



PARALOID™ AU-946 High Solids Acrylic Polyol

Product Description

PARALOID AU-946 is a hydroxyl functional acrylic crosslinker specifically designed for urethane coatings. This resin is particularly well suited where high solids are desired. When combined with aliphatic isocyanates, PARALOID AU-946 gives high solids coatings, which have ambient cure, excellent gloss and tint retention, toughness, and chemical resistance.

Formulations which incorporate this resin are particularly suitable as durable, long lasting decorative topcoats. Such applications include ships, storage tanks, bridges, automobiles, railroad cars, or other areas requiring heavy duty maintenance protection.

A formulation based on PARALOID AU-946:

- retains gloss and tint thereby reducing the need to repaint as often.
- maintain film integrity when exposed to corrosive chemicals
- provide longlasting protection because of abrasion resistance
- lengthens the painting season because of low temperature cure.

A formulation based on PARALOID AU-946 which also contains PARALOID Reactive Modifier QM-1007 allows the formulator to:

- further lower VOC.
- improve flexibility and impact resistance.
- extend gloss and color retention.

Further information on PARALOID Reactive Modifier QM-1007 is found in the formulating section.

Typical Properties

These properties are typical but do not constitute specifications.

Non-volatile content, % (measured at 105°C)	69
Solids Content, % (measured at 150°C)	67
Viscosity, cPs, 25°C	8,750
Solvent	methyl-n-amyl ketone
Hydroxyl Equivalent Weight	
Solids Basis	420
As Supplied	610
Density, lbs./gal. As Supplied	8.6
Bulking Value lbs./gal. As supplied	0.116
Tg, °C	50
Molecular Weight, Mw	7,500
Acid Number	2

**Properties of a Urethane Coating
Based on PARALOID AU-946/LUXATE HT2000**

Application Properties	
Set to Touch Time, hrs.	1
Tack Free Time (500 grams Zapon), hrs.	3
Viscosity Profile	
#4 Ford Cup, Seconds, at application	
Initial	18
1 Hour	19
3 Hours	25
5 Hours	38
Performance Properties (2 Weeks Ambient Cure)	
Hardness	
Pencil	5H
Knoop Hardness Number	16
Gloss:	
20°	93-96
60°	96-98
Flexibility	
1/8" Mandrel	No cracks
Impact Resistance (in.-lb.)	
Direct	25
Reverse	4
Chemical Resistance (Pencil Hardness)	
Initial	5H
6 hour spot tests	
10% NaOH	4H
10% HCl	3H
10% Acetic Acid	H
30 minute spot tests	
Cleaning Solution*	HB
Toluene	2H
Methyl amyl ketone	4H

**50/47/3 Butyl Cellosolve/water/ammonia

Formulating Suggestions

The two-component formulations given herein are recommended for initial evaluation of PARALOID AU-946. The recommended ratio (solids basis) for PARALOID AU-946/aliphatic isocyanate is 69/31 weight percent. This corresponds to a slight excess of isocyanate resin (1.0/1.05 meq hydroxyl/isocyanate). For best pot life, polyurethane grade solvents are recommended and contamination with water should be avoided. The following formulating suggestions are offered:

Experimental Reactive Modifier

PARALOID Reactive Modifier QM-1007 is an oxazolidine-functional liquid of very low volatility which contains blocked active hydrogens that are activated upon exposure to moisture at ambient or elevated temperature. After activation, it reacts with isocyanates and becomes a permanent part of the coating.

The following physical properties of PARALOID Reactive Modifier QM-1007 are typical but should not be considered specifications.

Non-Volatiles, "in-can"*, %	98
Viscosity at 25°C, cps	50
Equivalent Weight	100
% Hydroxyl	9
% Amine	7
Density, lbs./gal.	8.9

*As supplied and formulated. Non-volatiles content in films exposed to moisture should be measured by EPA and ASTM standard methods.

Catalyst Suggestions

Coatings using PARALOID AU-946 develop properties more rapidly with the use of a tin catalyst such as Dabco® T-12 (dibutyltin dilaurate). In practice, we recommend levels of 0.005 to 0.02% based on vehicle solids. Zinc octoate at levels of 0.01 to 0.06% is also recommended. The lower levels appear to be better for chemical resistance properties and extended pot life, while the higher provides very rapid dry times.

Flow Aid

In many formulations, the addition of a flow aid is beneficial. Either SF-1023 Silicone or Byk 300 can be tried in this application at a maximum of 0.1% on total resin solids.

UV Absorbers

The addition of UV absorbers and light stabilizers (1% each of Tinuvin 328® and Tinuvin 292 on total resin solids) can enhance the weathering properties of acrylic urethane coatings.

Isocyanate

Aliphatic (hexamethylenediisocyanates; HMDI) isocyanates are recommended for best weathering properties. To achieve maximum solids content, Luxate HT2000 is recommended. The isocyanates of HMDI, such as Luxate HT2000 and Desmodur N-3300, impart better appearance durability in PARALOID AU-946 urethane coatings than the biurets of HMDI, such as Desmodur N-75. Desmodur N-3300 can be substituted on an equal solids basis for Luxate HT2000 in the formulation given herein.

Colorants

Most colors can be produced using a sand mill grind in PARALOID AU-946. In some instances, it may be preferable to use a grinding medium such as PARALOID DM-55. If predispersed colorants are preferred, we recommend the use of acrylic-based colorants.

Defoamer

Dehydran ARA-7219 has been found to be an effective air release agent at 0.1 to 0.2% (on total paint weight) to minimize foam, particularly in airless spray applications.

**Acrylic Urethane White Enamel Formulation
Based on PARALOID AU-946 and LUXATE HT2000**

	Pounds	Gallons
Acrylic Component A		
PARALOID AU-946	99.0	11.51
Methyl n-Amyl Ketone	97.0	14.25
TiPure [®] R-960	262.3	7.97
Sand grind the above for 20 minutes; filter and let down with the following:		
PARALOID AU-946	346.2	40.2
Methyl n-Amyl Ketone	40.1	5.90
Metacure T-12, 1% in MAK	0.4	0.1
Byk [®] 300	0.4	0.05
	845.4	80.00
Isocyanate Component B		
Luxate HT2000	133.5	14.31
PM Acetate (PUG)	41.5	5.69
	175.0	20.00
Totals	1020.4	100.00
Physical Constants		
Solids by Weight, %	68.0	
Solids by Volume, %	52.4	
Pigments Volume Concentration, %	15.2	
Pigment/Binder Ratio	38/62	
Acrylic/Isocyanate Weight Ratio	69/31	
Acrylic/Isocyanate Equivalent Ratio	1.0/1.05	
Viscosity, #4 Ford Cup, sec.	60-70	
Viscosity, #4 Ford Cup, sec., dilute w/MAK to spray viscosity	18	

**Properties of Urethane Coating
Based on PARALOID AU-946/DESMODUR N-75 and
Modified with PARALOID Reactive Modifier QM-1007**

PARALOID Reactive Modifier QM-1007	0%	20%	40%
% Catalyst (Metacure T-12)	.01%	.005%	.005%
Application Properties			
VOC, lbs./gal.	3.9	3.4	3.0
Set to Touch, hrs.	1/2	1 1/2	1 1/4
Tack Free to Touch, hrs.	1 1/4	2 1/4	2 1/4
Dry Hard, hrs.	>7	>7	4 3/4
Viscosity Profile			
#4 Ford Cup, Seconds			
Initial	25	26	25
1 hr.	38	38	45
2 hrs.	57	54	96
3 hrs.	78	82	165
Performance Properties (2 Weeks Ambient Cure)			
Hardness			
Pencil	2H	2H	2H
Tukon (KHN)	13.2	12.7	12.6
Gloss			
20°	94	91	91
60°	97	97	96
Flexibility			
1/8" Mandrel	No cracks	No cracks	No cracks
Impact Resistance (in.-lb.)			
Reverse	4	20	60
Chemical and Solvent Resistance			
3 Hour spot tests			
10% HCl	no effect	no effect	no effect
10% Acetic Acid	no effect	no effect	no effect
10% NaOH	no effect	no effect	no effect
30 minute spot tests			
Xylene	no effect	no effect	no effect
Unleaded Gas	no effect	no effect	no effect
Exterior Durability			
Tinuvin 292 and Tinuvin 328 UV Additives (1% on binder solids)			
FLORIDA SOUTH 5° BLACK BOX			
60°/20° Gloss			
Initial	97/91	97/93	98/92
12 Months	76/40	86/63	87/60
24 Months	63/27	76/43	77/44
SPRING HOUSE, PA SOUTH 45°			
60°/20° Gloss			
Initial	97/91	97/93	98/92
12 Months	87/64	87/67	88/67
24 Months	69/38	78/50	85/60

**Acrylic Urethane White Enamel Formulation Based on
PARALOID AU-946/Experimental Reactive Modifier QM-1007/DESMODUR N-75**

Experimental Reactive Modifier QM-1007, % total resin solids				
Materials	20% Modification		40% Modification	
	Pounds	Gallons	Pounds	Gallons
Acrylic Component A				
Titanium dioxide				
(Ti-Pure R-960)	194.4	6.02	221.3	6.85
PARALOID AU-946	88.6	10.30	100.8	11.72
n-Butyl acetate (PUG)	70.8	9.63	80.5	0.95
Sand grind the above to desired dispersion filter and let down with:				
PARALOID AU-946	225.0	26.16	129.2	15.02
PARALOID Reactive Modifier QM-1007	52.6	5.91	102.9	11.56
Metacure T-12 (1%)*	2.1	0.31	2.6	0.35
Benzoic Acid (20%)**	4.5	0.60	5.1	0.68
n-Butyl acetate (PUG)	<u>56.8</u>	<u>7.73</u>	<u>21.2</u>	<u>2.89</u>
	695.0	66.66	663.5	60.0
Isocyanate Component B				
Desmodur N-75BA	255.9	28.92	346.9	39.19
n-butyl acetate (PUG)	<u>32.4</u>	<u>4.42</u>	<u>5.9</u>	<u>0.81</u>
	288.3	33.34	352.8	40.00
Totals	983.3	100.0	1016.3	100.0
Physical Constants				
Solids by Weight, %		65.5		70.6
Solids by Volume, %		52.0		58.1
Pigments Volume Concentration, %		11.6		11.8
Pigments/Binder Ratio		30/70		30/70
Acrylic/Diluent/Isocyanate Ratio				
by Weight Solids		46.2/11.6/42.2		29.8/19.9/50.3
Viscosity, #4 Ford Cup, sec		25		25
VOC, lb./gal.		3.4		3.0

*Metacure T-12 is reduced to 1% with n-butyl acetate to facilitate addition.

**Benzoic acid is dissolved at 20% solids in ethanol.

Sources of Materials Recommended

Designation	Description	Supplier
PARALOID DM-55	Dispersing Resin	The Dow Chemical Company Independence Mall West Philadelphia, PA 19105 215-592-3000
Byk 300	Flow Aid	Byk-Chemie USA 524 South Cherry Street Wallingford, CT 06492 203-265-2086
Metacure T-12	Tin Catalyst	Air Products & Chemicals Inc. P.O. Box 538 Allentown, PA 18105 800-345-3148
Dehydran ARA-7219	Defoamer	Henkel Corp. Process Chemicals Division 350 Mt. Kemble Avenue Morristown, NJ 07960 201-267-1000
Desmodur N-75BA Desmodur N-3300 Desmodur N-3390	Aliphatic Isocyanate	Bayer Corporation 100 Bayer Road Pittsburgh, PA 15205 412-777-2000
Colortrend 844 Series	Predispersed Colorants	DeGussa (Creanova) 220 Davidson Avenue Somerset, NJ 08873 732-560-6724
PM Acetate	Solvent	Lyondell Chemical 3801 West Chester Pike Newtown Square, PA 19023 610-359-2000
SF-1023 Silicone	Flow Aid	General Electric Co. Mechanicville Road Waterford, NY 12188 518-237-3330
Tinuvin 328 Tinuvin 292	UV Absorbers	CIBA Specialty Chemicals 540 White Plains Road Tarrytown, NY 10591 800-200-8224
TiPure R-960	Titanium Dioxide	E. I. duPont de Nemours & Co., Inc. Chemicals & Pigments Dept. Wilmington, DE 19898 800-441-9442
Luxate HT 2000	Aliphatic Isocyanate	Lyondell Chemical 3801 West Chester Pike Newtown Square, PA 19023 610-359-2000

Safe Handling Information

PARALOID AU-946 was found to be practically non-toxic in acute oral and dermal tests (LD50 >50 gm/kg) on laboratory rats and rabbits, respectively. It was slightly irritating to their eyes. This material may be a slight-to-moderate skin and eye irritant in humans.

The hazards associated with this product are due to the solvent. The product is highly flammable. Vapors can travel to a source of ignition and flash back. Heated material can form explosive vapors with air. It is important that Material Safety Data Sheets be reviewed to assure safe handling and storage.

Acute toxicity testing on PARALOID Reactive Modifier QM-1007 showed it to be practically non-toxic via single oral or dermal exposure LD50 >5 gm/kg in both cases. It was practically non-irritating to rabbit skin and moderately irritating to eyes. Reaction of PARALOID Reactive Modifier QM-1007 with water or moist air releases isobutyraldehyde, a severe eye and skin irritant.

Isocyanates recommended for formulation use in this bulletin are known health hazards if not handled properly. We, therefore, recommend that you contact your supplier of isocyanates for information regarding appropriate health and safety precautions for these materials prior to using them in your facilities.

The Dow Chemical Company Company maintains Material Safety Data Sheets (MSDS) on all of its products. These sheets contain pertinent information that you may need to protect your employees and customers against any known health or safety hazards associated with our products.

The Dow Chemical Company recommends that you obtain copies of our Material Safety Data Sheets on each of our products from your local Dow representative prior to its use in your facilities. We also suggest that you contact your supplier of other materials recommended for use with our products for appropriate health and safety precautions prior to their use.

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