	**6B**/ HB/ H	<6B/ F/ F	<6B/ HB/ HB

5-2 Trial for better formulation

Result: G-240(90 wt%)/ Salicylic acid(10 wt%) is better.

Table 7. Properties of Gaskamine 240 containing salicylic acid

Hardener No.	G240-2	G240-4	G-240
Formulation (wt%)			
G-240	95	90	100
Salicylic acid	5	10	
Properties			
Viscosity (mPa·s/ 25°C)	171	537	66
AHEW	108	114	103
Stability (5°C/ 3months)	Clear	Clear	-

Table 8. Properties of coating film cured with Gaskamine 240 containing salicylic acid

Hardener No.	G240-2	G240-4	G-240
Composition			
Ep801 (g)	100	100	100
Hardener (g)	50	53	48
Curing condition	5°C (80%RH)		
RCI drying time (hr: min)			
Set-to-touch	8:15	**6:45**	11:15
Dust free	22:45	**18:15**	>24:00
Dry through	>24:00	>24:00	>24:00
Appearance (7 days)			
Gloss/ Clarity/ Leveling	Ex/ Ex/ Ex	Ex/ Ex/ Ex	Ex/ Ex/ Ex
Dryness			
16hrs/ 1day/ 2days/ 7days	F/ Ex/ Ex/ Ex	**G**/ **Ex**/ Ex/ Ex	P/ P/ Ex/ Ex
Water spotting resistance			
16hrs/ 1day/ 2days/ 7days	F/ G/ Ex/ Ex	**G**/ **Ex**/ Ex/ Ex	P/ F/ Ex/ Ex
Pencil hardness			
1day/ 4days/ 7days	6B/ HB/ H	**4B**/ HB/ H	<6B/ HB/ HB

5-3 Curing performance of G-240/ Bis-F epoxy system cured at 5°C

Result: G240/ Salicylic acid formulation is effective for Bis-F type epoxy resin, especially curing speed and water spotting resistance.

Table 9. Properties of Gaskamine 240 containing salicylic acid

Hardener No.	G240-2	G240-4	G-240
Composition			
Ep807 (g)	100	100	100
Hardener (g)	64	68	61
Curing condition	5°C (80%RH)		
RCI drying time (hr: min)			
Set-to-touch	**6:30**	**4:15**	9:15
Dust free	**12:45**	**9:45**	14:30
Dry through	**18:30**	**17:30**	>24:00
Appearance (7 days)			
Gloss/ Clarity/ Leveling	**Ex/ Ex/ G**	**Ex/ Ex/ G**	Ex/ Ex/ G
Dryness			
16hrs/ 1day/ 2days/ 7days	G/ Ex/ Ex/ Ex	**Ex**/ Ex/ Ex/ Ex	G/ Ex/ Ex/ Ex
Water spotting resistance			
16hrs/ 1day/ 2days/ 7days	**G/ Ex/** Ex/ Ex	**G/ Ex/** Ex/ Ex	F/ F/ G/ G
Pencil hardness			
1day/ 4days/ 7days	HB/ F/ H	HB/ F/ H	HB/ H/ H

Table 10. Properties of epoxy compound

	Ep807
Commercial name	Epikote 807
Manufacturer	Japan Epoxy Resins Co.,Ltd.
Properties	
Color (Gardner)	0.2-0.4
Viscosity (mPa・s/ 25°C)	3280
EEW	169

6. Testing method

6-1 Coating condition and curing condition

Epoxy resin: Epikote 801 (EEW=216) (; Japan Epoxy Resins Co., Ltd.)
Epikote 807 (EEW=169) (; Japan Epoxy Resins Co., Ltd.)

Formulation: Stoichiometric amount based on active hydrogen equivalent weight.

Coating: 200μm doctor blade, on cold rolled steel (70 x 150 x 0.8 mm) sanded by #240 emery paper.

Curing: 7 days / 5°C (80%RH)

6-2 Testing method and evaluation

(1) RCI drying time

Coating 76μm initial thickness on glass plate (25×300×2 mm) with an applicator. The time to ST, DF and DT is measured.

ST: Set-to-touch
DF: Dust free
DT: Dry through
0:00 : Indicate hours and minutes

(2) Appearance

Gloss and clarity are evaluated visually.

Ex: Excellent G: Good
F: Fair P: Poor

Dryness is evaluated with the finger.

Ex: Dryness G: Slight stickiness
F: Stickiness P: Severe stickiness

(3) Water spotting resistance:

After curing the coating film at 5°C for 16 hours, 1 day, 2 days and 7 days, water with 10 mm in diameter is placed on the coating film and covered by glass cup. After 24 hours, water on the coating film is wiped up and the condition of the coating film is evaluated visually.

Ex: Excellent No visual change
G: Good Slightly lower gloss or clarity
F: Fair Slight surface whitening
P: Poor Whitening

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