PARALOID™ WR-97 Water-Reducible Acrylic Resin

Description

PARALOID WR-97 water-reducible acrylic solution resin can be crosslinked with urea and melamine resins to produce general purpose industrial coatings. These coatings systems are sprayable and can be produced in pebble or roller mills or in high speed dissolvers. Being water-reducible, they can be formulated to meet clean air regulations restricting the type and amounts of solvent emissions.

Typical properties of clear films and pigmented coatings as a function of melamine level and type are included in these notes.

Several different grinding procedures have been evaluated. These formulations are also included.

Typical Film Properties

PARALOID WR-97 resin has been evaluated in baked films crosslinked with Uformite™ MM-83 and Cymel™ 303 at an 80/20 acrylic/melamine ratio. Data for both clear and pigmented films are given in Table 1 to compare the results obtained with these melamine resins. Uformite MM-83 was evaluated at two acrylic/melamine ratios to evaluate the effect on this formulation variable. The results of the evaluation are given in Table 2.

Uformite MM-83 is supplied at 80% solids in alcohol by Reichhold Chemical Co. while Cymel 303 is supplied by American Cyanamid at 100% solids.

The pigmented formulation results were obtained using roller mill grinds similar to the one given in the formulation section (CTS-197-1). Similar results would be expected using the other grinding techniques since identical formulation constants are obtained.

Typical Physical Properties
These properties are typical but do not constitute specifications.

Appearance	Clear Viscous Liquid
Solids Content	69 to 71%
Solvent System	Isopropanol/butyl Cellosolve 83/17
Weight Per Gallon	8.34 lb
Specific Gravity	1.01
Flash Point, PMCC	62°F
Viscosity	10,000 to 17,500 cps.
Acid Number	39

Table 1: Film Properties PARALOID WR-97/Nitrogen Resin (80/20) ~ 1.2 mil on BONDERITE™ 1000

Nitrogen Resin	**Uformite MM-83**			**Cymel 303***		
Temperature, °F	300	350	350	300	350	350
Time, min.	30	10	20	30	10	20
Clear						
Hardness (KHN)	4.5	4.8	5.1	6.5	7.2	7.9
Mandrel flexibility, 1/4"	OK	OK	OK	OK	OK	OK
Impact resistance, direct	75	55	45	115	65	65
reverse	35	35	7	55	25	25
Print resistance	Good	Good	V. Good	Exc.	Exc.	V. Good
Pigmented (40/60 P/B ratio, pigment is rutile titanium dioxide)						
Hardness (KHN)	6.8	6.4	6.1	8.1	9.0	10.4
Mandrel flexibility, 1/4"	OK	OK	OK	OK	OK	OK
Impact resistance, direct	35	25	35	85	75	65
reverse	7	3	2	15	3	7
Print resistance	V. Good	V. Good	V. Good	Exc.	Exc.	Exc.
Gloss						
20°	75	75	76	86	85	83
20° overbake**	70	76	76	83	79	83
60°	91	91	91	97	97	97
60° overbake**	88	92	91	97	95	96
Color K						
initial	5.3	5.7	5.6	4.8	5.6	5.6
overbake**	6.6	5.6	5.6	5.9	5.2	6.6
Staining, 30 min						
mustard	Trace	Trace	Trace	None	None	None
ink	Light	V. Light	V. Light	None	None	None
lipstick	None	Trace	Trace	Trace	None	None
Solvent resistance, 30 min						
initial hardness	2H	2H	2H	2H	2H	2H
xylene	5B	5B	5B	B	2B	HB

* This system contains 1% Catalyst 1010 on binder. This was based on the supplier's recommendation and the level has not been optimized.

**Overbake conditions are 16 hours at 400°F (204°C).

Table 2: Film Properties PARALOID WR-97/Uformite MM-83 ~ 1.2 mil on BONDERITE 1000						
Ratio	**80/20**			**70/30**		
Temperature, °F	300	350	350	300	350	350
Time, min.	30	10	20	30	10	20
Clear						
Hardness (KHN)	4.5	4.8	5.1	11.1	9.4	10.3
Mandrel flexibility, 1/4"	OK	OK	OK	OK	OK	OK
Impact resistance, direct	75	55	45	35	25	25
reverse	35	35	7	7	3	3
Print resistance	Good	Good	V. Good	V. Good	V. Good	V. Good
Pigmented (40/60 P/B ratio, pigment is rutile titanium dioxide)						
Hardness (KHN)	6.8	6.4	6.1	12.6	10.5	11.2
Mandrel flexibility, 1/4"	OK	OK	OK	OK	moderate cracking	severe cracking
Impact resistance, direct	35	25	35	25	15	15
reverse	7	3	2	3	2	2
Print resistance	V. Good	V. Good	V. Good	Good	V. Good	V. Good
Gloss						
20°	75	75	76	75	75	75
20° overbake*	70	76	76	72	74	72
60°	91	91	91	91	91	91
60° overbake*	88	92	91	90	91	90
Color K						
initial	5.3	5.7	5.6	5.7	6.2	5.7
overbake*	6.6	5.6	5.6	5.5	5.6	5.9
Staining, 30 min						
mustard	Trace	Trace	Trace	Trace	Trace	None
ink	Light	V. Light	V. Light	V. Light	Trace	Trace
lipstick	None	Trace	Trace	None	None	None
Solvent resistance, 30 min						
initial hardness	2H	2H	2H	2H	2H	2H
xylene	5B	5B	5B	HB	HB	HB

*Overbake conditions are 16 hours at 400°F (204°C).

FORMULATION INFORMATION

Reduction Procedure

PARALOID WR-907 resin is supplied at 70% solids content in an isopropanol-butyl Cellosolve mixture. The resin must be neutralized to attain a clear solution. The following table gives the formulation. The dimethylaminoethanol should be premixed with PARALOID WR-97 before the water is added.

Material	Parts
PARALOID WR-97 (as supplied)	71.4
Dimethylaminoethanol (DMAE)	2.2
Water	26.4
	100.0

The above formulation results in 70% neutralization of the resin. If the solution does not clear, add a small amount of additional DMAE. Excessive DMAE should be avoided since an undesirably large viscosity increase will result.

For ease of handling, after neutralization, the resin should be reduced to 50% solids with water. As water is added, the PARALOID WR-97 will initially thicken or "body", but it will thin out as more water is added.

Defoamer

If a defoamer is required, there are several which are recommended. A higher chain alcohol (greater than 5 carbons long) such as octanol or dodecanol can be used at 2 to 3 weight % on binder solids. Alternatively, at 0.5 weight % on binder solids, Patcote 519 or Patcote 577 from Patco Coatings Products, or WS-211 from Wacker Chemical are also effective.

Compatibility of PARALOID WR-97

The compatibility of PARALOID WR-97 resin after being partially neutralized and reduced with water to 50% solids was determined with several other aqueous film forming materials. The results of these determinations are given in the following table:

Table 3: Compatibility of PARALOID WR-97 Ratio on Solids Basis PARALOID WR-97/Other Resin

	80/20	50/50	20/80
Aqueous colloidal dispersion			
ACRYSOL™ I-98	S	S	C
ACRYSOL WS-24	C	C	C
ACRYSOL WS-50	C	C	C
Aqueous acrylic emulsion			
RHOPLEX™ AC-604	C	C	C
RHOPLEX AC-658	I	I	I

C - compatible, S - slight haze, I - incompatibility evidenced by phase separation.

Starting Point Formulations

Formulations utilizing several grinding techniques are presented in this section for use in initial evaluation of PARALOID WR-97. Formulations of this type were used to determine the typical film properties given in Tables 1 and 2. All of these formulations may require a slight adjustment in dimethylaminoethanol level to achieve correct spray viscosity.

High-Gloss White Baking Finish Roller Mill Grind - Based on PARALOID WR-97 Experimental Formulation CTS-197-1	
Roller mill grind: (3 passes)	
PARALOID WR-97 (as supplied)	300.0
Dimethylaminoethanol	7.8
Rutile titanium dioxide	300.0
	607.8
Letdown	
Roller mill grind above	607.8
PARALOID WR-97 (as supplied)	127.5
Uformite MM-83 (as supplied)	93.6
Dimethylaminoethanol	3.3
Water	782.4
	1614.6
Formulation constants	
Pigment/binder ratio	44.5/55.5
Acrylic/melamine ratio	80/20
Solids content	41.7%
Water/solvent ratio, by volume	80/20
Spray viscosity, No. 4 Ford cup	30 seconds
VOC, lb/gal (calculated)	2.2

High-Gloss White Baking Finish Cowles Dissolver Grind - Based on PARALOID WR-97 Experimental Formulation CTS-197-2	
Charge to the tank and mix at low speed:	
PARALOID WR-97 (50% solids reduced with water; see the "Reduction Procedure" section)	150.0
Water	110.0
Add gradually while increasing speed:	
Rutile titanium dioxide	340.0
Grind at high speed for 12 to 15 minutes then reduce speed and letdown with the following:	
Water	734.1
Dimethylaminoethanol (DMAE)	9.8
PARALOID WR-97 (as supplied)	377.6
Uformite MM-83 (as supplied)	106.1
	1,827.6
Formulation constants	
Pigment/binder ratio	44.5/55.5
Acrylic/melamine ratio	80/20
Solids content	41.7%
Water/solvent ratio, by volume	80/20
Spray viscosity, No. 4 Ford cup	30 seconds
VOC, lb/gal (calculated)	2.2

High-Gloss White Baking Finish Sand Mill Grind - Based on PARALOID WR-97 Experimental Formulation CTS-197-3	
Charge to sand mill and grind: (15 minutes)	
PARALOID WR-97 (50% solids reduced with water; see the "Reduction Procedure" section)	20.0
Rutile titanium dioxide	50.0
Water	30.0
Sand	100.0
Filter then letdown as follows:	
Filtered grind above	89.00
PARALOID WR-97 (as supplied)	50.71
Uformite MM-83 (as supplied)	13.88
Dimethylaminoethanol (DMAE)	1.32
Water	84.62
	239.53
Formulation constants	
Pigment/binder ratio	44.5/55.5
Acrylic/melamine ratio	80/20
Solids content	41.7%
Water/solvent ratio, by volume	80/20
Viscosity, No. 4 Ford cup	30 seconds
VOC, lb/gal (calculated)	2.2

High-Gloss White Baking Finish Pebble Mill Grind - Based on PARALOID WR-97 Experimental Formulation CTS-197-4	
Pebble mill grind: (16 hours)	
PARALOID WR-97 (50% solids reduced with water; see the "Reduction Procedure" section)	20.0
Rutile titanium dioxide	50.0
Water	30.0
Letdown	
Pebble mill grind above	100.0
PARALOID WR-97 (as supplied)	57.0
Uformite MM-83 (as supplied)	15.6
Dimethylaminoethanol	1.5
Water	95.0
	269.1
Formulation constants	
Pigment/binder ratio	44.5/55.5
Acrylic/melamine ratio	80/20
Solids content	41.7%
Water/solvent ratio, by volume	80/20
Spray viscosity, No. 4 Ford cup	30 seconds
VOC, lb/gal (calculated)	2.2

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