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Refinish Sales
Competition Refinish Enamels
Baking Reducer

Memorandum Report No. M-264

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Philadelphia Laboratory
September 13, 1949

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EVALUATION AND DEVELOPMENT OF BAKING REDUCERS

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Introduction:

As a result of several inquiries from the field, the Wilmington Refinish Sales office has requested the laboratory to make a comprehensive evaluation of our present urea-formaldehyde baking reducer vs. competitive baking reducers and to survey other readily available nitrogen resins with the possibility of developing an improved baking reducer.

Conclusions:

As a result of this study, the following conclusions may be made:

(a) In many instances, competitive baking reducers required shorter baking schedules at given temperatures than our present baking reducer to produce the same degree of dry.

(b) A new product based on melamine, RK-487, was found to provide shorter baking schedules at given temperatures than our present urea-formaldehyde product. In some cases, competitive products were found to be equivalent to RK-487, but none of the baking reducers examined surpassed this product.

(c) Resamine 881, Uformite MK-61, and various U-F/melamine mixtures were examined, but none of these were found to be as good as melamine alone.

(d) It was found that the melamine product, RK-487, can be used at 12-1/2% reduction of enamels and still provide minimum baking schedules such as tack-free dry in 1 3/4 hours at 120°F., 1 1/2 hours at 150°F. and 1/2 hour at 175°F. Our present baking reducer is used at 25% reduction. RK-487 was also found to provide films with satisfactory wrinkle resistance and moisture resistance when added to an air dry enamel as a baking reducer.

(e) With regard to the differences in viscosity, it may be noted that our 93 Line and 181 Line enamels thinned with RK-5756 in accordance with current directions (25%) produced a very thin reduced enamel, while those enamels reduced at 12-1/2% with RK-487 will usually be thin enough for spraying. In the few cases, where necessary, "Dulux" thinner may be added.

(f) Calculation of costs to Refinish Sales show RK-487 at \$1.94/gal. compared to \$1.30/gal. for RK-5756. However, since RK-487 is used at half the amount of RK-5756, the cost of using the new product will be considerably less.

(g) From this study, it was observed that slight yellowing of whites and discoloration of metallic enamels was evident at the higher bakes. There was no noticeable difference between RK-487 and RK-5756 in this respect. Some of the competitive enamels, however, did show more discoloration.

Materials Used:

The materials used in this study included RK-5756 (DuPont urea-formaldehyde baking reducer); experimental baking reducers prepared from melamine, mixtures of melamine and urea-formaldehyde, Resamine 881, and Uformite MK-61; and competitive baking reducers. All of the above reducers were used with 93-508 and 181-10199 enamels. In addition, the competitive baking reducers were evaluated when used with their own white air-dry enamels.

Procedure:

All of the experimental reducers and RK-5756 were used at 25% and 12-1/2% reduction with 93-508 and with 181-10199 enamels. In addition, the competitive reducers were used with 93-508, with 181-10199, and with their own respective enamels at the reduction suggested by their package directions. The viscosities of all reducers, enamels, and reduced enamels were measured at 77°F. (for comparison see Table I).

The reduced enamels were sprayed on aluminum alloy panels in two successive coats so that the final dry film thickness was 1.0 ± 0.2 mil. Each enamel was applied to three panels so that each enamel could be baked at 120°F., at 150°F. and at 175°F. The time required to reach a given state of dry was recorded as the baking schedule at that temperature for that type of dry. The stages of dry were established as:

(a) Lint-Free Time - The time required at a given baking temperature for a film to be dry enough so that rayon lint (sprinkled on after the panel had reached room temperature) can be easily brushed off with a camel hair brush.

(b) Tack-Free Time - The time required at a given baking temperature for a film to be dry enough that it does not feel

tacky at room temperature.

(c) Through-Dry Time - The time required at a given baking temperature for a film to be dry with a hardness equivalent to hardness of the air-dry enamel after an overnight air dry.

The state of dry of each panel was examined at 15 minute intervals and the results of this study are noted in Table II.

The panels were also examined for discoloration compared to the color of the air-dry enamel after overnight dry. This evaluation is also noted on Table II.

Inasmuch as it appeared that the 12% melamine solution RK-487 used at 12-1/2% reduction of the enamel would be of most interest as a result of this study, wrinkle resistance and moisture resistance tests of this reduced enamel were made. It was noted that no wrinkling appeared at 3 mils when the panel was baked for two hours at 175°F. and in the water immersion test, the panel showed no film failure after 48 hours in water at 100°F.

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TABLE I

VISCOSITIES OF MATERIALS USED IN BAKING
REDUCER STUDY

(Measured At 77°F.)

<u>PACKAGED ENAMELS</u>	<u>REDUCER</u>		<u>% REDUCT.</u>	<u>REDUCED ENAMEL*</u>	
	<u>#10 Parlin</u>	<u>#1 Zahn</u>		<u>#2 Zahn</u>	<u>#10 Parlin</u>
DuPont 93-508	37"	25 (RK-5756)	25	21"	10" (theo.)
DuPont 181-10199	37"	25 (RK-5756)	25	21"	10" (theo.)
Ditzler	70"	35"	25	27"	17"
Martin Senour	64"	30"	12-1/2	46"	29"
Acme	52"	47"	10	102"	73"
Zac Lac	90"	38"	12-1/2	100"	72"
Nason	42"	28"	12-1/2	38"	23"
DuPont 93-508	37"	25" (RK-487)	12-1/2	28"	18"
DuPont 181-10199	37"	25" (" ")	12-1/2	28"	18"

* Reduced in accordance with package directions.

TABLE II

TIME REQUIRED FOR LINT FREE, TACK FREE, AND THROUGH DRY BAKES AT 120°F., 150°F., AND 175°F., AND DISCOLORATION NOTED AT HIGH TEMP. BAKE

Code	Enamel	Reducer	Reduct. %	120°F.			150°F.			175°F.			Discolorations
				LF	TF	TD	LF	TF	TD	LF	TF	TD	
R-47468	93-508	Melamine	25	90	105	240	45	90	180	15	30	60	V. Sl. Yellow
R-47473	181-10199	Melamine	25	90	105	240	45	90	180	15	30	60	V. Sl. Darker
R-47472	93-508	UF	25	120	150	300	75	120	270	30	45	75	V. Sl. Yellow
R-47477	181-10199	UF	25	120	150	300	75	120	240	30	45	75	V. Sl. Darker
R-53302	93-508	Resamine 881	25	105	135	270	75	120	225	15	30	60	V. Sl. Yellow
R-53304	181-10199	Resamine 881	25	105	135	270	75	120	270	15	30	60	V. Sl. Darker
R-53303	93-508	Uformite MX-61	25	105	135	270	75	120	225	15	30	60	V. Sl. Yellow
R-53305	181-10199	Uformite MX-61	25	105	135	270	75	120	225	15	30	60	V. Sl. Darker
R-53306	93-508	Melamine	12-1/2	90	105	240	45	90	180	15	30	60	V. Sl. Yellow
R-53313	181-10199	Melamine	12-1/2	90	105	240	45	90	180	15	30	60	V. Sl. Darker
R-53310	93-508	UF	12-1/2	135	150	330	90	120	240	15	30	60	V. Sl. Yellow
R-53317	181-10199	UF	12-1/2	105	150	300	90	120	270	30	45	75	V. Sl. Darker
R-53311	93-508	Resamine 881	12-1/2	135	150	330	90	120	240	15	30	60	V. Sl. Yellow
R-53312	93-508	Uformite MX-61	12-1/2	135	150	330	90	120	240	15	30	60	V. Sl. Yellow
R-47478	93-508	Ditzler	25	90	105	240	45	90	180	15	30	90	Sl. Yellow
R-47485	181-10199	Ditzler	25	90	105	25	45	90	180	15	30	90	Dark
R-47479	93-508	M. Senour	12-1/2	90	105	240	45	90	180	15	30	90	Yellow
R-47486	181-10199	M. Senour	12-1/2	90	105	240	45	90	180	15	30	90	V. Sl. Dark
R-47481	93-508	Acme	10	90	105	240	45	90	180	15	30	90	Sl. Yellow
R-47488	181-10199	Acme	10	90	105	240	45	90	180	15	30	90	V. Sl. Dark
R-47483	93-508	Zac-Lac	12-1/2	105	120	270	45	90	180	15	30	75	Sl. Yellow
R-47490	181-10199	Zac-Lac	12-1/2	105	120	270	45	90	180	15	30	75	Sl. Dark
R-47484	93-508	Nason	12-1/2	75	105	240	45	90	180	15	30	75	Yellow
R-47491	181-10199	Nason	12-1/2	75	105	240	45	90	180	15	30	75	Sl. Dark
R-47493	Acme	Acme	10	120	150	270	60	105	210	45	60	105	Sl. Yellow
R-47495	Zac-Lac	Zac-Lac	12-1/2	90	105	240	45	90	210	15	30	90	Sl. Yellow
R-47496	Nason	Nason	12-1/2	120	165	270	75	105	210	30	45	90	Sl. Yellow
R-47497	Ditzler	Ditzler	25	90	105	240	60	105	210	15	30	90	Sl. Yellow
R-47498	M. Senour	M. Senour	12-1/2	120	150	270	90	120	240	60	90	120	Sl. Yellow