

ANQUAWHITE™ 100 Curing Agent**DESCRIPTION**

Anquawhite 100 curing agent is a novel waterborne curing agent dispersion designed for use in ambient or heat cure two part epoxy systems.

Anquawhite 100 curing agent can be formulated with a variety of epoxy resins and waterborne epoxy dispersions while maintaining VOC levels < 100 g/l. It can also be formulated to high solids while maintaining low viscosity.

Formulations based on Anquawhite 100 curing agent and Ancarez™ AR555 epoxy resin offer long pot life, fast dry, high gloss, and high water resistance at low VOC.

Anquawhite 100 curing agent formulations also offer low yellowing, good acid and food stain resistance, and good water resistance.

ADVANTAGES

- Formulating latitude
- High solids, low viscosity
- Long pot life, fast dry, low VOC
- High gloss and stain resistance
- Low color and good color retention
- Hot tire pick up resistance
- Freeze thaw stable

APPLICATIONS

- Wall and floor coatings
- Institutional coatings
- Heavy duty maintenance coatings

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Anquawhite 100 curing agent.

TABLE 1: TYPICAL PROPERTIES

Appearance	Opaque White Dispersion
Color¹ (Gardner)	-
Viscosity² @ 25°C (mPa.s)	150-300
Amine Value³ (mg KOH/g)	100
Specific Gravity @ 25°C (g/ml)	1.05
Total Solids Content, (wt %)	55
Solvent (wt %)	Water 41 Propylene glycol methyl ether 4
Equivalent Wt/{H}	350
Recommended Use Level⁴, (PHR)	140-180
Recommended Use Level⁵, (PHR)	30-50

TABLE 2: TYPICAL HANDLING PROPERTIES

Pot Life @ @ 20°C⁴, (h)	2.4	
Pot Life @ @ 20°C⁵, (h)	4-8	
	LER⁷	SED⁸
Dry Times (h)⁵		
Set to Touch	1/2	1/4
Dry to Touch	6	2
Hard dry	12	5

TABLE 3: TYPICAL PERFORMANCE

	LER⁷	SED⁸
Gloss (60°C)	85	90
Pencil Hardness	F	F
Impact Resistance (Direct, in lb)	20	40
Impact Resistance (Reverse, in lb)	4	8
Taber Abrasion⁹	-	110

Footnotes:

- (1) ASTM D1544-80
- (2) Brookfield, RVTD, Spindle 4
- (3) Perchloric Acid Titration
- (4) With Bisphenol A Diglycidyl ether (EEW=190)
- (5) With Ancarez AR555 Solid Epoxy Dispersion
- (6) ASTM D-1640
- (7) Bisphenol A Liquid Epoxy Resin (EEW 190)
- (8) Ancarez AR555 Solid Epoxy Dispersion
- (9) 1,000 cycles, CS 17 Wheel, 1 Kg Weight

SUPPLEMENTARY DATA

Anquawhite 100 curing agent is an amine functional polymer dispersed in water and propylene glycol methyl ether.

It is designed for use with either liquid epoxy resins or solid epoxy dispersions in two component water borne epoxy coatings.

TABLE 4: KEY PROPERTIES

Non-volatile	55%
Water	41%
PM Solvent	4%
Particle Size	0.5 Micron
Particle Stabilization	Nonionic Surfactant
AHEW	350
Viscosity	200 cPs

TABLE 5: EPOXY SELECTION AND USE LEVELS

	Use Level	Characteristics
Bis A Liquid Epoxy	140-180 phr	High strength and Chemical Resistance
Diluent Modified Epoxy*	140-170 phr	Improved Handling and Flow
Acrylate Modified Epoxy**	190-210 phr	Faster Dry Speed, Improved Weathering
Solid Epoxy Dispersion Ancarez AR555	30-50 phr	Long Pot Life, Fast Dry, High Yellowing Resistance

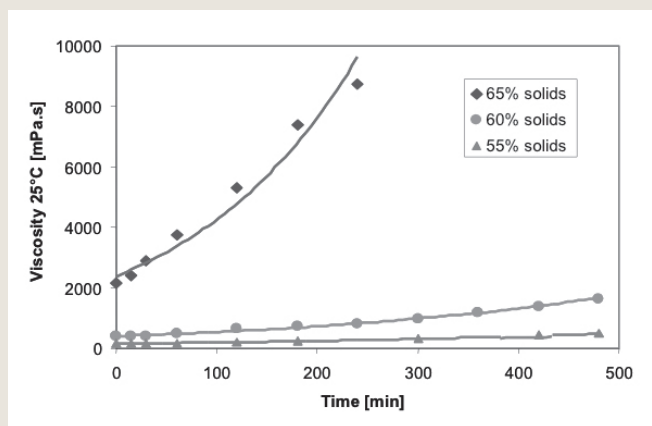
* Modified with 15% Epodil 748 diluent

**Modified with 10% Pentaerythritol Tetraacrylate

POT LIFE — LIQUID EPOXY BASED FORMULATIONS:

Liquid Epoxy formulations typically have 1-3 hour pot lives characterized by steady viscosity increase throughout the pot life. End of pot life is signaled by poor flow out of the applied coating due to high viscosity. Pot life can be extended beyond 3 hours by lowering the solids content of the paint as shown in the graph below.

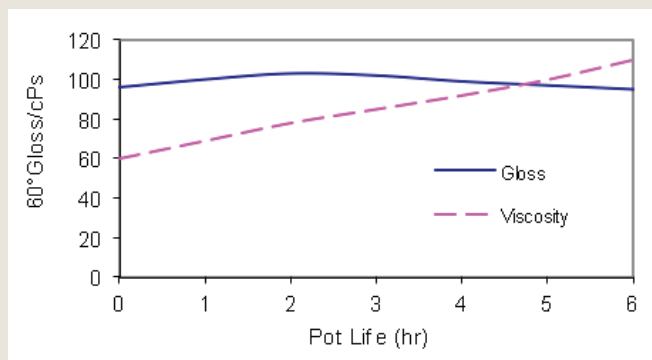
FIGURE 1: LIQUID EPOXY FORMULATIONS - EFFECT OF SOLIDS CONTENT ON POT LIFE



POT LIFE – ANCAREZ AR555 EPOXY RESIN BASED FORMULATIONS:

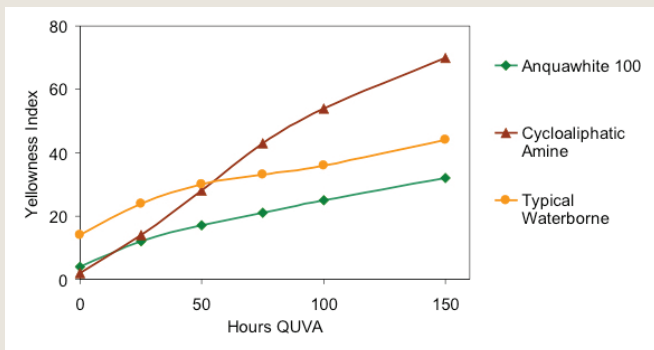
Formulations based on Ancarez AR555 solid epoxy dispersion exhibit long pot lives with only moderate viscosity increase throughout pot life. End of pot life is determined by a reduction in gloss which is indicative of reduced coalescence. Pot life can be lengthened by the addition of coalescing solvents such as Propylene Glycol Phenyl Ether (PPH), Propylene Glycol Methyl Ether (PM), or Propylene Glycol n-Propyl Ether (PnP).

FIGURE 2: ANQUAWHITE 100 CURING AGENT - ANCAREZ AR555 RESIN GLOSS & VISCOSITY



YELLOWING RESISTANCE: Anquawhite 100 curing agent exhibits a low initial color that allows the formulation of transparent or white top coatings. It also offers better color stability than other waterborne systems or 100% solids formulations as demonstrated in the graph below. Yellowing resistance can be further improved by using excess epoxy in the formulation.

FIGURE 3: YELLOWING OF EPOXY CLEAR COATS AFTER QUVA EXPOSURE



CHEMICAL AND STAIN RESISTANCE: Anquawhite 100 curing agent has been benchmarked for chemical spot and stain resistance against established water-based epoxy technology. Good solvent resistance is observed for all water-based systems, however, Anquawhite 100 curing agent offers marked improvements in acid resistance. Anquawhite 100 curing agent based coatings remain intact upon sulfuric acid or acetic acid exposure whereas other water-based systems show severe failures.

TABLE 6: CHEMICAL SPOT RESISTANCE 1H AND 18H EXPOSURE

	Anquawhite 100		Waterborne A		Waterborne B	
	1h	18h	1h	18h	1h	18h
Toluene	+	+	+	+	+	+
Ethanol	+	+	+	+	+	+
Sulphuric acid (10%)	+	+	+	+	H	B
Acetic acid (3%)	+	+	H	B	H	B
Acetic acid (10%)	H/B	B	B	B	B	B

+ =no change; H=haze; B=blisters

FOOD STAIN RESISTANCE 18H EXPOSURE: Anquawhite 100 curing agent exhibits markedly better stain resistance against common foodstuffs. Coatings formulated with Anquawhite 100 curing agent are virtually unaffected after exposure whereas other water-based systems are significantly attacked.

TABLE 7: STAIN RESISTANCE

	Anquawhite 100	Waterborne A	Waterborne B
Coffee	no change	slight stain	slight stain
Ketchup	no change	yellow stain	stain/blisters
Mustard	no change	yellow stain	stain/blisters
Red Wine	slight stain	yellow stain	yellow stain

ABRASION RESISTANCE: Anquawhite 100 curing agent formulated coatings exhibit abrasion resistance typical of epoxy coatings. Abrasion resistance can be optimized by adjusting epoxy-amine stoichiometry. Increasing epoxy lowers abrasion resistance while increasing Anquawhite 100 curing agent improves abrasion resistance as shown in the table below. Abrasion resistance can be further optimized by the addition of abrasion resistant pigments such as crystalline silica or aluminum oxide.

TABLE 8: ABRASION RESISTANCE

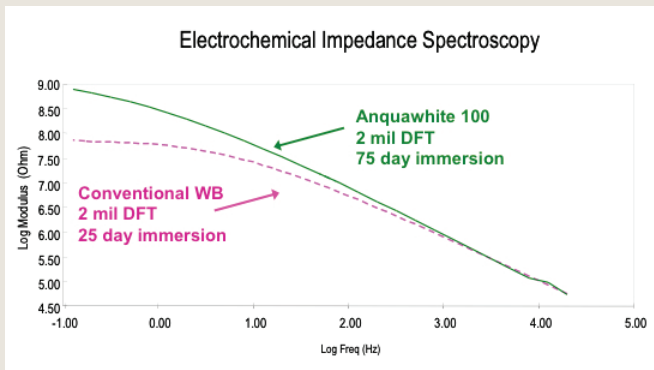
Stoichiometry (Epoxy* : Amine)	Taber Abrasion (mg wt loss)
0.6 : 1	108
0.7 : 1	120
0.85 : 1	153
1 : 1	175

Ancrez AR555 assuming EEW 1300, CS 17 wheel, 1 Kg wt, 1,000 cycles.

WATER RESISTANCE: Anquawhite 100 curing agent-Ancarez AR555 resin clear coats, exposed to condensing humidity for 5,000 hrs, exhibited whitening but no loss of adhesion, no blistering, and only modest softening.

Anquawhite 100 curing agent-Ancarez AR555 resin clear coats (2 mil DFT) immersed in 1M NaCl, exhibited excellent barrier properties, maintaining high pore resistance after long term immersion as measured by EIS and shown in the Bode plot (figure 4).

FIGURE 4: ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY



STORAGE STABILITY AND FREEZE-THAW STABILITY:

Anquawhite 100 curing agent exhibits good storage stability for at least 12 months from date of manufacture. Storage temperature should be kept below 35°C to avoid accelerated settlement. If a soft settlement is formed it can be easily stirred up without negative impact on product and coating performance.

Freeze-thaw stability has been tested in accordance with ASTM D2243-95. After five cycles of freeze/thaw, particle size was unaffected and no settlement was formed. Clear coat performance as measured by surface appearance, gloss, drying speed and hardness development was unchanged.

ADDITIVES: Defoamers — Surfynol® DF-62 and DF 110D surfactants (Evonik), Foamex 840 (Evonik), and PI-4 (Dee Fo) have been identified as effective defoamers. Typical use levels are 0.2-0.4% based on total formulation weight. When using strong defoamers such as Surfynol DF 62, it is advisable to also add Surfynol 420 (0.1-0.2%) to counteract cratering.

Wetting Agents – Surfynol 420 and 440 surfactants are very effective for improving substrate wetting, crater reduction, and leveling. Typical use levels are 0.1-0.2% based on total formulation weight.

Pigment wetting agents - For incorporating pigments by high speed dispersion, Surfynol 141 and Disperbyk 190 (BYK Chemie) have been found to be effective dispersing agents.

Typical use levels are 1-3 % based on pigment weight.

TINT BASES: To minimize flooding and floating, non-ionic or universal tint bases such as Creanova M 888, M 803, COVON and Elementis WD, UL tint bases are recommended.

RHEOLOGY MODIFIERS: Urethane associative thickeners such as Rheolate 310 and Acrysol RM 8W are recommended for reducing pigment settling and for improving sag resistance. Typical use levels are 0.2-0.5% based on total formulation weight. Addition of rheology modifiers to either Anquawhite 100 curing agent or Ancarez AR555 resin should be done slowly with good agitation to avoid destabilizing the dispersion.

PROCESSING GUIDELINES: Additives should always be introduced to Anquawhite 100 curing agent slowly with good agitation. In some cases it is good practice to pre-dilute the additive in water to reduce any possibility of shocking the dispersion.

A pigment dispersant such as Disperbyk 190 surfactant should be used when introducing pigments. Dispersing agents should be added to the formulation before pigments are introduced.

In liquid epoxy based formulations, it is advisable to add a surfactant to the epoxy to ensure good emulsification even when the mixing of the A + B components of the paint is marginal. Nonyl phenol ethoxylates with ~ 40 moles of ethylene oxide and an HLB of ~ 15 work well as liquid epoxy emulsifiers. Typical use level is 4-5% based on the weight of the epoxy resin.

HOT TIRE PICK UP RESISTANCE: Anquawhite 100 curing agent based formulations exhibit good hot tire pick up resistance. Coatings were applied and cured 1 day at ambient temperature. A section of new tire tread was then placed on the coating and 40 psi pressure was then applied at 50°C for 2 hours. Anquawhite 100 curing agent based coatings were very comparable to the waterborne epoxy industry standard as shown below.

TABLE 9: HOT TIRE PICK UP RESISTANCE

	Appearance	Adhesion	Damage
Anquawhite 100- Ancarez AR555 Enamel	Slight Staining	No Loss of Adhesion	No wrinkling, tearing, or blistering
Anquawhite 100 – Liquid Epoxy Enamel	Slight Staining	No Loss of Adhesion	No wrinkling, tearing, or blistering
Industry Standard Waterborne Epoxy	Slight Staining	No Loss of Adhesion	No wrinkling, tearing, or blistering

**TABLE 10:
STARTING POINT FORMULATIONS
LIQUID EPOXY CLEAR COAT**

A SIDE	lb	gal
Liquid Epoxy (EEW 190)	262.13	27.07
Epodil 748 diluent	46.26	6.23
Total A side	308.39	33.30
B SIDE		
Anquawhite 100 curing agent	543.85	62.05
DI H ₂ O	33.55	4.02
Surfynol DF 110D surfactant	4.19	0.50
Surfynol 420 surfactant	1.05	0.13
Total B Side	582.64	66.70
Total A + B	891.04	100.00
PVC	0	
VOC (lb/gal)	0.31	
Wt Solids	69%	
Vol Solids	67%	

**TABLE 11:
STARTING POINT FORMULATIONS SOLID EPOXY
DISPERSION BASED CLEAR COAT**

A SIDE	lb	gal
Ancarez AR555 Resin	606.57	66.67
B SIDE		
Anquawhite 100 curing agent	265.37	30.28
DI H ₂ O	23.05	2.76
Defoamer	2.43	0.29
Total B	290.85	33.33
Totals	897.42	100.00
PVC	0.0%	
VOC (lb/gal)	0.17	
Wt Solids	66%	
Vol Solids	51%	

**TABLE 12:
STARTING POINT FORMULATIONS
LIQUID EPOXY WHITE GLOSS ENAMEL**

A SIDE	lb	gal
Liquid Epoxy Resin	199.54	20.61
Propylene glycol phenyl ether	38.94	4.39
Total	238.48	25.00
B SIDE		
Anquawhite 100 curing agent	347.19	39.61
Disperbyk 190 surfactant	19.47	2.20
Surfynol DF 110D surfactant	4.87	0.58
Rheolate 310 thickener	9.73	1.17
Water	165.47	19.82
TIPure R 706	350.42	10.76
Igepal CO 897 surfactant	9.73	0.27
Surfynol 420 surfactant	4.87	0.58
Total	911.74	75.00
Total A + B	1150.22	100.00
PVC	20.8%	
VOC (lb/gal)	0.75	
VOC (gm/l)	90	
Wt Solids	79%	
Vol Solids	56%	

**TABLE 13:
STARTING POINT FORMULATIONS LIQUID
EPOXY BASED WHITE GLOSS ENAMEL**

A SIDE	lb	gal
Ancarez 555 Resin	413.63	45.05
Acrysol RM 8W thickener (25% in water)	41.36	4.96
Total	454.99	50.00
B SIDE		
Anquawhite 100 Curative	144.77	16.52
DI H ₂ O	188.20	22.55
Disperbyk 190 surfactant	10.34	1.17
DF 110D	4.14	0.50
R706	289.54	8.89
Surfynol 420 surfactant	3.10	0.37
Totals	1095.08	100.00
PVC	19.5%	
VOC (lb/gal)	0.11	
Vol Solids	65%	
Vol Solids	47%	

Epoxy Curing Agents and Modifiers

ANQUAWHITE™ 100 Curing Agent

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