

Epoxy Curing Agents and Modifiers

Anquamine® 721 Curing Agent

Technical Datasheet

Description

Anquamine 721 waterborne curing agent is a modified amine curing agent designed for use in waterborne epoxy coatings where cost effectiveness and high performance are key requirements.

Anquamine 721 curing agent can be formulated to low or zero VOC. It offers good pot life, good dry speed, and good emulsion stability even at low solids. Cured coatings exhibit high gloss, a balance of hardness and flexibility, and very good adhesion to concrete.

Advantages

- Cost Effective
- Low Color
- High Gloss
- Good Hardness Development
- Good Flexibility
- Excellent Adhesion to Concrete
- Zero VOC

Applications

- Concrete Primers
- Topcoats
- Wall Coatings

Storage Life

At least 12 months from date of manufacture in original sealed container at ambient temperature. Store away from excessive heat and humidity in tightly closed containers.

Handling Precautions

Refer to the Material Safety Data Sheet on Anquamine 721 curing agent.

Typical Properties

Appearance	Amber Liquid
Color ¹ (Gardner)	4
Viscosity ² @ 77 °F (cPs)	40,000
Amine Value ³ (mg KOH/g)	150-190
Specific Gravity @ 77 °F	1.05
Weight per Gallon	8.74
Flash Point ⁴ (°F)	>200
Total Solids Content (wt %)	50
Equivalent Wt/{H}	275
Recommended Use Level, (phr EEW 190)	140-180

Typical Handling Properties*

Pot Life	60-90 min *
Thin Film Set Time ⁵ (23 °C)	5.5 hrs*

Typical Performance*

Persoz Hardness	1 day @ 23 °C	175*
Persoz Hardness	7 days @ 23 °C	260*
Persoz Hardness	14 days @ 23 °C	300*

* Cured with liquid Bisphenol-A based epoxy resin (EEW=190) Use level 150 phr, 40% weight solids in water.

1. ASTM D 1544-80
2. Brookfield RVTD, spindle 4
3. Perchloric Acid Titration
4. Seta CC
5. ASTM D 5895 Stage III

Typical Cure Schedule

- 1) 2 to 7 days at ambient temperature.
- 2) Gel at ambient temperature plus 2 hours at 212 °F

Dilution

Anquamine 721 waterborne curing agent exhibits good viscosity reduction upon dilution with water. Figure 1 represents the viscosity dilution profiles of Anquamine 721 curative compared to Anquamine 360 and Anquamine 701 curing agents. Anquamine 360 is an industrial standard water soluble polyamide and exhibits high viscosity retention on dilution. Anquamine 721 curing agent retains viscosity at low solids for cost effective concrete primer and paint applications. This property is beneficial to formulate and apply paint with high body at low solids.

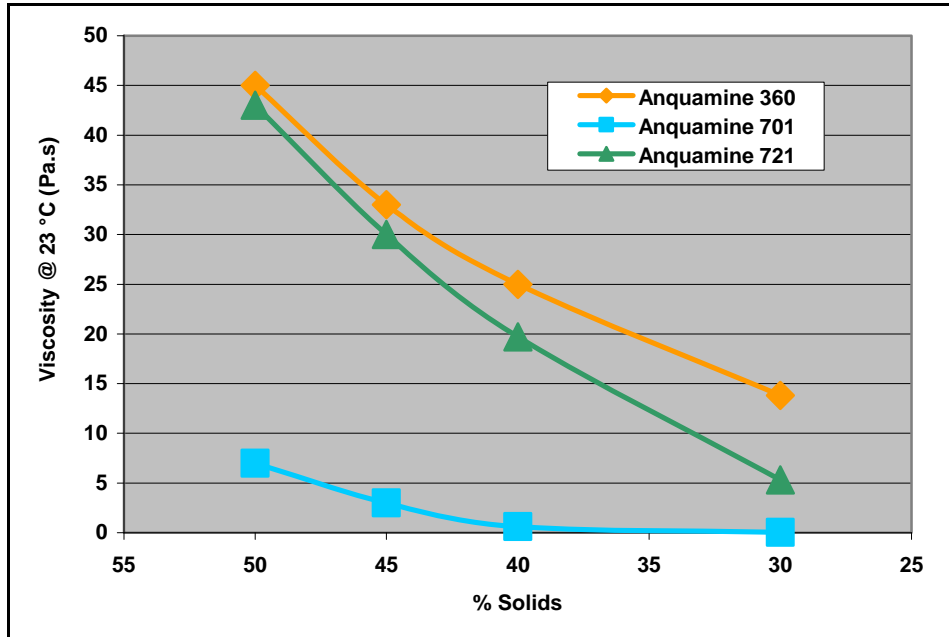


Figure 1 - Dilution profile Anquamine 360, Anquamine 701 and Anquamine 721 curing agents

Pot Life

The viscosity profile of Anquamine 721 curing agent exhibits a stable viscosity for at least 60 minutes to yield cured coatings with a high and constant gloss throughout the pot life. After 60-90 minutes a sharp increase in viscosity represents a visible end of pot-life.

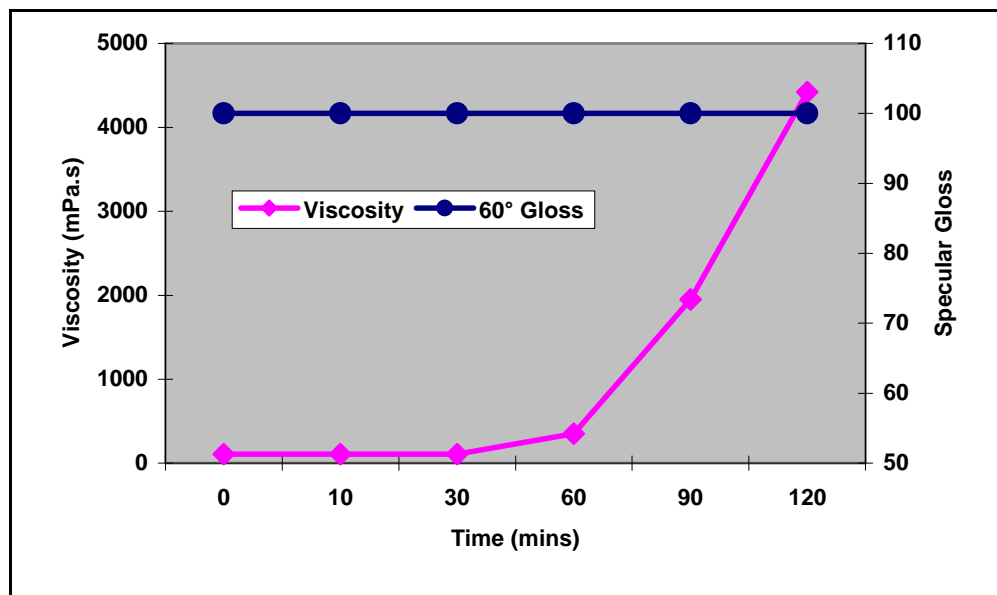


Figure 2 - Viscosity profile and 60° Gloss of Anquamine 721 curing agent (With standard LER EEW = 190, 150 phr, 40% solids)

Coating Properties

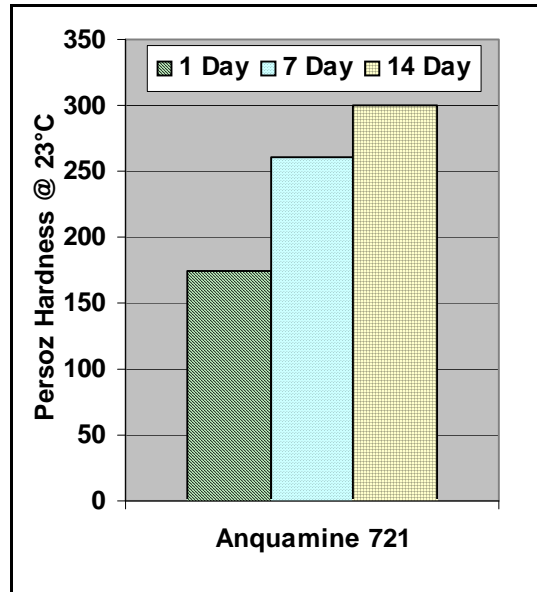


Figure 3 – Hardness Development and Dry Speed of Anquamine 721 curing agent with Liquid Epoxy Resin @ 23 °C

Figure 3 shows the hardness development of unmodified Bisphenol A diglycidyl ether epoxy resin cured with Anquamine 721 curing agent using a mix ratio of 150 PHR. Anquamine 721 curing agent yields coatings with an ultimate hardness of approximately 300 as measured by Persoz pendulum hardness with undiluted liquid epoxy resin.

It is recommended to use Anquamine 721 curing agent at advised stoichiometry of 150PHR (EEW=190). Anquamine 721 curing agent can be used at 10-15% above the recommended loading to accelerate hardness development and increase ultimate hardness by 25% without negatively impacting other properties.

Recommended Epoxy Resins

Anquamine 721 curing agent exhibits good compatibility with standard liquid epoxy resins based on Bisphenol A or F.

Reactive diluents will offer improved handling and formulating latitude within coating formulations. As with all systems, the inclusion of diluents will retard the hardness development and ultimate hardness of cured coatings.

When using diluent modified epoxy resins, it is advisable to add additional emulsifier to the epoxy resin. 5% emulsifier (based on epoxy resin weight) will improve epoxy diluent emulsification and avoid poor incorporation of the diluent into the coating.

A diluent level of 10% (based on epoxy resin weight) will yield a resin viscosity of approx. 2,000 cPs and deliver a good balance of handling and property development

Emulsifiers

Additional emulsifiers are recommended for formulations such as DIY products which may be hand mixed with low shear.

The typical use level is 5% emulsifier based on epoxy resin weight. Emulsifiers are most effective when added to the epoxy resin component of the formulation rather than the curing agent component.

EO-PO block copolymers such as Pluronic® P123 co-polymer have been effective.

Nonyl Phenol Ethoxylates such as Igepal® CO-897 and Hydropalat® 65 surfactants have also been effective. If using Hydropalat® 65 surfactant, increase use level to 7.5% to account for the lower solids content.

Dispersants / Defoamers / Wetting Agents

Defoamers such as Surfynol® DF62, Dee Fo® P-14, Tego® Foamex 822, and BYK® 045 are very suitable for use in coating formulations to give optimum air release and surface properties.

Pigment dispersants such as Surfynol® CT-131 and Disperbyk® 190 dispersants can be used to effectively aid in wetting pigments and increasing flow and leveling properties to give a system which yields good surface and flow properties.

Pigment dispersants should be pre-mixed with pigments before adding Anquamine 721 to avoid wetting pigment surfaces with Anquamine 721.

Rheology Modifiers

The Rheology of formulations with Anquamine 721 curing agent can be effectively controlled with the use of thixotropic agents such as polyurethane thickeners, hydroxyethylcellulose, and Bentonite clays.

Tafigel® PUR-55 and Natrosol® 250MHR modifiers have shown good thixotropic properties in paint formulations with Anquamine 721 curing agent, allowing for good application viscosity and anti-sag performance. However, due to the inherent thixotropy of Anquamine 721 curing agent systems can be formulated without the need of external thickeners.

Colorants

Anquamine 721 is compatible with a variety of tint bases such as COLORTREND® PLUS, COLORTREND®, COVON® and TYNT-AYD® WD and UL tint bases. In general waterborne epoxies are most compatible with non-ionically stabilized tint bases..

Starting Point Formulation – 2K Clear Concrete Primer

This clear coating is ideal as a concrete primer to seal the pores in the concrete and to provide excellent adhesion to the substrate and the following coat. This formulation is designed for all types of cementitious substrates including damp concrete. This primer can be overcoated with all types of systems including other waterborne or solvent free coatings. The primer formulation has 100 g/l VOC.

The primer is prepared by mixing Component-A and Component-B for 2 minutes to produce a homogeneous emulsion (mechanical or hand mixing is acceptable). Once the emulsion is formed, the formulation is ready to use.

			By Wt.	By Vol.
<i>A-Component</i>				
1. Liquid Epoxy Resin	EEW = 190	Various	24.35	4.05
2. Solid Epoxy Resin	EPON™ Resin 1001-H-75	Hexion	6.09	1.06
3. Benzyl Alcohol	Various	Various	1.24	0.23
4. PM Solvent	Various	Various	2.17	0.46
5. Emulsifier	Pluronic® P123 emulsifier	BASF	1.43	0.27
			35.28	6.07
A-Component Manufacture Procedure:				
<ul style="list-style-type: none"> • Charge components 1-2 and stir until homogeneous at low shear rate. • Add remaining components at low shear rate. 				
<i>B-Component</i>				
6. Curing Agent	Anquamine® 721 curing agent	Air Products	37.27	6.85
7. Defoamer	Dee Fo® PI-4 defoamer	Ultra Additives	0.19	0.04
8. Defoamer	Surfynol® 420 surfactant	Air Products	0.37	0.08
9. Diluent	DI Water	Local	26.27	5.07
10. Acetic Acid	Glacial	Various	0.62	0.11
			64.72	12.14
B-Component Manufacture Procedure:				
<ul style="list-style-type: none"> • Charge components 6-8 and stir until homogeneous at low shear rate. • Add remaining components at low shear rate. 				
Total			100.00	18.21

Notes:

Removing Solid Epoxy Resin will reduce VOC and moderately increase dry times

Benzyl Alcohol is considered 100% volatile for VOC and Solids calculations

Acetic Acid is added to extend pot life. Removing Acetic Acid will reduce VOC, shorten pot life and increase cure speed.

Hardness development can be improved by adding Ancamine K.54 accelerator (typical level: 1% based on curing agent weight) to the curing agent side of the formulation.

Technical Data

Mixing ratio - A to B	vol	1:2
Solid Content - Mix	%	47 wt / 50 vol
Pot-life	minutes	60
Mix Viscosity		
- Initial	cPs	665
- 60 minutes	cPs	900
- 90 minutes	cPs	3300
Dry-time (BK Recorder)		
- Thin film set time	hours	8.5

Starting Point Formulation – 3K Clear Concrete Primer

This clear coating which is ideal as a concrete primer system is prepared by taking 60 parts of Anquamine 721 curative and diluting to 40% solids. This is then mixed with 40 parts of component A for 2-3 minutes using hand mixing to produce a homogeneous emulsion. Once the emulsion is formed, water is slowly added to give the desired application viscosity and mixed for 1-3 minutes before application. To produce a coating with 40% mixed solids, 60 parts of water is required, this will give an initial application viscosity of 100 – 200 cPs.

			By Wt.
A-Component			
1. Liquid Epoxy Resin	EEW = 190	Various	40.0
B-Component			
1. Curing Agent	Anquamine® 721 curing agent	Air Products	60.0
2. Diluent	DI Water	Local	15.0
Sub Total			115.0
<i>Mix part A & B until emulsion is homogeneous</i>			
C-Component - General Primer (40% solids)			
4. Diluent	Water	Local	60.0
<i>After mixing Part A and B, water addition is required to adjust to application viscosity.</i>			

Technical Data

Mixing ratio - A to B to C	weight	40 : 75 : 60
Density - Mix	lb/gal	8.5
Solid Content - Mix	Wt %	40
Pot-life	minutes	60-90
Mix Viscosity		
- Initial	cPs	200
- 60 minutes	cPs	280
- 90 minutes	cPs	1400
Dry-time (BK Recorder)		
- Thin film set time	hours	5.5
Persoz Hardness	1 day	175
	7 day	260
	14 day	300

Starting Point Formulation – Semi-Gloss White Concrete Paint

This semi-gloss enamel is designed to produce tintable high aesthetic topcoats. Anquamine 721 curing agent exhibits exceptional pigment paste compatibility so that a variety of custom colors can be produced from one base formulation.

The paint formulation has 112 g/l VOC and can be readily modified to meet lower VOC targets.

The paint is prepared by mixing Component-A and Component-B for 2 minutes to produce a homogeneous mixture (mechanical or hand mixing is acceptable). Once mixed, the formulation is ready to use, no induction time is required.

			By Wt. (lb)	By Vol. (gal)
<i>A-Component</i>				
1. Liquid Epoxy Resin	EEW = 190	Various	141.8	14.7
2. Emulsifier	Pluronic® P123 emulsifier	BASF	8.5	1.0
3. Microcrystalline Silica	Imsil® A-10 silica	Unimin	73.6	3.3
4. DI Water		Local	48.7	5.8
5. Defoamer	Dee Fo® PI-4	Ultra Additives	1.6	0.2
			274.3	25.0
A-Component Manufacture Procedure:				
<ul style="list-style-type: none"> • Charge components 1-2 and stir until homogeneous at low shear. • Slowly component 3 while increasing speed to 10-20 ft/sec. • Grind with high speed disperser at approx. 70 ft/sec to a Hegman of 6. • Add remaining component at low shear rate. 				
<i>B-Component</i>				
6. Curing Agent	Anquamine® 721 curing agent	Air Products	226.3	25.9
7. Benzyl Alcohol	Various	Various	32.7	3.8
8. Acetic Acid	Glacial	Various	9.9	1.1
9. Defoamer	Tego® Foamex 822 defoamer	Degussa	2.0	0.2
10. Diluent	DI Water	Local	62.6	7.5
11. Dispersant	Surfynol® CT-131 surfactant	Air Products	4.9	0.5
12. TiO ₂	Ti-Pure® R-960 TiO ₂	DuPont	143.5	4.4
13. Talc	Talc WCD 399	Brenntag Specialties	81.0	3.4
14. Defoamer	Surfynol® 440 surfactant	Air Products	4.0	0.5
15. Thixotropic agent	2 % Natrosol® 250MHR	Hercules	214.5	25.6
16. Diluent	DI Water	Local	19.0	2.3
			797.1	75.0
B-Component Manufacture Procedure:				
<ul style="list-style-type: none"> • Charge components 6-8 and stir until homogeneous at low shear. • Slowly add components 9-11 at low shear. • Slowly add components 12-13 while increasing speed to 10-20 ft/sec. • Grind with high speed disperser at approx. 70 ft/sec to a Hegman of 6. • Add remaining components at low shear rate. 				
Total			1072.5	100.00

Notes: Benzyl Alcohol is considered 100% volatile for VOC and Solids calculations
Acetic Acid extends pot life. Removing Acetic Acid reduces VOC, shortens pot life & increases cure speed.

Hardness development can be improved by adding Ancamine® K.54 accelerator (typical level: 1% based on curing agent weight) to the curing agent side of the formulation, in this formulation, 1-3 lb.

Tint base such as COLORTREND®PLUS base from Degussa can be added to the B-Component; in this formulation 10 – 25 lb is acceptable.

Technical Data

Mixing ratio	- A to B	vol	1:3
Density	- Mix	lb/gal	10.73
Solid Content	- Mix	%	54 wt / 40 vol
Pot-life		hours	2.5
Mix Viscosity			
- Initial		KU	85
- 1 hr		KU	105
- 2 hr		KU	125
- 3 hr		KU	> 140
Dry-time (BK Recorder)			
- Thin film set time		hours	8.5
Persoz Hardness	14 day		184
Pencil Hardness	14 day		3H
Chemical Resistance	IPA rubs Toluene rubs MEK rubs		Pass at 200 Pass at 200 Fails at 62
Chemical Resistance 24 hr spot test	Vinegar Lemon juice Ketchup Mustard 10% acetic acid 30% nitric acid 60% perchloric acid Lactic acid		Pass Slight Stain Slight Stain Stain Softens, stain Fails Fails Fails

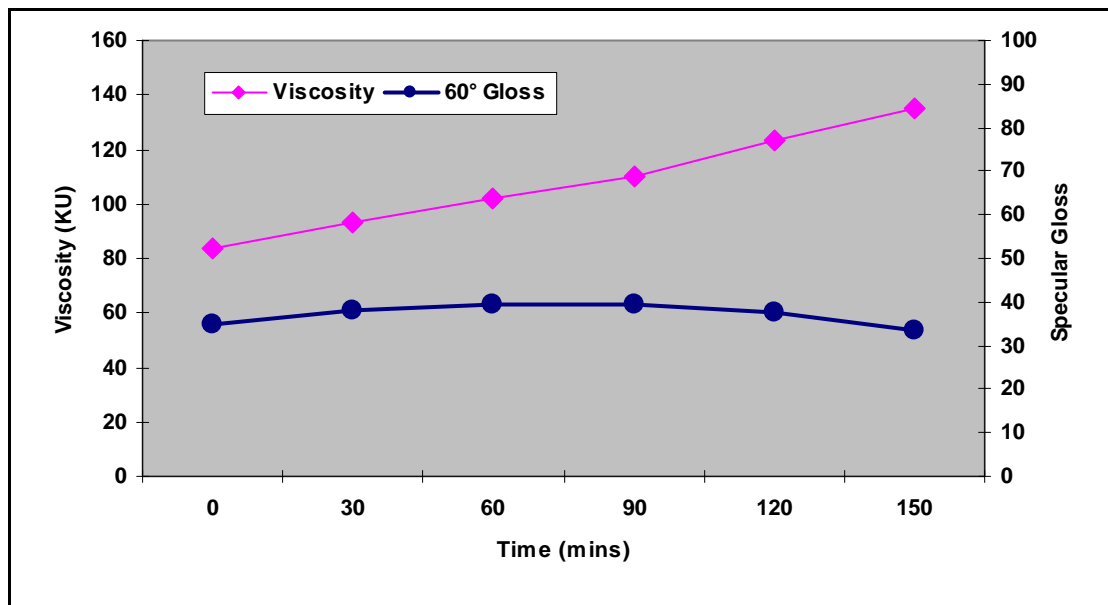


Figure 4 – Viscosity profile and 60 ° Gloss of Anquamine® 721 curing agent
(Semi-gloss concrete paint starting point formulation)

tell me more
www.airproducts.com