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WEATHER-BARRIER MASTICS
IMPROVED PERFORMANCE WITH AN EXPERIMENTAL ACRYLIC LATEX MIXTURE IN THE FORMULATION

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SUMMARY A mastic formulation has been developed based on a mixture of UCAR Latex 874 HS (90.3%) and BAKELITE Aqueous Ink Resin M-3 (9.7%). The new mastic passes the shrinkage tests, elongation and low temperature requirements for an acrylic mastic. Exposure performance has not been established as yet.

The most striking feature of the new mastic, compared to product based on UCAR Latex 891, is much improved adhesion to glass, ceramic tile, aluminum, steel and wood. In addition there is reason to believe the new latex will minimize some of the settling and foaming problems which have plagued UCAR 891.

INTRODUCTION The investigation of a new latex for weather-barrier mastic formulation application was started for two reasons. One, there has been a recurring question about the product stability of UCAR Latex 891 by one of our customers, B and B Engineering, of Houston, Texas. Secondly, Mr. Herb Rosenblatt, Technical Director of Desota, Inc., Sonneborn Division, DesPlaines, Illinois, expressed interest to Mr. Frank Squillaro, Carbide Salesman, for a mastic that had good adhesion to wood and steel substrates and have a certain degree of flame retardancy (1).

Messrs. W. F. Hill, Jr., of this Department, and C. E. Metten, now in the Sales Department, developed the UCAR 891, E-1166, basic mastic formulation. The basic formulation is a good one. However, it did not meet the basic adhesion requirements of Mr. Rosenblatt and was difficult to formulate with UCAR 891. Attempts to get adhesion with UCAR 891 and Silane Adhesion Promoter A-187 were successful; however, prolonged mastic storage resulted in an unstable mastic.

DISCUSSION The performance of UCAR Latex 891 in mastic formulating has been somewhat spotty, according to Mr. Joe Venable of B and B Engineering. On a recent visit with Mr. Venable, he indicated a strong desire for a more stable latex for this application. Coincidental with Mr. Venable's problem was the request from Mr. Rosenblatt for a mastic with good adhesion properties. Work was already in progress on the use of BAKELITE Aqueous Dispersion M-3 [ethylene/20% acrylic acid copolymer in dimethylethanolamine and water (32.5% S)], as an adhesion promoter in UCAR Latex 874 HS (58% S).

The mixture of UCAR 874 and M-3 resins gives a clear film which is softer than either resin. For example, the Sward Hardness of a 0.008 inch cured film of UCAR Latex 874 was 4, the M-3 was 3, and a 96%/4% M-3 mixture reading was 1. A qualitative observation under the microscope also indicates that the mixture has a softer film than either latex cured singly. Both latexes are softened by FLEXOL Plasticizers TBF and tricresyl phosphate. The latex mixture, used in the E-1166 mastic formulation, consisted of 90.3% by weight UCAR Latex 874 HS (58% S) and 9.3% M-3 (32.5% S). The mixture contains about 55.5% S. The shelf stability of the mixture is still good at 2 1/2 months. There are no apparent seeds, separation, or viscosity build-up.

The only other change made in the E-1166 basic formulation was to use Calidria SG-210 Grade asbestos. The original formulation suggested asbestos 7M (40 parts) and 5K (20 parts). The latter is a long fiber type asbestos.

Basic Formulation (12-DHR-50) and Estimated RMC

The basic mastic formulation is listed in attached Table I. The formulation has a higher total solids content than the former E-1166 (71% versus 64) and a subsequent slightly higher density (10.5 versus 10.42 lbs/gal). In calculating the estimated RMC, 80 cents/dry pound was used for the M-3 resin. This, along with the higher TS, increased the estimated RMC from $1.40/gallon to $1.65/gallon. As a note of interest, the latter cost is in the range of a low quality butyl rubber caulk.

The mastic mixing procedure, using UCAR 891 Latex, was quite critical with respect to excess foam, aeration, and mastic viscosity stability. In the suggested mixing procedure for (12-DHR-50), Table II, the only ingredient that might take a little extra time to wet is asbestos. This caution is needed to minimize lumping. In general, foam has not been a problem. The final formulation is certainly not air-free; however, air has not posed a problem in the formulations made to date (3 one-gallon batches).

Tensile, Elongation Test Data

The weather-barrier mastic (12-DHR-50), was tested by the tentative test procedures shown in attached Appendix A. The tensile and elongation data are listed in Table III. These data were obtained by Mr. D. H. Mullin, of this Department. A comparison of the average results with those of E-1166(3) and a commercial material, from the Napco Corporation, Houston, Texas, are depicted in Table VI. The data are those representating accelerated aging cure. The most notable differences are in the % elongation values. As expected, the tensile strength, psi, decreased somewhat. This usually happens when the film elongation increases, particularly when the only change is in additives.

In general, the new latex mixture increased elongation from about 45 to 200%. The Napco material has very little elongation. As a result, it has a significantly higher tensile strength. The Napco mastic film extensibility is such that shrinkage cracks might present a problem.

180° Peel Adhesion

Perhaps the most important data, as far as Desoto is concerned, are the 180° Peel Adhesion results. These data are listed in Table IV. Corresponding data on the UCAR 891 Latex and Napco materials are shown in Table VII. These data show that the adhesion properties of the cured films increase from 0.5 p.i. to about 22 p.i. on difficult to bond substrates. In addition, test number 11, Table IV, shows that, with incomplete drying, see Figure 1, on a porous substrate (pinewood), complete rewetting (submersion in water), and on redrying there is still excellent adhesion. The bond to glass, aluminum, steel, wood, and ceramic tile are such that cohesive film failure is obtained. In contrast, E-1166 and Napco materials show adhesive film failures, under the same test conditions, Appendix A. These results represent a tremendous improvement over the UCAR 891 Latex mastics.

Miscellaneous Test Data

There were certain miscellaneous tests performed on the material that are pertinent to end-use applications. These data are listed in Table V, and pertain to the film hardness, slump, temperature sensitivity, shrinkage, and viscosity stability. Also included is the drying rate on a non-porous substrate, at room temperature, Figure 1.

The (12-DHR-50) mastic is softer than the E-1166 formulation with UCAR 891 Latex. It has a Shore A Hardness of 23.6, as opposed to about 75 for E-1166. This will probably make it more subject to dirt pickup. The material does not slump, shrink from the lips of a filled aluminum cup, has very little viscosity buildup under accelerated temperature conditions, and the cured film is flexible at -15°C.

It should also be noted, in Figure 1, that on a non-porous substrate, the removal of the last traces of water is quite slow. The theoretical water content is 28.9% by weight. About 9% water still remained in the 1/16-inch film after 23 hours. However, the surface cure of the applied film is such that it is not attacked by running top-water, after about 2 hours, Figure 1. This was determined by casting a (6X.025 inch) film on glass and checking water sensitivity at various time intervals. At two hours cure, at (77°F-50% R.H.), the film appeared impervious to tap-water, even under pressure. This means that rain-water should not be a problem if it occurs a couple of hours after application.

BIBLIOGRAPHY

(1) D. Harold Reed, Letter to Mr. Frank Squillaro, Clifton Sales Office, May 12, 1969.

(2) D. Harold Reed, Letter to Mr. R. M. Nilson, Chicago Sales Office, August 15, 1969.

(3) C. E. Metten, Letter to Mr. J. Nesmith, New York Office, 33rd Floor, February 26, 1969.

NOTEBOOK REFERENCE: 12-DHR-50

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Attachments
7 Tables
1 Figure
1 Appendix A

TABLE I

WEATHER BARRIER MASTIC (12-DHR-50)

Ingredients	Pounds	Pounds/ 100 Gallons	% by Wt
1. Experimental UCAR Latex, Union Carbide (55.5% T)	2434.8	681.89	64.39
2. Pigment Paste Dispersion Super Imperse Blue B (50% T)	3.6	1.01	0.10
3. Calgon	11.2	3.14	0.30
4. Calidria SG-210 Asbestos, Union Carbide	44.0	12.22	1.16
5. Mica, Mineralite 3X	508.8	142.48	13.45
6. Titanium Dioxide (R-901)	35.2	9.85	0.93
7. Clay, Kingsley	169.2	47.39	4.47
8. Chlorowax 70	79.2	22.19	2.09
9. Antimony Oxide	6.0	1.71	0.16
10. Dicalite SA-3	248.4	69.57	6.58
11. Tricresyl Phosphate, Union Carbide	223.6	62.62	5.91
12. PMA-30	8.0	2.23	0.21
13. Colloid 581B (15% T)	9.6	2.70	0.25
	3781.6	1059.00	100.00

Total Solids, % by wt	71.1
Density, lbs/gallon	10.59
Estimated RMC, $/gallon	1.65

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TABLE II

WEATHER BARRIER MASTIC (12-DHR-50)

SUGGESTED MIXING PROCEDURE

Ingredients and Order of Addition

1. Experimental UCAR Latex
2. Pigment Paste Dispersion, Super Imperse Blue B (50% S)
3. Calgon
   Note: Mix until homogeneous
4. Calidria SG-210 Asbestos
   Note: Mix until lumps have disappeared, or until the asbestos is thoroughly wet.

Add Singly or as a Mixture

5. Mica, Mineralite 3X
6. Titanium Dioxide (R-901)
7. Kingsley Clay
8. Chlorowax 70
9. Antimony Oxide
10. Dicalite SA-3
    Note: Mix until the particles are wetted.
11. Tricresyl Phosphate
12. PMA-30
13. Colloid 581B
    Mixing: The above mixture is then mixed for two hours in a one-gallon Baker-Perkins, Sigma Blade Type Mixer, at 79 rpm. A plant-size mixer, in most cases, is more efficient.

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TABLE III

TENSILE DATA
WEATHER BARRIER MASTIC (12-DHR-50)

Film Cured 1/2 Hour at 150°F

Tests Run at Room Temperature

	Tensile, psi		% Elongation	
	Break	Yield	Break	Yield
	33	80	314	64
	38	68	261	69
	44	66	147	70
	39	77	216	64
	43	66	264	85
	30	68	308	70
Avg.	38	71	252	70

Tests Run at 35°F

	Tensile, psi		% Elongation	
	Break	Yield	Break	Yield
	299	-	>200 (a)	-
	205	-	>200 (a)	-
	232	-	>200 (a)	-
	310	-	120	-
Avg.	261		Approx. 200	

Note: (a) Non-breaks, reached limits of extensibility in environmental chamber.

Film Cured at Hours/°F: 0.5/150 + 0.5/225 + 1.5/300

Tests Run at Room Temperature

	Tensile, psi		% Elongation	
	Break	Yield	Break	Yield
	189	201	219	164
	162	163	218	213
	177	203	226	166
	202	206	200	170
	168	177	277	210
	203	207	229	200
	164	166	259	203
	108	115	222	150
Avg.	172	180	231	185

Tests Run at 35°F

	Tensile, psi		% Elongation	
	Break	Yield	Break	Yield
	491	-	173	-
	575	-	186	-
	630	-	144	-
	444	-	>200 (a)	-
	395	-	143	-
	217	-	>200 (a)	-
	245	-	>200 (a)	-
	213	-	>200 (a)	-
Avg.	401		Approx. 200	

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TABLE IV

WEATHER BARRIER MASTIC (12-DHR-50)
TENSILE ADHESION DATA, 180° PEEL TEST (b)

Films Cured 3 Days at 77°F - 50% Relative Humidity

		Tensile, p.i.	Type of Failure
1.	180° Peel, Adhesion to yellow pine wood	19.0 (a)	Cohesive
2.	180° Peel, Adhesion to aluminum	18.5 (a)	Cohesive
3.	180° Peel, Adhesion to steel	19.0 (a)	Cohesive
4.	180° Peel, Adhesion to glass	15.4 (a)	Cohesive, trace of adhesive
5.	180° Peel, Adhesion to ceramic tile	19.0 (a)	Cohesive, trace of adhesive

Films Cured Overnight at 60°C,
Recondition to 77°F - 50% R. H.

6.	180° Peel, Adhesion to aluminum	20.53 (a)	Cohesive
7.	180° Peel, Adhesion to steel	21.30 (a)	Cohesive
8.	180° Peel, Adhesion to glass	22.00 (a)	Cohesive
9.	180° Peel, Adhesion to ceramic tile	22.00 (a)	Cohesive
10.	180° Peel, Adhesion to yellow pine wood	22.00 (a)	Cohesive
11.	180° Peel, Adhesion to yellow pine wood	26.5	Cohesive (c)

Note: (a) The films were pulled to maximum extensibility and then cut with a razor blade to get the average p.i. over a (6" x 1") area.

(b) See Test Procedure.

(c) The film was cured overnight at 77°F-50% R.H., submerged 24 hours in water, cured 4 days at 77°F-50% R.H., and then tested.

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TABLE V

WEATHER BARRIER MASTIC (12-DHR-50)
ADDITIONAL PROPERTIES

1. Shore A Hardness (5" x 2" x 1/4") Film on Aluminum 23.6

2. Film Flexibility (6" x 1" x 0.025") Film on Teflon:

   (a) At -20°C becomes hard

   (b) At -15°C will wrap around a 1/2" diameter preconditioned aluminum rod.

3. Viscosity Stability

   (a) At 23°C 101 grams through a 1/8" orifice, under 50 psi pressure in a 6-oz polyethylene caulk cartridge, in 10 seconds.

   (b) After 20 days in 60°C oven, 113 grams under the same condition.

4. Slump in a 6" x 3/4" width x 1/2" depth steel channel - None

5. Aluminum cup shrinkage - No cracking or pulling away from the lips of the cup.

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TABLE VI

TENSILE PROPERTIES

COMPARISON OF COMMERCIAL AND "UCAR" 891 MASTICS WITH (12-DHR-50)

TEST TEMPERATURE[b]

	Room Temperature		35°F	
	Tensile, psi	% Elongation	Tensile, psi	% Elongation
(12-DHR-50)	172	231	401	Approx.200[c]
UCAR 891 (E-1166)[a]	483	44	819	59
NAPCO Mastic, S-2308, Napco Corporation, Houston, Texas	600	19	1870	4

Note:

[a]Letter by Mr. C. E. Metten to Mr. J. Nesmith, February 26, 1969.

[b]The above films were cured 0.5 hours at 150°F plus 0.5 hours at 225°F plus 1.5 hours at 300°F to simulate aged conditions. The Instron data were obtained by Mr. D. H. Mullins.

[c]Non-breaks, four of the eight test films reached limits of extensibility in the environmental chamber.

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TABLE VII

WEATHER BARRIER MASTICS

TENSILE ADHESION DATA, 180° PEEL TEST

FILMS CURED 3 DAYS AT 77°F - 50% RELATIVE HUMIDITY

UCAR 891 Mastic Formulation E-1166

		Tensile, p.i.	Type of Failure
1.	180° Peel, Adhesion to steel	3.6	Adhesive, trace of cohesive
2.	180° Peel, Adhesion to aluminum	1.0	Adhesive
3.	180° Peel, Adhesion to glass	1.5	Adhesive
4.	180° Peel, Adhesion to yellow pine wood	2.0	Adhesive

Napco, A Commercial Mastic

		Tensile, p.i.	Type of Failure
5.	180° Peel, Adhesion to steel	2.0	Adhesive
6.	180° Peel, Adhesion to aluminum	0.5	Adhesive
7.	180° Peel, Adhesion to glass	3.0	Adhesive
8.	180° Peel, Adhesion to yellow pine wood	4.5	Adhesive

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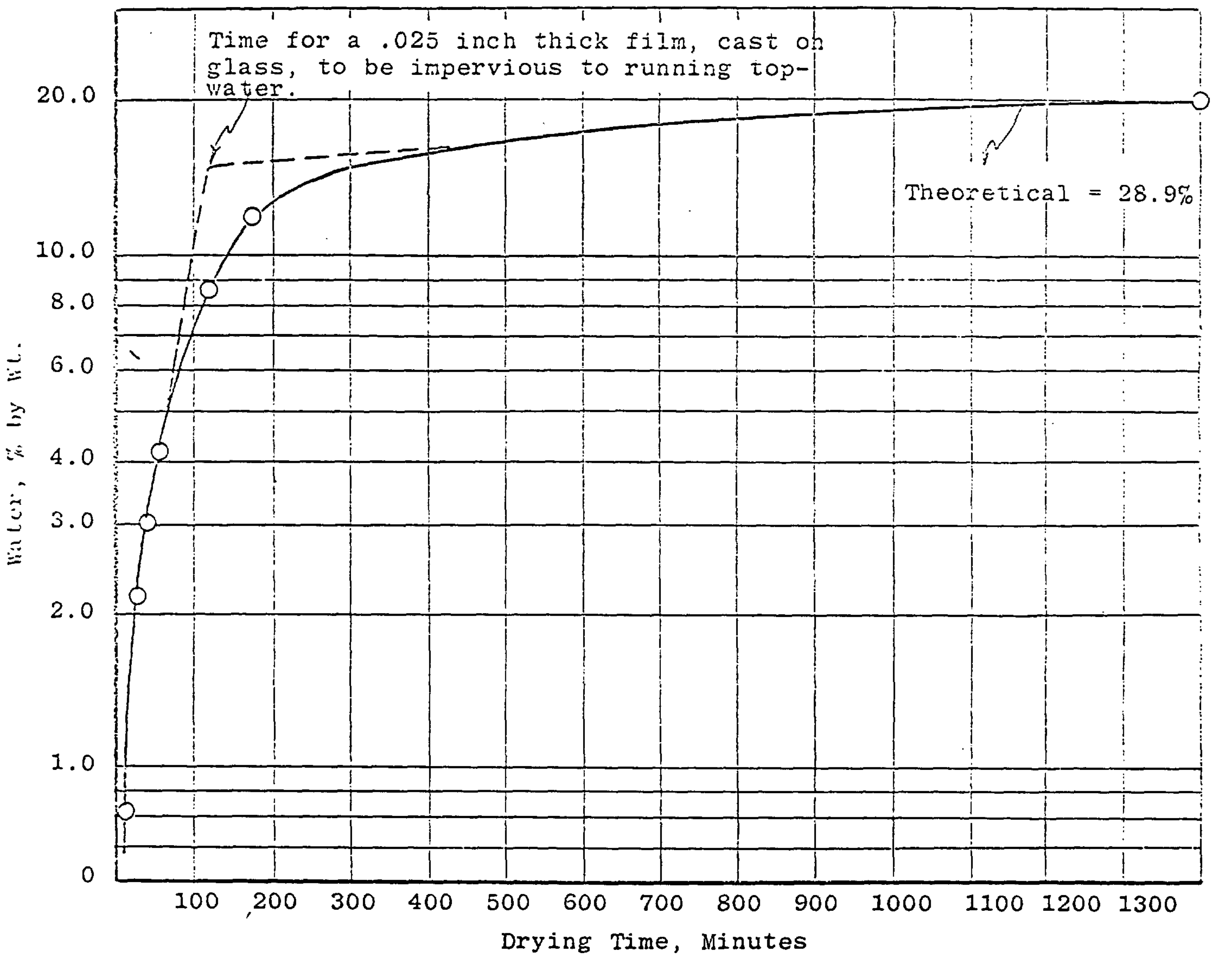
DRYING RATE

WEATHER-BARRIER MASTIC (12-DHR-50)

% Water Vs Time

1/16 Inch Layer in a Concentric Plastic Disc



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