

(2009 /4 /13 2008 / 12 /15)

()

(FA) (AA) .
 (EA) (AN) (TFA) (BA)
 (ΔW%) (MBA) - (BAm) -

°10

: FA TFA ΔW% . °50 30

TFA > BA > AA > FA

MBA AN 1% BAM

: 30%

MBA > AN > EA > BAm

BAM EA

MBA AN

ΔW%

The Abnormal Behaviour of Epoxy Resin in Acidic and Basic Organic Media

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ABSTRACT

The present work deals with the influence of aging effect on epoxy resin exposed to different organic acidic and basic media. Four organic acids, acetic acid (AA), formic acid (FA), *n*-butyric acid (BAc) and trifluoroacetic acid (TFA), beside the following, four Amines, aniline (AN), ethanol amine (EA), *n*-butyl amine (BAm) and *n*-methyl benzyl amine (MBA) were used.

The minimum values of $\Delta W\%$ in acidic medium was detected at low temperature (10°C) then increased at 30°C and attained relatively constant values at 50°C. Trifluoroacetic acid shows a maximum values of $\Delta W\%$ while minimum values observed in FA according to the following sequence.

$$\text{TFA} > \text{BA} > \text{AA} > \text{FA}$$

In basic media (amines), $\Delta W\%$ values not exceed 1% in BA, while they reach almostly 30% in AN and MBA. $\Delta W\%$ values are decreased in the following order:

$$\text{MBA} > \text{AN} > \text{EA} \geq \text{BAm}$$

Except in EA and BAm, it was found that the values of $\Delta W\%$ is directly proportional to the formula weight. Amines with aromatic rings like AN and MBA which considered as weak bases are behave in similar manner as acids and give high $\Delta W\%$ values. This study declare that the organic compound added to the epoxy inspite of their nature (acid or base), were effect on the epoxy weight through certaine sterical or chemical interaction. The treatment of epoxy resin with amines rised there softening temperature, where organic acids have no effect .

() .(Nicholson, 1997)

(Mohamed, 1993)

.....

(Mark, 1989)

.(Mabson *et al.*, 1984)

(Elias, 1984)

/DGEBA

(A-)

(Diglycidyl ether bisphenol-A

(Al-Yawor, 2006 Al-Duleemy, 2005 Abd-Alhamed, 2002)

.BDH Aldrich Fluka : .1

- : .

(1.05 (Leyco-Pox 103) : .
(Lycochem, Cologen, (25°C) gm/cm³
.Germany)

.(3 :7) : .2

)

(0.1×1×1) (°30

: .3

30 10) ()
.(30 7 1) (°50

(W)

: (ΔW) (W₀)

$$\overline{\Delta W\%} = \frac{W - W_0}{W_0} \times 100$$

$$\overline{(\Delta W\%)} \quad) \quad (1)$$

°10
 30 7 1
 $\overline{\Delta W\%}$ $\overline{(\Delta W\%)}$
 °50 . °30 °10

$\overline{(\Delta W\%)}$

: FA TFA
 TFA > BA > AA > FA

$$(\quad) \quad (2)$$

$\overline{\Delta W\%}$

: $\overline{\Delta W\%}$
 MBA > AN > EA > BAm

29%

$\overline{\Delta W\%}$

1%

BAm

.30%

MBA

(TFA)		(BAc)		(AA)		(FA)			
$\overline{(\Delta W\%)}$	$(\Delta W\%)$	$\overline{(\Delta W\%)}$	$(\Delta W\%)$	$\overline{(\Delta W\%)}$	$(\Delta W\%)$	$\overline{(\Delta W\%)}$	$(\Delta W\%)$	()	(°)
23.85	20.85	11.80	4.04	9.14	6.41	5.40	4.36	1	10
	23.48		12.76		8.37		5.76	7	
	27.23		18.59		12.65		6.07	30	
29.11	24.83	18.49	8.98	10.75	6.14	11.50	9.50	1	30
	29.60		18.18		10.85		11.78	7	
	32.85		28.32		15.28		13.23	30	
25.85	19.68	17.71	10.88	10.71	6.34	13.11	10.99	1	50
	27.71		17.14		8.88		13.32	7	
	30.16		24.33		16.92		15.03	30	

:2

ن-مثيل بنزيل امين (MBA)		انيلين (AN)		بيوتيل امين (BAm)		ايتانول امين (EA)		القاعدة العضوية		
المعدل (ΔW%)	القاعدة المتنافذة (ΔW%)	المعدل (ΔW%)	القاعدة المتنافذة (ΔW%)	المعدل (ΔW%)	القاعدة المتنافذة (ΔW%)	المعدل (ΔW%)	القاعدة المتنافذة (ΔW%)	الزمن (يوم)	درجة حرارة المعاملة (م°)	
21.40	17.31	6.97	3.47	0.09	0.05	3.62	1.34	1	10	
	20.89		5.62					0.10		7
	25.99		11.82					0.12		30
26.44	23.43	29.90	23.08	0.28	0.15	6.36	2.76	1	30	
	26.54		30.77					0.26		7
	29.36		35.86					0.42		30
30.51	27.35	27.60	25.26	0.25	0.08	6.91	4.41	1	50	
	28.89		27.63					0.25		7
	35.28		29.91					0.41		30

(Nunez et al. 1999)

: Fick

(DGEBA)

$$\frac{dc}{dt} = D \cdot \frac{d^2c}{dx^2} \dots \dots \dots (1)$$

.....

$$\frac{M_t}{M_{\max}} = \frac{4\sqrt{Dt}}{h\sqrt{\pi}} \dots\dots\dots (2)$$

$$\frac{M_t}{M_{\max}} = \frac{4\sqrt{Dt}}{h\sqrt{\pi}} \dots\dots\dots (2)$$

$$\dots\dots\dots (3)$$

:3

(S.D.)	(ΔW%)	(°)
0.019	0.952	23
0.072	1.478	47
0.030	2.057	58
0.057	2.656	77
0.028	2.847	100

(Jelinski *et al.*, 1985)

.1%

1%

.(bound water)

.(microvoids and microcapillaries)

. °100

%2.8

(pH)

(1)

.(Abd Al-Hameed, 2002)

(ΔW%)

pH

(ΔW%)

-0.5)

°48

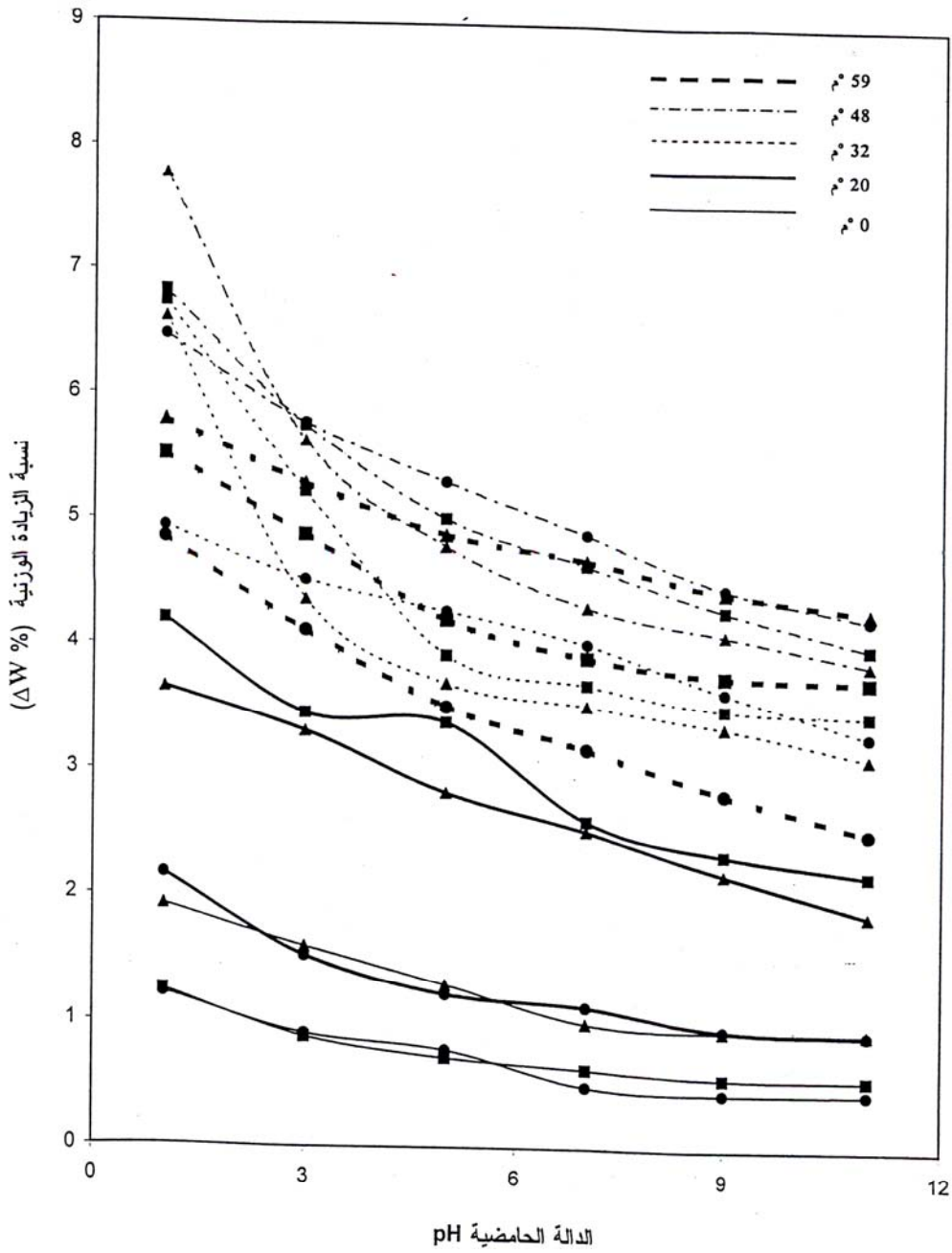
(%7-4)

(ΔW%)

.(%2

.pH

(pH = 1)



:1

.(▲) 21 (■) 14 (●) 7

.....

(Lee and Neville 1967 and Mark et al. 1967)

()

30%

(%8-7)

pKa

 $\overline{\Delta W\%}$

(4)

.FA

TFA

AA

BA

AN)

(°50-30)

EA

BAm

(MBA

pKa

(%1

)

BAm

(pKa)

(Handbook, 1982)

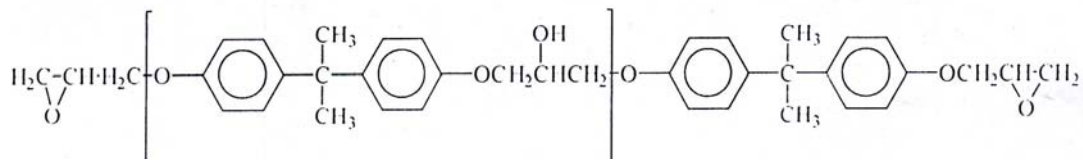
pKa Ka :4

(°)	pKa	Ka	
25	0.70	2.10×10^{-1}	(TFA)
20	3.75	1.77×10^{-4}	(FA)
25	4.75	4.75×10^{-5}	(AA)
20	4.81	1.54×10^{-5}	(BA)
25	4.63	2.39×10^{-5}	(AN)
25	9.50	3.16×10^{-10}	(EA)
...	(MBA) -
25	9.33	4.67×10^{-10}	(BzA)
20	10.77	1.69×10^{-11}	(BAm) -n

A

(DGEBA)

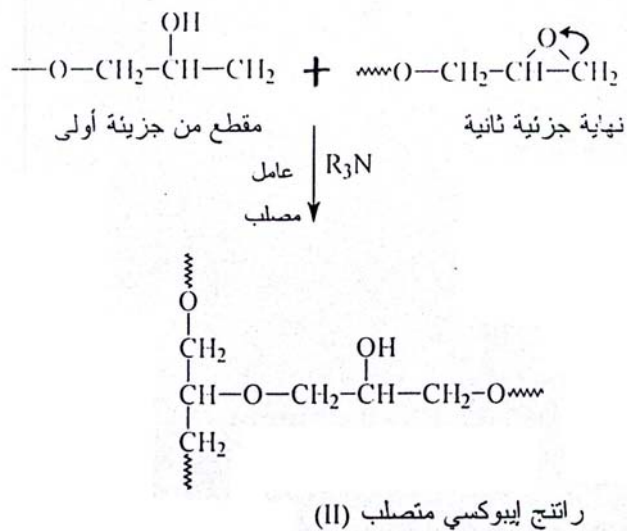
(1) (prepolymer)



(1) Prepolymer

(R₃N)

.(McMurry, 2004) (II)



:(Mohamed, 1993) (III)

()

(-)

$\overline{\Delta W\%}$ (Abd Al-Hameed, 2002)
 pKa 7% 5%
 $[H_3O^+]$ pKa
 (0.7) TFA pKa
 $\overline{\Delta W\%}$
 BAc $\overline{\Delta W\%}$ AA FA $\overline{\Delta W\%}$ 4.8=pKa
 $\overline{\Delta W\%}$ (pKa = 10.77) BAm
 .TFA
 $\overline{\Delta W\%}$
 (MF)
 : (5) pKa $\overline{\Delta W\%}$

.....

$\overline{(\Delta W\%)}$		pKa	MF	MF	:5
50C°	30C°				
30.51	26.44	(*)	121	(MBA)	-
25.85	29.11	0.7	114	(TFA)	
27.60	29.90	4.63	93	(AN)	
17.74	18.49	4.81	88	(BA)	-
0.25	0.28	10.77	73	(BAm)	-
6.91	6.36	9.5	61	(EA)	
10.71	10.75	4.75	60	(AA)	
13.11	11.50	3.75	46	(FA)	

(pKa=9.33)

pKa

(N-MBA)

pKa

(*)

 $\overline{\Delta W\%}$

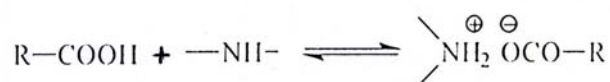
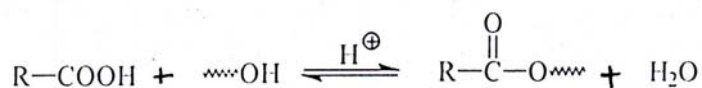
EA BAm

 $\overline{\Delta W\%}$

(MF)

(associates)

:



()

(TFA)

(MBA, AN)

()

()

$\overline{\Delta W\%}$

dipole-dipole

(6)

(Softening Point)

$\overline{\Delta W\%}$

-n

pKa

(5)

°			
:			
30	7		
90	87	85	(FA)
103	105	105	(AA)
80	85	83	(BAc)
86	92	90	(TFA)
160	165	175	(EA)
105	115	117	(BAm) -
110	110	113	(AN)
97	92	90	(n-MBA) -

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