ALLIED RESEARCH BULLETIN

NUMBER RC-67

SUBJECT

EXTERIOR HOUSE PAINTS

LEAD-ZINC TITANIUM TYPE VS. CRYPTONE MS-130 TYPES

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ALLIED RESEARCH LABORATORIES

CHICAGO, ILLINOIS

B

Exterior House Paints

Lead-Zinc Titanium Type vs. Cryptone MS-130 Types

Final Report on Panels 1444-72C, Regular vs. MS-130 Pigmentation, (5091) vs. (5091) plus (314) or (2281)

Introduction

The purpose of this series of exposures was fundamentally two-fold:

(1). To compare a lead-zinc-titanium type of pigmentation against modifications of New Jersey Zinc Company's Cryptone MS-130 leaded zinc recommendations, and

(2). To determine the value of straight unbodied linseed oil vehicle as compared with others carrying a percentage of bodied oil, either linseed or tung.

This series was studied in the laboratory after 51 months exposure, vertical south, at Chicago. Some of the panels were quite badly deteriorated, but this was not true of any first grade formulations except where the wood was obviously faulty. The series falls into five more or less distinct groups of comparisons, as follows:

Basic Formulations Represented

(a.) Rx 471 Comparison: In the first group, comprising about three-fourths of the panels, three main pigmentations and four main vehicles are compared, all self-primed. This may be shown by a tabulation:

Pigmentation

A. Rx 471, 1935 formula

45.4%	-	412
34.6%	-	18
10.0%	-	1403
10.0%	-	20 L

Vehicle

1. Rx 471, 1935 formula

68 gal.	-	(5091)
3 "	-	(348)
4½ "	-	(2241)
3/4 "		(12)W
1/8 "		(152)

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Pigmentation	Vehicle
B. O. W. Special 75% - MS-130 25% - 412	2. As 1, but using 8% of (314), a Q-bodied linseed oil, in place of that amount of (5091).
C. O. W. Special 60% - MS-130 30% - 412 10% - 20 L	3. As 1, but using 5% of (2281), bodied chinawood oil, for (5091).
D. O. W. Special 50% - MS-130 40% - 412 10% - 20 L	4. As 1, but using 15% of (2281) for (5091)

The paints in this group, formed by combinations of the above pigmentations and vehicles, are referred to in the tabulation of data as A1, A2, B1, B2, D4, etc.

(b). Adjusted P.V.C. Comparison: In this group, the various vehicle changes are compared, with all paints adjusted to 29% p.v.c., about 1% higher than the regular 1935 paint. Pigmentation A is the only one used in this group, and the paints are referred to in the tabulation of final data as 29 A1, 29 A2, etc. All paints are self primed. The pigment volumes, as compared with those of group (a), are as follows:

Group (a)			Group (b)		
A1	-	27.6%	29 A1	-	28.7%
A2	-	27.5	29 A2	-	28.6%
A3	-	27.5	29 A3	-	28.6%
A4	-	27.6	29 A4	-	28.7%

(c). Lead-in-oil Comparison: A special lead-in-oil system is compared with the four vehicles in this group, pigmentation B being used throughout. All paints are used over lead-in-oil primer prepared as follows: 11 lbs. of paste containing 89% by weight of basic lead carbonate, 9% linseed oil, and 2% turps, reduced with 3-1/2 pt. of (2), 1-1/2 pt. of (14) and 2 oz. of (440).

(d). Family Paint Comparison: In this group, regular Rx 300's of 1936 and of 1937 and a special Family Paint using 43% MS-130 and 28.5% each of 412 and 20 L with regular Rx 300 vehicle of 1937 are compared. All paints are self primed.

(e). Undercoater Comparisons: One third of each panel in the whole series makes up a group of tests comparing the various test paints as undercoaters. This section of each panel carries two coats of Rx 471, C1327, which is paint A1 in group (a), over a prime coat of the particular test paint carried on the same panel.

Preparation of Panels

The whole series is exposed both on cedar and on yellow pine siding panels, each panel consisting of three sections. The guide in each case is Rx 471, C 1327, a production sample, self-primed. A section marked "A" consists of the various test paints, self-primed, and a section marked "B" carries two coats of Rx 471, C 1327, over the corresponding test paint as primer. All the panels are three-coat work, the usual reductions being, 2 pints (2) and 2 pints (14) for the primer, 2 pints (14) for the second coat, and full body for the finish coat.

The "B" sections in the following tabulation of final data designated as "A1", represent the undercoater comparisons explained in (e) above, and the "A" sections represent the four other types of tests according to the designations.

Note on Dirt Collection

Judging of dirt collection was somewhat difficult in the examination, and requires the following explanation.

In the Family Paint and lead-in-oil tests, the dirt is of the naturally adhering type, seriously affecting the general appearance. In all other tests, the dirt is not a serious naturally adhering type, but rather seems to be forced into the paint film in streaks and blotches, due possibly to handling of the panels. There was evidence of mildew on some panels, but its occurrence appeared to be haphazard, and it is rated merely as dirt.

Tabulation of Composition and Data

Final Examination Data (51 months)

Cedar

Panel No.	Type	Chalk	Check	Crack	Flake	Eros'n	Dirt	General Appearance
1472	A1	VB					C	G
(a)	Basic	Comparison						
1444 A	B1	VB					B	(F)
B	A1	VB	(S)				C	G
1445 A	B2	VB					(B)	G
B	A1	VB					(C)	(F)
1446 A	B3	VB					B	P
B	A1	VB					C	G
1447 A	B4	VB					B	P
B	A1	VB					C	G
1448 A	C1	VB					(B)	F
B	A1	VB					C	G
1451 A	C2	VB					B	(F)
B	A1	VB					C	(G)
1449 A	C3	VB					(B)	(F)
B	A1	VB				C	(C)	G
1450 A	C4	VB					(B)	(F)
B	A1	VB					(C)	(G)
1452 A	D1	VB					(B)	F
B	A1	VB					C	(G)
1453 A	D2	VB				(B)	(C)	(F)
B	A1	VB					S	G
1454 A	D3	VB				C	(C)	(G)
B	A1	VB				S	(C)	G
1455 A	D4	B	(S)			C	(C)	G
B	A1	VB	(S)			(C)	(C)	(G)
1460 A	A1	VB	(C)	(C)			(C)	(G)
B	A1	VB					C	(G)
1463 A	A2	VB					C	(G)
B	A1	VB					C	(G)
1461 A	A3	VB					C	(G)
B	A1	VB					(C)	G
1462 A	A4	VB					C	F
B	A1	VB					(C)	(G)

Tabulation of Composition and Data

Final Examination Data (61 months)

Yellow Pine

Panel No.	Type	Chalk	Check	Crack	Flake	Eros'n	Dirt	General Appearance
1472	A1	VB	S to C	C to B	S to B		C	(G) to (F)
(a) Basic comparison								
1444 A	B1	VB					(C)	(F)
B	A1	VB	C	B			C	P
1445 A	B2	VB	S				B	P
B	A1	VB	B^w	C^w			C	(G)
1446 A	B3	VB	C	C		(C)	B	P
B	A1	VB	B^w	C^w			C	(G)
1447 A	B4	VB	S^b	C^b			(B)	P
B	A1	VB	B	B			C	(G)
1448 A	C1	VB	S^b	C^b			(B)	F
B	A1	VB	B	B			C	F
1451 A	C2	VB	S^b	S^b			(B)	P*
B	A1	VB	B	B			(B)	F
1449 A	C3	VB	C^b	C^b		C	C	(F)*
B	A1	VB	B	C			(C)	(G)
1450 A	C4	VB	S^b	A^b		(C)	(B)	(F)
B	A1	VB	C^b	C^b			(C)	(G)
1452 A	D1	VB	C^b	B^b	C	C	(B)	F
B	A1	VB	B^w	B^w	C		C	F
1453 A	D2	VB	S^b	C^b			(C)	P
B	A1	VB	B	(B)			C	P
1454 A	D3	VB					(C)	P*
B	A1	VB					(C)	P*
1455 A	D4	(B)	S^b	A^b		(C)	C	F
B	A1	VB	B	S			C	(G)
1460 A	A1	VB	C	C			C	(G)
B	A1	VB	B^w	B^w	S^w		C	F
1463 A	A2	VB	C	B	C		C	F
B	A1	VB	C	B	C		C	F
1461 A	A3	VB	C^b	B^b	B^b		(C)	P*
B	A1	VB	B	B	VB	(C)	C	VP
1462 A	A4	VB	C^b	B^b	$(B)^b$		C	P
B	A1	VB	B	B	(B)	(C)	C	P

*Poor general appearance is mainly due to poor hiding.

w = Worse in this respect than guide
b = Better than guide. Unless so marked, guide and test paint are equal.

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Tabulation of Composition and Data
Supplementary Series

Final Examination Data (51 months)

Cedar

Panel No.	Type	Chalk	Check	Crack	Flake	Erosion	Dirt	General Appearance
guide 1472	A1	VB					C	G
(b) Adjusted p.v.c. comparison								
1456 A	29A1	VB	(S)	S			C	(G)
B	A1	VB	(S)	S			C	(G)
1459 A	29A2	VB					C	(G)
B	A1	VB					(C)	G
1457 A	29A3	VB				C	C	F
B	A1	VB				C	(C)	F
1458 A	29A4	VB				S	(C)	(G)
B	A1	VB				S	(C)	(G)
(c) Lead-in-oil comparison								
guide 1467 A	Rx.17	VB	VB**	B	S		B	VP
B	A1	VB	C	fissures			(C)	(G)
1468 A	B1	VVB				C	C	P
B	A1						(C)	(G)
1469 A	B2	VVB				B	B	P
B	A1	VB	S^w	fissures			(C)	G
1470 A	B3	VVB	(B)	(B)	(B)	B	B	P
B	A1	VB	C	C^w		B	(C)	F
1471 A	B4	VVB	B	B	B	VB	B	P
B	A1	VB	S^b				C	(G)
(d) Family Paint Comparison								
1465 A	F.P. reg. 2-18-37	VB	VB**	B	C		(B)	VP
B	A1	VB					S	G
1466 A	F.P. reg. 6-20-36	VB	B				C	P
B	A1	VB					(C)	G
1464 A	F.P. Spec. Veh. #1	VB	(C)				C	(F)
B	A1	VB					C	(G)

**Alligatoring

w = Worse in this respect than guide
b = Better than guide. Unless so marked, guide and test paint are equal.

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Tabulation of Composition and Data
Supplementary Series

Final Examination Data (51 months)

Yellow Pine

Panel No.		Type	Chalk	Check	Flake	Erosion	Crack	Dirt	General Appearance
1472 guide		A1	VB	S to C	S to B		C to B	C	(G) to (F)
(b) Adjusted p.v.c. comparison									
1456	A	29A1	VB	B^w			C^w	C	F
	B	A1	VB	B^w			C^w	C	F
1459	A	29A2	VB	C^b			C^b	C	(G)
	B	A1	VB	B			(B)	C	(G)
1457	A	29A3	VB	C	B	S	B	(C)	P
	B	A1	VB	B	S	(C)	B	(C)	(F)
1458	A	29A4	VB	(S)		S	S	C	(G)
	B	A1	VB	S		S	S	C	(G)
(c) Lead-in-oil comparison									
1467	A guide	Px 17	VB	VB**	C		B^w	B	VP
	B	A1	B	B^w	fissures		S^w	C	F
1468	A	B1	VVB	B^w	B		B^w	C	P
	B	A1	VB	B^w			C^w	C	F
1469	A	B2	VVB			B		B	P
	B	A1	VB	C	fissures	(C)	(C)	C	F
1470	A	B3	VVB	B	B	B	B	(B)	P
	B	A1	VB	(B)	VB	B	VB^w	C	P
1471	A	B4	VVB	B	B	B	B	(B)	P
	B	A1	VB	B			C	C	F
(d) Family paint comparison									
1465	A	F.P.reg. 2-18-37	VB	VB^w		B	S^w S	(B)	VP
	B	A1	VB	S			S	(C)	G
1466	A	F.P. reg. 6-30-36	VB	S				C	(F)
	B	A1	VB	$(C)^w$			S^w	C	(G)
1464	A	F.P.Spec. Veh.#1	VB	S^b			S^b	(C)	F
	B	A1	VB	C			(C)	(C)	G

**Alligatoring

w = Worse in this respect than guide.
b = Better than guide. Unless so marked, guide and test paint are equal.

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General Conclusions

It should be stated that the following conclusions are open to some question because the differences between the various formulas in final appearance are slight on the cedar panels, and the yellow pine panels, always lacking in uniformity, had to be considered rather heavily in order to discriminate between the test paints. This reservation applies most seriously to group (a).

(c). Rx 471 Comparison

1. The worst cracking and flaking occurs with the regular 1935 pigmentation, with the regular linseed oil vehicle appearing to perform slightly better than the others with this pigment. However, there is conflicting evidence as to the vehicle performance, and it is very difficult to determine to what extent the wood used is responsible for the defects noted.

2. The 75% MS-130 pigmentation has possibly the least checking and cracking, but it is only a slight edge over the other MS-130 pigmentations, that is, those with less MS-130 and more leaded zinc.

3. The regular 1935 vehicle using only (5091) is the only one showing any superiority. It exhibits less checking, cracking and dirt than the others when used with the regular 1935 pigmentation, and has the edge over the others when used with the 75% MS-130 pigmentation because of less tendency toward dirt collection. However, the vehicle containing 8% of Q-bodied linseed oil seems to perform as well or slightly better with the 50% and 60% MS 130 than the regular vehicle.

In other words, considering only integrity of film (not dirt collection) and only the MS-130 pigmentations, the use of 8% of

(314) results in a general improvement over the regular vehicle. It should be said in this connection that the conclusions were reached on the basis of minor differences on yellow pine panels, the effect of which on the paint film is not uniform.

Vehicles using 5% and 15% of chinawood oil are characterized by a tendency to erode, resulting in a definite reduction of hiding power. This is true with all pigments involved, but it is difficult to discern any increase in the tendency due to increased amount (15%) of the chinawood oil. Since this erosion is slightly but definitely greater in the case of the 75% MS 130 pigmentation, the advantage of this pigmentation stated above in (2) is somewhat offset.

4. On all panel sections on which the MS-130 pigment is used, the characteristic sparkle or glint of mica is clearly noticeable.

(b). Adjusted P.V.C. Comparison

1. The vehicle using 8% of Q-bodied linseed oil shows the least checking and cracking of any vehicle in this group, as well as the best general appearance. Only the regular 1935 pigmentation is involved, and the p.v.c. is nearer the optimum than in (a). The indication is that the substitution of (314) for (5091) up to 8% is an improvement, under these conditions, but that the use of chinawood oil is not. It is noted that the previously mentioned erosion tendency of the latter is present under the optimum conditions of p.v.c. also.

2. The fault of the regular vehicle seems to be a greater tendency to check and crack, especially as compared with the

vehicle using (314). In this group also, the differences noted were comparatively slight, but it seems safe to state that the adjusted p.v.c. results in a general improvement over the unadjusted group (a).

(c). Lead-in-oil Comparison

1. In one clear cut case, the regular 1936 formula, used in this series without variation of the vehicle, is better in resistance to checking and cracking and general appearance than the 75% MS-130 pigmentation with the regular vehicle, in fact better than the latter pigmentation with any of the vehicles described above. This is over the lead-in-oil primer.

2. The 75% MS-130 erodes and flakes worse than the white lead top coat, but the latter, because of dirt and alligatoring, is worse in general appearance.

3. With the MS-130 pigmentation (75%), using lead-in-oil primer, the regular vehicle is best. The Q-bodied linseed oil, and to a definitely greater extent, the chinawood oil, seem to cause a tendency toward erosion.

4. Exposure of wood due to flaking and erosion or both is much worse than on the comparable self-primed panels.

(d). Family Paint Comparison

1. The special Family Paint containing 43% MS-130 and 28.5% each of 412 and 20 L shows up much better than the regular Rx 300 of either 1936 or 1937. There is a general improvement, most noticeable in the much better resistance of the former to checking and cracking. The special formula amounts substantially to a replacement of the lithopone of the regular Rx 300 by MS-130. The cost is practically the same as that of the 1937 formula, while that of the 1936 formula is

about 2 cents higher, so it appears that the MS-130 pigmentation offers a very reasonable medium cost formulation.

2. The Family Paint formula of 1936 exhibits less checking, cracking, and flaking and erosion than that of 1937, probably due to the use of comparatively more leaded zinc in the former.

(e). Undercoater Comparisons

Since this is a large group, involving the use of all the test paints mentioned above as primers under the regular 1935 Rx 471 (factory production sample), and since variations are slight, except in cases where there is a strong possibility of adverse effects due to the wood used, the evaluation is difficult. In general, the durability and appearance of the Rx 471 self-primed is as good as or better than when used over the various test paints as primers. There is no clear cut example of one primer being better than another, except that lead-in-oil is inferior, as described in (c). Nor is there any case in which a particular test paint used as primer gives outstanding results, either good or poor. In other words, these results do not justify ascribing any particular virtues as primers to a leaded zinc MS-130 combination as compared to a leaded zinc-titanium combination.

The last statement should be considered in connection with New Jersey Zinc Company's claims for high "compatability" of their Cryptone MS-130 leaded zinc primers with various types of top coats. Their recommendations for a two coat system now call for an 85% Cryptone MS-130, 15% 35/65 leaded zinc primer, with a 70% Cryptone MS-130, 30% 35/65 leaded zinc top coat.

January 30, 1942

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ALLIED RESEARCH BULLETIN

RC-68

SUBJECT

DURABILITY AND TINT RETENTION OF LEAD-ZINC HOUSE PAINTS AS INFLUENCED BY LEAD TITANATE OR NON-CHALKING TiO_2

Prepared by: J. W. Chapin

March 4, 1942

ALLIED RESEARCH LABORATORIES

CHICAGO, ILLINOIS

Durability and Tint Retention of Lead-Zinc House Paints as Influenced by Lead Titanate or Non-chalking TiO_2

Progress Report on Exposures 4546-4633 F and C

Introduction

This series of exposures was begun in October, 1940 and represents an extensive study of the durability, dirt collection, and tint retention properties of various types of leaded zinc. The study of durability was actually secondary to that of the other properties in the planning of the series. This report brings up to date the findings published in Research Bulletin RC-64 (August 25, 1941) based on 9 month readings of the Chicago exposures, but is primarily concerned with the results of Florida exposures at 16 months. The Florida panels were examined in the laboratory. All paints are tinted to Colonial Yellow.

A good idea of the purpose and plan of the test may be obtained from the introductory parts of Bulletin RC-64. The following two basic pigmentations were used, with the regular Rx 375 vehicle.

Formula A	Formula B
10% Basic Lead Carbonate or Sulfate	10% Basic Lead Carbonate or Sulfate
45% Leaded Zinc 35/65	46% Leaded Zinc 35/65
25% Lead Titanate	14% Non-chalking Titanium Oxide
20% Asbestine	30% Asbestine

These general formulas were suggested by Dr. Holley apparently primarily to compare the behavior of lead titanate vs. non-chalking TiO_2 in a lead-zinc paint. All the formulations are reasonably close in theoretical opacity and in cost, but apparently the series was not based strictly on either of these considerations. Various leaded zinc - white lead combinations appear in both formula types. All the paints were exposed at Chicago, but only a limited number of the

B type paints were exposed at Florida, as tie-ins.

Summary of Results

(1) Lead titanate (A) vs. 2031 T (B) formulations.

Florida Results at 16 months:

	Checking		Fading		Mildew*		Chalking	
	A	B	A	B	A	B	A	B
Sl. or absent	25	5	2	0				
Less than def.	1	0	4	3	9	6	12	2
Definite	1	2	9	3	5	4	11	3
Less than bad	3	3	11	2	3	1	4	3
Bad	2	3	6	5	15	2	5	5
% less than def.	81.2	40.0	19.0	23.0	28.0	46.0	37.5	15.0
% definite or worse	18.8	60.0	81.0	77.0	72.0	54.0	62.5	85.0

Chicago results at 16 months:

	Checking		Fading		Dirt*		Chalking	
	A	B	A	B	A	B	A	B
Sl. or absent	No check-		10	0	0	0	0	0
Less than def.	ing on any		10	0	0	0	0	0
Definite	panels		6	1	0	21	0	0
Less than bad			7	13	25	14	15	11
Bad			10	30	18	9	28	33
% less than def.			46.5	0.0	0.0	0.0	0.0	0.0
% definite or worse			53.5	100.0	100.0	100.0	100.0	100.0

*See also complete tabulation pages 6-11.

The Florida exposures show clearly that:

1. Formula A, using 1895, is much more resistant to checking than formula B, using 2031 T.
2. Formula A is definitely less free-chalking than B. The fact that over half of the B type formulas are omitted on Florida exposure detracts from the value of this particular comparison, and probably accounts for the seeming similarity as to fading.

The Chicago exposures, representing all the originally planned samples, do not contradict the Florida results at 16 months, although the definite superiority of the A formula as to tint retention is more clearly shown. However, there is no checking, and the chalking results are all bad or nearly so. This is probably due to lack of washing by rain which may change rapidly in the spring.

One conclusion based mainly on this and previous Chicago readings is outstanding; in all cases where there is good tint retention due to slow chalking, mainly with the lead titanate (A) formulation, there is also bad dirt collection, and the resulting dingy appearance is in many cases fully as objectionable as some of the worst fading. Because of the temporary condition as to chalking mentioned above, this conclusion is not entirely clear on the basis of the present readings alone.

(2) Co-fumed vs. mechanically mixed leaded zinc

Florida results at 16 months

	Checking				Fading				Chalking			
	Co-fumed		Mech. Mix		Co-Fumed		Mech. Mix		Co-fumed		Mech. Mix	
	A	B	A	B	A	B	A	B	A	B	A	B
Sl. or absent	18	1	7	4	0	0	2	0	6	0	2	1
Less than def.	0	0	1	0	1	0	3	3	2	0	2	1
Definite	0	0	1	2	8	1	1	2	3	0	8	2
Less than bad	0	0	3	3	7	0	4	2	2	1	2	2
Bad	0	0	2	3	2	0	4	5	5	0	0	5
% less than def.	100.0		46.2		5.3		30.8		42.1		23.0	
% def. or worse	0.0		53.8		94.7		69.2		57.9		77.0	

Chicago results at 16 months

	Checking				Fading			
	Co-fumed		Mech. Mix		Co-fumed		Mech. Mix	
	A	B	A	B	A	B	A	B
Sl. or absent		None			1	0	9	0
Less than def.					3	0	7	0
Definite					1	0	5	1
Less than bad					7	6	0	7
Bad					9	16	1	14
% less than def.					9.3		37.2	
% def. or worse					90.7		62.8	

From the Florida results, the following conclusions may be drawn:

1. Co-fumed leaded zinc results in much less checking than the mechanically mixed.
2. The co-fumed causes considerable fading, being in practically all cases, definite or worse.
3. Chalking is quite evenly divided; at least the co-fumed pigment is not outstandingly bad.

The mechanical mixtures in each case, show greater variation in behavior. It seems inadvisable to analyze this group further on the basis of the A and B formulas, especially since only one B type paint with co-fumed leaded zinc was exposed at Florida, but summary (3) compares the various types of mechanical mixes. The Chicago results agree very well with the Florida results as to tint retention, with the mechanical mixes more clearly superior to the co-fumed. Further, it seems clear that while both types of leaded zinc show bad fading with the B formula, the mechanically mixed type is much better for use with the A formula than co-fumed.

(3) Acicular vs. non-acicular zinc oxides in mechanical mixes

Florida results at 16 months

	Checking		Fading		Chalking	
	Acic.	Non Acic.	Acic.	Non-Acic	Acic.	Non-Acic.
Slight or absent	9	2	2	0	3	0
Less than def.	0	1	6	0	3	0
Definite	1	2	2	1	4	7
Less than bad	2	4	2	4	2	2
Bad	2	3	2	7	2	3
% less than definite	64.0	25.0	57.1	0.0	43.0	0.0
% definite or worse	36.0	75.0	42.9	100.0	57.0	100.0

Chicago results at 16 months

	Checking		Fading	
	Acic.	Non-Acic.	Acic.	Non-Acic
Slight or absent	None		4	5
Less than def.			1	6
Definite			3	3
Less than bad			1	6
Bad			5	10
% less than def.			35.7	36.6
% def. or worse			64.3	63.4

The conclusions from the Florida data are:

1. Acicular zinc oxides show less checking than the non-acicular.
2. Acicular zinc oxides are much better as to tint retention.
3. There is a distinct correlation between heavy chalking, in which the non-aciculars are worst, and tint retention. It should be stated at this point that a less complete study of the co-fumed samples shows the acicular leaded zincs to be superior to the non-acicular both as to chalking and fading.

The Chicago results do not agree with the above conclusions as to fading. It is clear that the addition of the B paints, missing from Florida exposure, changes the situation materially, and that the true conclusion over the whole series is that the acicular zinc oxide is only slightly, if any, better than the non-acicular as to tint retention.

Tabulation of Data - Florida, 16 months

Panel No.		Mech. Mix	Acic ZnO	Acic. Pb-Zn	Chalk	Check	Fade	Mildew*	General App.
4646	guide, Rx 375, C 450				(B) to B	(S)	(B) to VB	A to B	F to P
Formula A, Lead Titanate									
	Lead-Zinc								
4647	ZZZ-33, Nat. H.T.S.	X	X		(C)	S	S	B	P
48	St. Joe, Nat. H.T.S.	X			C	B	B	(C)	P
49	XX-50, Nat. H.T.S.	X			C	(B)	(B)	C	(F)
50	XX-503, Nat. H.T.S.	X			C	S	(B)	C	(F)
51	ZZZ-33 18	X	X		S	A	S	VB	VP
52	St. Joe 18	X							
53	XX-50, 18	X			(B)	S	(B)	(B)	P
54	XX-503, 18	X							
55	ZZZ-33, Nat. A.B.S.	X	X						
56	St. Joe, Nat. A.B.S.	X							
57	XX-50, Nat. A. B. S.	X			(B)	B	S	B	F
58	XX-503, Nat. A.B.S.	X							
59	ZZZ-33, 9	X	X						
60	St. Joe, 9	X							
61	XX-50, 9	X			C	C	(B)	B	P
62	XX-503, 9	X							
63	ZZZ-33, S-W H.T.S.	X	X		S	A	(C)	VB	VP
64	St. Joe, S-W H.T.S.	X			C	(B)	C	(B)	(F)
65	XX-50, S-W H.T.S.	X			C	(B)	VB	(C)	(F)
66	XX-503, S-W H.T.S.	X			C	(S)	B	C	(F)
67	412, 18				C	A	C	B	P
68	ZZZ-11 Nat. H.T.S.	X	X		C	A	(C)	B	P
69	ZZZ-22 Nat. H.T.S.	X	X		(C)	A	(C)	VB	VP
70	1526, 18				B	A	B	C	(F)
71	Lehi 635, 18			X					
72	Lehi 60, 18								

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Panel No.	Lead-Zinc	Mech. Mix	Acic. ZnO	Acic. Pb-Zn	Chalk	Check	Fade	Mildew*	General App.
4573	Azo 35L, S-W H.T.S.								
74	412, S-W H.T.S.				B	S	(B)	(C)	(F)
75	Lehi 635, S-W H.T.S.			X	C	A	(B)	(B)	P
76	Lehi 60, S-W H.T.S.				(C)	A	(B)	VB	VP
77	Azo 35L, S-W H.T.S.				(B)	A	(B)	(C)	(F)
78	412, Nat. H.T.S.				(B)	A	(B)	(C)	(F)
79	Lehi 635, Nat. H.T.S.			X	(C)	C	VB	C	VP
80	Lehi 60, Nat. H.T.S.				S	A	C	VB	VP
81	Azo 35L, Nat. H.T.S.				S	A	C	VB	VP
82	412, Nat. A.B.S.				S	(S)	C	B	VP
83	Lehi 635, Nat. A.B.S.			X	C	(S)	(C)	C	(F)
84	Lehi 60, Nat. A.B.S.				B	(S)	(B)	(C)	P
85	Azo 35 L, Nat. A.B.S.				B	(S)	B	(C)	P
86	E.P. 70/30, XX-92				B	(C)	(B)	(C)	(F)
87	E.P. 70/30, ZZZ-11		X		S	A	C	VB	VP
88	E.P. 70/80, ZZZ-22		X		S	A	C	VB	VP
89	E.P. 70/30, ZZZ-33		X		S	A	C	VB	VP
Formula B, using 2031 T									
4590	As 4547				B	C	(C)	(C)	(G)
91	As 4548								
92	As 4549				B	B	B	(C)	P
93	As 4550								
94	As 4551				S	A	C	VB	VP
95	As 4552								
96	As 4553				B	C	B	C	P
97	As 4554								
98	As 4555				C	S	(C)	(C)	(G)
99	As 4556								
4600	As 4557				B	B	S	B	P
01	As 4558								
02	As 4559				(B)	(S)	C	B	P
03	As 4560								

Panel No.	Lead-Zinc	Mech. Mix	Acic. ZnO	Acic. Pb-Zn	Chalk	Check	Fade	Mildew*	General App.
04	As 4561				(B)	(B)	(C)	B	(F)
05	As 4562								
06	As 4563				(C)	(S)	(C)	C	(F)
07	As 4564								
08	As 4565				B	B	B	S	P
09	As 4566								
10	As 4567				(B)	(S)	C	C	(F)
11	As 4568								
12	As 4569				C	(B)	(B)	C	(F)
13	As 4571				C	(B)	(B)	(B)	(F)
14	As 4572								
15	As 4573								
16	As 4574								
17	As 4575								
18	As 4576								
19	As 4577								
20	As 4578								
21	As 4579								
22	As 4580								
23	As 4581								
24	As 4582								
25	As 4583								
26	As 4584								
27	As 4585								
28	Special B1 - as reg. but 1/3 of 2031T replaced by 1895								
29	Special B2 - As Spec. B1 but using Lehi 635								
30	As 4586								
31	As 4587								
32	As 4588								
33	As 4589								

*In a few cases, this refers to ordinary dirt rather than mildew.

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Tabulation of Data - Chicago, 16 months

Panel No.	Lead-Zinc	Mech. Mix	Acic. ZnO	Acic. Pb-Zn	Chalk**	Check	Fade	Dirt	General App.
4546	guide, Rx 375, C 450				C to (B)	None	VB	(B) to B	P
	Formula A, Lead Titanate								
4547	ZZZ-33 Nat. H.T.S.	X	X		(B)		S	B	F
48	St. Joe, Nat. H.T.S.	X			(B)		S	B	F
49	XX-50, Nat. H.T.S.	X			(B)		(C)	B	(F)
50	XX-503, Nat. H.T.S.	X			(B)		(C)	B	(F)
51	ZZZ-33, 18	X	X		(B)		(C)	B	(F)
52	St. Joe, 18	X			(B)		(C)	B	(F)
53	XX-50, 18	X			(B)		(C)	B	(F)
54	XX-503, 18	X			B		(C)	B	(F)
55	ZZZ-33, Nat. A.B.S.	X	X		B		C	(B)	(F)
56	St. Joe, Nat. A.B.S.	X			B		C	(B)	(F)
57	XX-50, Nat. A.B.S.	X			B		C	(B)	(F)
58	XX-503, Nat. A.B.S.	X			B		B	(B)	P
59	ZZZ-33, 9	X	X		B		(C)	B	(F)
60	St. Joe, 9	X			B		(C)	B	(F)
61	XX-50, 9	X			B		S	B	(F)
62	XX-503, 9	X			B		C	(B)	(F)
63	ZZZ-33, S-W H.T.S.	X	X		(B)		(S)	(B)	(F)
64	St. Joe, S-W H.T.S.	X			(B)		S	(B)	(F)
65	XX-50, S-W H.T.S.	X			B		S	B	(F)
66	XX-503, S-W H.T.S.	X			B		(C)	B	(F)
67	412, 18				VB		B	(B)	P
68	ZZZ-11, Nat. H.T.S.	X	X		(B)		S	B	(F)
69	ZZZ-22, Nat. H.T.S.	X	X		(B)		S	(B)	F
70	1526, 18				B		B	(B)	P
71	Lehi 635, 18			X	B		B	(B)	P
72	Lehi 60, 18				B		B	(B)	P

Panel No.	Lead-Zinc	Mech. Mix	Acic. ZnO	Acic. Pb-Zn	Chalk**	Check	Fade	Dirt	General App.
4573	Azo 35L, S-W H.T.S.				B	None	B	(B)	P
74	412, S-W H.T.S.				B		(B)	(B)	(F)
75	Lehi, 635, S-W H.T.S.			X	B		(B)	(B)	(F)
76	Lehi 60, S-W H.T.S.				B		(B)	(B)	(F)
77	Azo 35L, S-W H.T.S.				B		(B)	(B)	(F)
78	412, Nat. H.T.S.				B		(B)	(B)	(F)
79	Lehi 635, Nat. H.T.S.			X	B		C	(B)	(F)
80	Lehi 60, Nat. H.T.S.				B		(B)	(B)	(F)
81	Azo 35L, Nat. H.T.S.				B		(B)	(B)	(F)
82	412, Nat. A.B.S.				B		B	(B)	P
83	Lehi 635, Nat. A.B.S.			X	B		B	(B)	P
84	Lehi 60, Nat. A.B.S.				B		B	(B)	P
85	Azo 35L, Nat. A.B.S.				B		B	(B)	P
86	E.P. 70/30, XX-92				(B)		S	B	(F)
87	E.P. 70/30, ZZZ-11		X		(B)		(C)	B	(F)
88	E.P. 70/80, ZZZ-22		X		(B)		(C)	B	(F)
89	E.P. 70/30, ZZZ-33		X		(B)		(C)	B	(F)

Formula B, using 2031 T

Panel No.	Lead-Zinc	Mech. Mix	Acic. ZnO	Acic. Pb-Zn	Chalk**	Check	Fade	Dirt	General App.
4590	As 4547				B		B	B	P
91	As 4548				B		(B)	B	P
92	As 4549				B		B	B	P
93	As 4550				B		B	B	P
94	As 4551				B		B	B	P
95	As 4552				B		(B)	B	P
96	As 4553				B		(B)	B	P
97	As 4554				B		(B)	B	P
98	As 4555				(B)		B	C	(F)
99	As 4556				B		B	C	(F)
4600	As 4557				B		B	C	(F)
01	As 4558				(B)		B	C	(F)
02	As 4559				B		B	(B)	(F)
03	As 4560				B		B	C	(F)

Panel No.		Mech. Mix	Acic. ZnO	Acic. Pb-Zn	Chalk**	Check	Fade	Dirt	General App.
4604	As 4561				B	None	B	C	(F)
05	As 4562				B		B	C	(F)
06	As 4563				B		B	C	(F)
07	As 4564				B		(B)	B	P
08	As 4565				B		(B)	B	P
09	As 4566				B		B	(B)	P
10	As 4567				(B)		B	C	F
11	As 4568				B		(B)	B	P
12	As 4569				B		C	B	P
13	As 4571				(B)		B	C	(F)
14	As 4572				(B)		B	C	(F)
15	As 4573				(B)		B	C	(F)
16	As 4574				(B)		B	C	(F)
17	As 4575				B		B	C	(F)
18	As 4576				B		B	C	(F)
19	As 4577				B		B	C	(F)
20	As 4578				B		B	(B)	P
21	As 4579				B		B	(B)	P
22	As 4580				B		B	(B)	P
23	As 4581				B		B	(B)	(F)
24	As 4582				(B)		B	C	(F)
25	As 4583				(B)		(B)	C	(F)
26	As 4584				(B)		(B)	C	(F)
27	As 4585				(B)		(B)	C	(F)
28	Special B1 - as reg. but 1/3 of 2031 T replaced by 1895				B		(B)	C	(F)
29	Special B2 - as spec. B1 but using Lehi 635.				B		(B)	(B)	(F)
30	As 4586				B		(B)	(B)	(F)
31	As 4587				B		B	B	P
32	As 4588				B		B	B	P
33	As 4589				B		B	(B)	(F)

**Chalk here is heavy due to lack of natural washing. Loose dirt also adheres, so that under normal conditions, there would be less B and (B) chalk and dirt ratings.

General Formulas

Formula A

10% Basic Lead Carbonate or Sulfate
45% Leaded Zinc 35/65
25% Lead Titanate
20% Asbestine

Vehicle as Rx 375, 1/5/40

Formula B

10% Basic Lead Carbonate or Sulfate
46% Leaded Zinc 35/65
14% Non-chalking Titanium Dioxide
30% Asbestine

Vehicle as Rx 375, 1/5/40

Abbreviations

ZZZ-11 - American Zinc Co. zinc oxide, large, acicular, medium oil absorption.

ZZZ-22 - American Zinc Co. zinc oxide, larger, acicular, high oil absorption.

ZZZ-33 - American Zinc Co. zinc oxide, large, less acicular, low oil absorption.

St. Joe - St. Joseph Lead Co. zinc oxide, non-acicular.

XX-50 - New Jersey Zinc Co. zinc oxide, medium, non-acicular.

XX-503 - New Jersey Zinc Co. zinc oxide, larger, non-acicular.

XX-92 - New Jersey Zinc Co. zinc oxide, small, non-acicular, (our 108N)

Lehi 635 - New Jersey Zinc Co. 65/35 leaded zinc, acicular.

Lehi 60 - New Jersey Zinc Co. 65/35 leaded zinc, non-acicular.

Azo 35L - American Zinc Co. 65/35 leaded zinc, non-acicular.

Nat. H.T.S. - National Lead Co. basic lead carbonate, high tinting strength.

S-W H.T.S. - Sherwin-Williams basic lead carbonate, high tinting strength.

Nat. A.B.S. - National Lead Co. acicular basic lead sulfate.

E.P. 70/30 - Eagle-Picher Co. leaded zinc, 70% white lead - 30% zinc oxide, non-acicular.

General Conclusions

One general impression of the whole series at this stage is that the dirty appearance of most of the paints which chalk slowly and fade only slightly makes them less desirable than even some of the most badly faded but clean samples.

In order to correlate this report more closely with Bulletin RC-64, the following conclusions as to tint retention, based on statements from the Bulletin are compared.

	Chicago, 9 months	Chicago, 16 months	Florida, 16 months
1.	Guide fades much worse than others.	True	True
2.	Mechanically mixed leaded zincs better than co-fumed.	True	True
3.	No particular brand of leaded zinc is outstanding.	True	True
4.	Basic lead sulfate equivalent to carbonate except that acicular basic sulfate is inferior.	True	True
5.	St. Joseph's, ZZZ-11, ZZZ-23, ZZZ 33, and XX50 zinc oxides show best tint retention.	True	St. Joseph & XX-50 seem to be inferior
6.	High-leaded (E. P. 70/30) leaded zinc blended with acicular zinc oxide to a 35/65 basis is no better in tint retention than straight co-fumed.	The blend is slightly better in Formula A	As Chicago, 16 months.
7.	HTS Lead is good with any of the straight zinc oxides, except XX-508.	True	True, but except also St. Joseph & XX-50,
8.	Formula A (lead titanate) is distinctly superior in tint retention.	True	Insufficient data. Tend to be more nearly equal.

Thus, viewing all the exposures as a whole, there seems to be a good general agreement as to trends. Though the Florida exposures have the disadvantage of haphazard mildew growth, it is clear that free chalking is effective in stopping it. If the mildew could be assumed to have no effect other than appearance, then it seems that the Florida results are more valuable than those at Chicago to date, because of their more severe exposure conditions.

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#112 - Cont.

in order to get best results as regards fire retardance and at the same time maintaining resistance to high humidity. Probably the value used in the Forest Products' formulation, namely 45.5%, is a good medium value.

#86 - Durability of Pigments with Special Reference to Leaded Zinc and White Lead

The experimental Zilo pastes mentioned under Project #97 last month have been prepared for exposure at Chicago and Coffeyville. These exposures will compare regular Rx 12 with special pastes made with basic carbonate white lead and 414 W, also with inert, and one with some TiO_2. SWP 471 and Charleston White will also be used for comparison.

#160 -Painting Bricks

A research bulletin is being prepared covering the results after 21 months exposure vertical south at Chicago of various systems for the painting of asbestos cement shingles. The best systems include the use of a chlorinated rubber primer coat followed by conventional top coats such as SWP or Brick & Stucco Paints. This system is superior to two coats of chlorinated rubber paints, the two coat SWP system, or the regular Brick and Stucco system. Photographs will be used to illustrate the differences in performance of the various painting systems.

#162 - Studies of Flat Wall Paint Formulation

Storage tests are under way in which comparisons are being made of the suspension properties of various stearates in Flattone. Included are the following M. W. Parsons' soaps:

Calcium Stearate No. 50
Calcium Stearate No. 51
Aluminum Stearate No. 101
Aluminum Stearate No. 351
Zinc Stearate L.S. #7
Zinc Stearate No. 21

A sample of Spencer-Kellogg's Non-Penetrating Linseed Oil (Sulphur Chloride treated) was tried as a replacement for (2330) in Flattone White. Results from this test show no advantage with respect to ghosting, flow, or brushing. The Spencer-Kellogg oil produced a very low body which would result in poor suspension and bad package condition.

Work has been under way on the reformulation of Semi-Lustre White to eliminate the use of lithopone, using titanium pigments as replacements. The vehicles used were the new types of varnishes developed in the Varnish Research Division, such as V-11096, V-11098, and V-11101. The nature of these varnishes has been described elsewhere. The V-11098 and V-11101 varnishes cause too high initial body. V-11096 was satisfactory

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initially but showed a progressive increase in viscosity for several days. This feature is being studied further by the Varnish Research Division.

Due to the improved resin outlook, we are now working on the use of titanium pigments to replace lithopone, using the regular vehicle.

#77 - Mildew Inhibitors

The Kem Tone samples mentioned in the last report in which certain preservatives had been added show the following results after one month's storage:

1. Kem-Tone control. No preservative - no decomposition.
2. Kem-Tone + 0.5% Copper Naphthenate (11% Cu). No decomposition. Bad color.
3. Kem-Tone + 0.5% Protela. No decomposition. Poor Color.
4. Kem-Tone + 0.5% Dowicide G. No decomposition. Color OK.
5. Kem-Tone + 0.5% Dowicide 6. No decomposition. Color OK.

After these materials were painted on cloth and placed in the humidity cabinet for a month, the following results were obtained:

1. Kem-Tone control. Definite mildew growth.
2. Kem-Tone + 0.5% Copper Naphthenate - No mildew growth. (The Copper Naphthenate was not dispersed and should be tried in mineral spirits solution).
3. Kem-Tone + 0.5% Protela. No mildew growth.
4. Kem-Tone + 0.5% Dowicide G. Bad mildew growth.
5. Kem-Tone + 0.5% Dowicide 6. Slight mildew growth.

No work was done on the following projects during the month:

#150 - Durability Studies of Zinc Sulphide Pigment Combinations

#148 - Examination of White Lead

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#97 - Cont.

series 6459 - 6466 and 6467 - 74 described above but represent earlier batches, based on earlier formulations of the white. Subsequently it is proposed to prepare complete series of both white, the whites tinted, and the tint bases, with up to date revisions, covering all the titanium oxide types offered. (Panels 6482 - 6497).

The Cleveland Technical Service Department submitted a sample of micronized composite SWP Gloss White pigment to be blended with oil and drier before application, to approximate the regular SWP tint base formula of 1/23/42. Panels were prepared for exposure at Chicago and Coffeyville, tinted to match SWP Warm Drab against the regular tint. (Panels 6479 - 81).

Additional exposures were prepared during the month on Family Paint White, Rx 30C. On Mr. Mills' request for a Family Paint formula conserving linseed oil, further investigation was made of the possibilities of using larger quantities of soybean oil. A formula employing appreciable quantities of soybean oil in conjunction with maleic treated linseed had given good performance in previous exposures. New exposures were prepared replacing the maleic treated linseed with raw linseed oil, using pigmentations of leaded zinc - Titanox AA - magnesium silicate against the regular formulas of 7/25/40 and 5/14/42 employing leaded zinc - lithopone - zinc sulfide - magnesium silicate, and leaded zinc - lithopone - Titanox RC - magnesium silicate, respectively. Exposures are at Chicago and Coffeyville. (Panels 6637 - 6643).

A report was prepared covering exposures at Chicago for 10-1/2 months of shellac and shellac substitutes to coat over and seal knots and sap streaks in low grade lumber such as might be used in army cantonments. Besides shellac, the substitutes used included a shellac substitute, Marvelac, using alcohol soluble Manila; aluminum paint; Metalead, a flaked lead paste; and a special yellow pine sealer prepared in cooperation with the Southern States Federation.

The results are somewhat contradictory at this stage, but shellac and the S. S. Federation primers are best. Marvelac and the aluminum primer are quite effective, but the latter tends to allow pitch staining and the former tends towards cracking and scaling. In general, Metalead is inferior, although doing well on some panels.

The top coats used in this series include SWP Gloss White and specification paints which might be used on such construction, such as TT-P-36a white and cream tint.

#86 - Durability of Pigments with Special Reference to Leaded Zinc and White Lead

At the present time, SWP Gloss White is pigmented with approximately equal amounts of 412 and 414 W in the leaded zinc portion.

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#6 - Cont.

In view of the lower actual cost of production of 414 W, it was decided to investigate the possibilities of expanding the use of this pigment. Experimental batches of SWP will be prepared with all the leaded zinc introduced as 414 W, also with equal parts of 414 W and 1526, and two parts of 414 W and one part of 1526. The TiO_2 will be introduced as 1403 and R 200.

For further check on the durability of 414 W, panels were prepared for exposure at Chicago and Coffeyville, of SWP Ivory and Cream, comparing 414 W, 1526, and 412, on the basis of equal lead and zinc contents. (Panels 6475 - 6478).

#12 - Exterior Primers

In last month's report, mention was made of a proposed formula for SWP 450 Undercoater to increase the p.v.c. to 39% to reduce the tendencies towards crawling of the top coats. At the technical meeting held during the month, further changes were recommended:

1. Reduce the zinc oxide content to 10%, using 414 W, to improve performance over woods of lower paintability.

2. Add one gallon of oil, preferably (2), to give more margin of safety on oil content.

3. Maintain opacity as near 159 units as possible.

4. Set up alternate formulas using 2030 or 1403 to use up present stocks, and also the R 110 type to take advantage of the higher opacity.

5. With the added oil described in item 2, it was agreed that no further additions of oil on application would be recommended.

A formula was prepared and submitted to Cleveland, incorporating the above suggestions. The theoretical opacity drops below the figure set, but actual opacity on brush-out is good. Further work is dependent on results of actual production batches. Exposures will be prepared with and without oil additions in the first coat on new wood.

The Cleveland Technical Service Department has suggested that Celite used in 450 Undercoater is responsible for the rusting of nail heads. Samples of undercoater based on the formula of 1/14/42 with the regular amount of Celite and with only magnesium silicate as the inert, have been prepared for exposure on special panels to check this feature.

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Cont.

#103 - Cont.

This series is now supplemented with an alkyd series. Other vehicles will be added as time allows. The majority of the work will be carried on in dark gray shades using crystal black and lamp black for the infra-red reflecting and non-reflecting tints respectively. It is hoped that in this color there is the least probability of reading into the results various exposure effects due to physical-chemical properties inherent in the pigment and in its relation to the vehicle, that are detached from the problem we are studying. We are also trying to observe progressive changes in infra-red reflection coincident with the aging of the panels under observation.

A presentation of our theories on the mono-layer protection by fatty acids was made before the Gibson Island Corrosion Conference of the American Association for the Advancement of Science.

#177 - Pigment Studies

An investigation has been instituted on general research on white pigments under R. R. Bruhn. One of the first phases to be studied will be the opacity values, which are now assigned different values dependent on the system used. The opacities will be determined over a representative range of p.v.c.'s normally used in (a) Flat Wall Paints, (b) Enamels, and (c) House Paints, in each series using a vehicle of the type used in such classes of paints.

At present brush application over Morest form 03-B is proving most feasible since the consistency differences, which in some cases are quite wide, can be nullified most easily. Form 03-B affords areas for three measurements of contrast ratio on each sheet. The New Jersey Zinc Reflectometer has been completely reconditioned and will be available for opacity determinations as soon as the microammeter has been repaired by the manufacturer.

A representative series of paints were prepared at 30% p.v.c. in (5091) Processed Linseed Oil, employing as pigments Quick Process lead carbonate, Old Dutch carbonate, lead sulphate, titanium calcium 1271 dry, TiO_2 1403, French Process zinc oxide, 412 leaded zinc, and 461 S lithopone. These paints cover a wide variety of types of pigments and will be used to establish the method and technique.

In preparation for further study of the particle size distribution of pigments, the microscopic equipment has been checked over, and a review made of the methods and procedures used by other operators. Developments at Coffeyville with the Bird centrifuge are being followed, and samples will be analyzed when operation indicates that this is advisable.

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Cont.

#178 - Studies of Dark Colored House Paints

A project number has been assigned to the study of dark colored house paints. This will be a long range research problem to investigate the causes of the loss of drying, early and non-uniform loss of gloss, after-tack or "sweating back," and even softening of dark colored house paints, - the latter phenomenon often occurring after many years of exposure.

Batches were prepared on Rex 498 SWP Moss Green, Rex 388 SWP Modern Brown, Rex 484 SWP Bottle Green, Rex 393 SWP Tobacco Brown, and Rex 352 SWP French Crown Green, with and without zinc oxide. The pH of all the pigments actually used was determined, since this may have some bearing on the subsequent behavior of the paint. We are also checking the possibilities of trouble coming from water soluble compounds in the pigments, particularly ferrous sulphate. Washed pigments will be compared with the original materials.

The various paints will be exposed on glass, and the sol $\leftrightarrow$ gel transformation will be followed by solvent extraction. The gel to sol transformation which may occur to some degree in the very old films would indicate we should look for a peptizing agent which accumulates as the film ages.

#162 - Studies of Flat Wall Paint Formulation

Further work was done during the month on the problem of "ghosting" of flat wall paints. Paints were made in which all raw oil was eliminated and 8 pounds of Flaxoap added per hundred gallons. There was no improvement. Vehicle binder to pigment volume ratios were lowered to 0.6 without improvement, and grinding the tinting colors in the paint in the pebble mill did not help.

#160 - Painting Bricks

Allied Research Bulletin RC 73, "Exposure Studies of the Painting of Asbestos Cement Shingles," was issued during the month.

#148 - Examination of White Lead

Panels 4479-82 F and C were examined after 24 months' exposure at Florida and Chicago of SWP Rex 462 Cream in which the basic carbonate white lead was successively, old Carter White Lead of tinting strength 100, Carter White Lead of tinting strength 110, and one of the early batches of high tinting strength white lead having a tinting strength of 129. The major difference is that the H.T.S. lead shows no checking even after 24 months' exposure at Florida while all the others show slight micro-checking. All show less fading than when BW 104 was used. BW 104 at that time was straight Old Dutch Lead.

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In this connection it would be worth remembering that the average particle size of Old Dutch lead may vary from 1 to 10 microns, with the particle size decreasing sharply for Carter Process, and even further for H.T.S. lead. The carbonate ratios will run from 11.8 to 12.3 for Old Dutch, 11.3 to 11.9 for the previous Carter lead, and precisely 11.0 for H.T.S. lead. Therefore, fade resistance and check resistance increases with lower carbonate ratio and smaller particle size. The latter point, which is in conflict with findings on other pigments, may be due to the unusually large particles in Old Dutch, or it may be due to the dominating effect of the carbonate ratio.

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No work was done during the month on the following projects:

#86 - Durability of Pigments with Special Reference to Leaded Zinc and White Lead

#112 - Fire Retardant Paints

#150 - Durability Studies of Zinc Sulphide Pigment Combinations

#164 - Reformulation Studies of House Paint to Reduce Dirt Collection

#105 - Synthetic Bulletin Colors

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#12 - Cont.

After the primers had dried for three days, a portion of each surface was recoated with the Low Visibility Ocean Gray, and the panel again allowed to dry for two days more. The panels, which were painted on the face and only a portion of the edges, were then laid, open face down, in a tank of fresh water and in salt water. After three days the primers and the two coat systems were checked for adhesion. The blue lead primers in general appeared to be superior to the red lead primers as regards adhesion. In most cases the latter seemed to have less adhesion and were more brittle. The differences were less pronounced in salt water than in fresh.

The best of the entire series was blue lead in the 40 gallon extended phenolic vehicle. The second best was the blue lead pigmentation of equal parts of the phenolic and alkyd varnish at 40 gallon length, and the third best the blue lead in alkyd at the same length. Any of the shorter vehicles seem to be deficient in elasticity.

The conventional oil primers, such as the red lead primer, SWP Undercoater, and the Titanium Pigment Corp. zincless primer after the short drying period were too soft to withstand the water test. It appears that the fast painting schedule required by the early launching of these ships would not permit the application of conventional long oil painting systems.

This work is of a preliminary form, and will be followed by a further check on the formulas set up by the Maritime Commission and under conditions more directly applicable to the service conditions. This work is being done in cooperation with the Newark Technical Service and they are being kept informed of our work.

#162 - Studies of Flat Wall Paint Formulation

Work has been in progress on the development of a Flat-Tone formula using the heavy bodied SO_2 treated linseed oil (2394) as a replacement for reduced bodied linseed oil (2330) and the varnish (2830)S. An experimental factory batch will be made on the new formula. The new SO_2 treated oil appears to reduce the ghosting tendencies of the regular Calcium Titanox formula. If the tests are verified using the factory batch, a new formula revision will be sent through for distribution.

A study is being made of paints designed to meet the requirements of Federal Specifications TT-P-51a and E-TT-P-51a. Brightness and hiding power will be checked on the Reflectometer, but this work is being delayed for the time being, because of necessary repairs on the micro-ammeter. The S-W formulation will be checked against the Lowe Brothers materials meeting the same specifications. There is a discrepancy in the amount of opaque pigments in these various formulas. The purpose of this check is to determine the precise amount of opacity pigments required to meet the specification and at the same time afford the most economical formulation.

M. VAN LOO
Cont.

#177 - Pigment Studies

The opacity evaluations of the various white pigments described in the last monthly report have been held up due to the necessary repairs on the Reflectometer.

Following Mr. Holton's suggestions, a study is being made of the various extender pigments used in house paints, in the hope that a combination of extender pigments may be found at an optimum pigment-volume-concentration which will effect either an improvement in the product or an economy of oil in the formula. It is planned that the following extender pigments will be studied at 25%, 30%, 35%, 40% and 45% pigment-volume-concentration ratios using the opaque pigment combination of SWP Gloss White - Rex 471, but with the vehicle for the time being as all (5091) - Processed Linseed Oil. P.V.C. ratio is being controlled entirely by the amount of inert used. The actual inerts under consideration are: Regular magnesium silicate, a highly acicular magnesium silicate, diatomaceous silica - Dicalite L, crystalline silica - Silex, Pyrophyllite, barytes, gypsum, Metronite, and Atomite. So far the paints made using the magnesium silicate, crystalline silica, and barytes have been prepared.

In the study of luminescent pigments the early work included examination of luminous pigments secured from the New Jersey Zinc Company, the Lunex Corporation and the General Luminescent Corp. of Chicago. The early samples examined were:

1. Strontium Sulphide #84-5, from the General Luminescent Corp.
2. Phosphorescent Strontium Pigment L-704 100%, from the New Jersey Zinc Co.
3. Calcium Sulphide #824 G pigment, from the Lunex Corp., Davenport, Iowa.
4. #800 G Luminous pigment, from the Lunex Corp.

The various luminescent pigments were incorporated in an all oil vehicle of low acid value - Spencer Kellogg's OKO oil, GL 2000, and an alkyd varnish, V 15171.

The results of these tests indicated that the M 2-1/2 vacuum bodied OKO linseed oil is too high in viscosity for proper brushing and spraying, and a lower bodied oil will be tried. The lacquer solution apparently produces some reactivity with the luminous pigments and a progressive increase in body occurs, finally resulting in some cases in a solid gel. The Glyptal varnish and naphthenate drier combination recommended by the New Jersey Zinc Company caused progressive darkening and did not produce the brightness or luminosity obtained with the lacquer vehicle.

The pigments from the Lunex Corp. were both coarse in texture and do not produce a very desirable paint film. The New Jersey Zinc sample L 704 was finer in texture and brighter in luminosity. At the present time it appears that one of the most interesting luminescent pigments is #824 FS 1 Luminous Pigment received more recently from the Lunex Corp. It seems to be almost entirely unreactive with the various vehicles, showing no tendency toward after-bodying. The luminosity is good. The Acryloid vehicle (6097) is the most suitable vehicle found thus far, although it has the disadvantage of very fast drying, which makes application difficult. Although the

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Lunex pigment 824 FS 1 showed no after-bodying in the Acryloid vehicle, both the New Jersey Zinc pigment L-704 and the General Luminescent Corp. of Chicago 84-5 body even with the Acryloid vehicle. An odor of hydrogen sulphide is evident when these two pigments are incorporated into the Acryloid vehicle.

#86 - Durability of Pigments with Special Reference to Leaded Zinc and White Lead

Panels 4500-40 F were returned after 24 months' exposure in Florida. Previous reports have been made on these panels at 14 months and 17 months. The series compares various co-fumed and mechanically mixed leaded zincs having the following basic formula:

33.8% - Basic carbonate or sulphate white lead
14.3% - Semi-nonchalking titanium dioxide
22.9% - Magnesium silicate
29.0% - Zinc oxide

The general conclusions are about the same as at 17 months, with the following new developments:

1. A serious increase in checking and cracking due to National's Acicular Basic Lead Sulphate.

2. A similar increase in the case of basic sulphate white lead, 9 dry, but to a less extent.

3. An increase in checking due to the high lead sulphate Eagle-Picher leaded zinc - 108 N zinc oxide combination.

#148 - Examination of White Lead

An extensive search of records and examination of all available panels disclosed no outstanding examples of superiority of either basic carbonate or basic sulphate white lead in exterior paint formulations. There were no cases, however, where basic sulphate was shown to be superior and several cases where basic carbonate appeared to be preferable, chiefly because of excessive chalking of the paints carrying the sulphate, which affects the tints quite seriously due to a greater degree of fading.

#77 - Mildew Inhibitors

Panels 6182-5 F, C and 6245-8 C on mildew resistant paints after six months' exposure at Florida and Chicago show the S-W system of Mildew Resistant Treated SWP Undercoater and Gloss White to be definitely more resistant to mildew than Cook's Mildew Resistant Paint. The S-W system shows a yellowish discoloration in Florida but less at Chicago. The Havana tests will be examined to determine whether the use of tetrachlorphenol has detracted from the durability, since the Florida tests show a slight pitting of the surface, possibly erosion. The Chicago exposures show no signs of such failure.

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Films of SWP French Crown Green and SWP Modern Brown, with and without zinc oxide, were put on exposure, on glass, for subsequent acetone insoluble determinations.

#86 - Durability of Pigments with Special Reference to Leaded Zinc and White Lead

Panels 2291-2316 C were examined after 45 months' exposure at Chicago covering exposures of co-fumed versus mechanically mixed leaded zincs. Two basic formulas were used; one, a pigmentation based on Pittsburgh's #1-50 formula, carrying 53.6% lead sulphate and zinc oxide equivalent to leaded zinc, 35% lead carbonate, and 11.4% magnesium silicate, and the second, a special single pigmentation formula using 50/50 leaded zinc combinations.

Acicular zinc oxide/lead sulphate combinations seem to be the best combination. 108 dry zinc oxide and National's acicular basic lead sulphate promote checking and fading. The co-fumed leaded zincs are definitely better in durability but inferior in tint retention. Old Dutch lead carbonate is better in durability but shows more dirt collection than lead sulphate.

#12 - Exterior Primers

Experimental batches made under the Proposed Federal Specification for Exterior Primers using the two special oils described in our last monthly report have now aged for three weeks and have maintained their viscosities within acceptable limits. The oils were Dr. Schneider's (319) Batch #5 and Mr. Appleton's LA 760. Dr. Schneider's (319) has an acid value of 9.1 which appears to be the maximum that could be used without excessive after-body. The viscosities run as follows:

Viscosities on S-W Cup, #3 Orifice at 75° F.

OJ 508 F (319) Batch #5			OJ 506 F LA 760		
Fresh	31.8	seconds	Fresh	28.4	seconds
Over night	36.8	"	Over night	32.4	"
3 days	34.5	"	3 days	-	
7 "	39.0	"	7 "	34	"
21 "	39.8	"	21 "	37.5	"

A comparison has been made between Celite 110 and 289 in the new Rex 450 Undercoater formula. Due to the inferior color of the 289, the undercoater becomes slightly dirtier in color, but because of the very white initial color of the new formula, this reduction in brightness may be desirable. The sheen using 289 is equal to standard, perhaps more uniform. A factory batch will be made, and if satisfactory, samples will be sent to Cleveland for consideration. Costs would be reduced slightly.

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#77 - Cont.

Reports were received from Havana, Cuba, covering results of exposures of Rex 54 Barn Red, Rex 461 SWP Willow Green, Rex 499 SWP Antique Brown, Rex 498 SWP Moss Green, and Rex 471 SWP Gloss White, having several mildew resistance treatments.

With the SWP Gloss White, 4% tetrachlorphenol is best, showing only slight mildew growth compared to very bad for the control. In descending order are 2% cuprous oxide, 5% zinc borate, 3% zinc as Nuodex Zinc, 2% tetrachlorphenol, 4% cuprous oxide (an anomalous result), 1/2% zinc as Nuodex Zinc, 5% phthalic anhydride, and 5% zinc benzoate. With Barn Red the use of 1/2 pound of zinc oxide plus 2% and 4% tetrachlorphenol show no mildew growth and excellent appearance, with good results also obtained with 5% cuprous oxide. The controls show very bad mildew growth. With the dark colored house paints, the use of 1/4 pound of Kadox zinc oxide plus 5% cuprous oxide gives excellent results, also the Kadox oxide plus 2% tetrachlorphenol. In the zinc oxides, Kadox zinc oxide was best, superior to other oxides such as XX 2, XX 50, and the acicular oxides such as ZZZ 11, 22, or 33.

There were no other film failures such as chalking, cracking, or peeling on any of the above panels. The exposures were in a location conducive to mildew growth rather than to determine weather resistance.

#162 - Studies of Flat Wall Paint Formulation

The proposed revisions of Flat-Tone formulas to use the heavy bodied SO_2 treated linseed oil have not been made in the factory to date because of lack of available equipment. During the month the Varnish Research Division submitted two flat wall paint vehicles for test. LA 770 was a blown and heat bodied oil having an acid value between 1 and 2. LA 772 was similar but with an acid value of 30, obtained by the introduction of fatty acids. Both oils when used in the flat paints produced low body and poor flow.

Titanium Pigments' Primer Flat Wall Paint F 3473 was reproduced. Compared with Paintercraft Flat #10, F 3473 had better hiding but much poorer enamel hold-out, more "ghosting," less uniformity, and much poorer washability.

#177 - Pigment Studies

Luminescent Pigments

In continuing the study of luminescent coatings the pigment offered by the Lunex Corp. #824FS1 has proven itself the most attractive material yet tested. From the standpoint of initial brilliance and long luminous life it is equal to any competitive material. The pigment is not reactive with either an Acryloid or a nitrocellulose base vehicle. As far as price is concerned, this material is much less costly than any competitive first grade product.

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We have concluded that a two section package is a necessity. Suspending agents such as aluminum, calcium, and zinc stearates have all been tried without success.

With the Acryloid vehicle the introduction of 10% dibutyl phthalate will extend the application time to 5 - 10 minutes. 1% aluminum stearate improves the flow of the paint.

Flat Wall Paint Specifications TT-P-51a and E-TT-P-51a

A comparison has been made photo-electrically of paints prepared by S-W and Lowe Brothers to meet the above specifications. The work to date indicates variations of contrast ratios at 250 square feet per gallon spreading rates of from 98.7% to 97.4%, all passed by inspectors. Considerable promise has been shown as to possibilities of conserving opaque pigment through the use of Atomite and Limeolith calcium carbonate as the inerts.

#160 - Painting Bricks

Approximately two years ago, several new unpainted asbestos cement shingles were placed on exposure to weather. These weathered panels have now been painted with selected painting systems drawn from results on panels 2174 C, 2178 C, 2184 C, and 2192 C referred to in Allied Research Bulletin RC-73.

The systems used are all two coat applications. As primers the following materials were used: SWP Gloss White with one pint of raw oil added to the gallon, SWP 450 Undercoater, Brick and Stucco White reduced 100% with Brick and Stucco Reducer, and the special chlorinated rubber primer OJ 152 C. SWP Gloss White was used as the top coat for all the panels. The exposures numbered 6808 through 6811 C are exposed at Chicago, vertical south, with the backs of the panels exposed north to the elements to permit moisture penetration and possible alkaline attack.

#179 - De-icing Paints for Aircraft

The purpose of this investigation is to find a finish for aircraft which would help to prevent the formation of ice on the leading edges of wings and control surfaces. To date the paints seem to fall into three groups. The first depends on the incorporation of a considerable amount of a low freezing point liquid such as glycerol or glycol which are constantly exuded by the paint coating. Such paints are usually emulsions, of rather limited life of usefulness. The second group depends on the presence of soluble salts which dissolve in the first ice formed, lowering its freezing point. The third group relies on the protection of electrical conducting films of considerable resistance, which can be heated by the passage of an electrical current. Mr. Fasig has suggested a study of the materials such as are used in Thermat heating pads, and patents on this material are being investigated.

ALLIED RESEARCH LABORATORIES

Report of Investigations for November, 1942

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#162 - Studies of Flat Wall Paint Formulation

Paintercraft Maintenance Flat No. 3, Rex 27877 has been reformulated and a gallon sample of the new development has been forwarded to Mr. Mills for approval. In general, the new formulation was patterned after that of Paintercraft Flat #10, Rex 65310. Soya and castor oils and the varnish contained in the original vehicle were replaced by linseed oil and zinc resinate solution, using the heavy bodied SO_2 treated linseed (2394) as the principal vehicle constituent. The opaque pigmentation is now titanium calcium - rutile titanium oxide. The uniformity of sheen has been improved by the use of magnesium silicate instead of Celite 281. The raw material cost per gallon was reduced approximately 9¢ per gallon.

Work is now under way to reformulate Rex 26609 - Flat Wall Paint White #74, and Rex 26573 - Maintenance Wall Paint #73, to eliminate dehydrated castor oil and to modernize the formulas along the lines employed in #10 and Flat-Tone.

Revisions have also been sent through for approval to Cleveland for Flat-Tone White and light tints in which the dehydrated castor has been eliminated by substitution of the SO_2 treated linseed (2394) for the linseed-dehydrated castor bodied oil (2530), and using zinc resinate (3071) for the resin content. The proposed revisions are based on a lithopone - zinc sulphide pigmentation which will reduce ghosting tendencies. The working properties have been improved.

#97 - SWP 471

During the month a proposed formula, OJ 572 F, has been submitted for consideration for the SWP tint base, to use the non-chalking rutile titanium oxide R 610 and to eliminate lead titanate. The pigmentation is:

31.8%	Zinc Oxide
5.7%	Basic Sulphate White Lead
20.5%	Basic Carbonate White Lead
12.0%	Titanium Oxide (R 610)
30.0%	Magnesium Silicate

The pigment-volume-concentration is 28%, and the vehicle is 84% oil, 16% driers and thinners by weight. The raw material cost is reduced about 1-1/4¢ per gallon below the present regular tint base.

Krebs' R 610 Rutile Titanium Oxide was selected in preference to R 510 for use in the tints on the basis of inspection of Krebs' exhibit of exposure panels. Their panels covered tint exposures of buffs and grays both south and north exposures at Wilmington, Dela[illegible] [illegible] and [illegible]-1/2 years, using two basic pigmentations.

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#97 - Cont.

at six month intervals so that comparisons can be made of each paint at different stages of weathering. The above changes, if found to be satisfactory after exposure, would reduce the magnesium silicate to less than half the original. It is to be understood that as yet this is not a recommended procedure.

The house test at 11131 S. Hoyne Avenue, Chicago, was inspected. This test represents a comparison of an experimental tint CY 8001 (20% lead titanate, 45% leaded zinc, 35% magnesium silicate) with regular Rex 496 SWP Ivory C 2918 representing the 1938 formula carrying 3% free chalking TiO_2. After 40 months' exposure the 20% lead titanate is holding its chalk more than the regular so that the masking effect gives the impression of less color retention.

During the month a panel was placed on exposure at Chicago only (6837-38) of Sicya Soya Oil Paint versus SWP Gloss White. The label on the Sicya White states that the oil used is entirely soybean oil treated to cause a shifting of the double bonds to produce a quick drying vehicle. The initial drying is much slower than SWP although eventually the film becomes very hard. The paint is highly enamelized, with very sticky brushing and very high flow.

The experimental batches of whites and tints mentioned in the last report, testing Gloucester's zinc titanates and titanium oxides, have now been put on exposure at Chicago (6839-6858). These supplement the series 6770 to 6807.

Test paints were prepared for exposure comparing SWP Gloss White regular with a special using as the oil in the vehicle Pittsburgh's Soya Extract Oil P-215-X. The special soya paint was very yellow in color.

#86 - Durability of Pigments with Special
Reference to Leaded Zinc and White Lead

Mr. Adams was at the laboratory during the month to work with Mr. Chapin in a special study of parallel exposures at Chicago, Coffeyville, and Florida. Over 600 panels were examined very carefully for chalking, film failure, color change, dirt retention, mildew, and hail damage. The purpose was not only to analyze the results of individual tests, but also to compare the rate of change at the three locations. Included were the two large series 4500-45 white, and 4546 - 4633 tinted, involving various lead-zinc and titanium combinations.

The results of the main series are being written up by Mr. Adams, and will be condensed and the results correlated with all the series involved, and a summary prepared. The only general observations possible at present are:

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Cont.

#86 - Cont.

1. Coffeyville exposures show a rate of change approximately midway between those of Miami and Chicago as a year-around average, although approaching close to Miami for several of the summer months.

2. The factor of hail damage at Coffeyville must be considered seriously, as hail storms are frequent enough to damage a rather high percentage of the panels.

3. Florida exposures are the only ones showing appreciable checking and cracking in the main series to date.

#164 - Reformulation Studies of House Paint to Reduce Dirt Collection

House tests in the Chicago area of interest in this investigation were inspected during the month. The test at 11421 Union Avenue represents a comparison between the SWP Gloss White of 6-24-38 and a similar formulation in which half of the linseed oil in the vehicle is replaced by treated soybean oil, V 11067. After 41 months of exposure the soybean oil paint appears very similar to the regular on all sides of the house except on the north where it is holding the chalk and appears dirtier than the regular used as the guide. From a durability standpoint treated soybean oil, V 11067, appears to be equal to linseed and probably will give longer protection due to its tendency to hold the chalk, which in turn protects the film.

The house test at 11071 S. Esmond Street represents a comparison between the synthetic oil, ARV 1979 ("kangaroo oil") and linseed in the SWP Gloss White formula of 7-19-40. 16 gallons of the castor-soya "kangaroo" oil are used per 100 gallons of the special. This oil has especially fast drying properties, and it was thought that its use in exterior paints would accelerate the rate of drying and the sol to gel transformation, thus reducing dirt collection. After 24 months' exposure, the special (CH 1415) was chalking slightly faster than the guide on the south and east sides and appeared slightly better in general appearance. There were no other film failures on the guide or special.

The house at 10504 Wentworth represents a test of SWP Cold Weather Reducer. The house was painted in late October and early November, 1940 in temperatures ranging down to 37° F. The house was painted with Rex 387 - SWP Canary Yellow reduced only with turpentine and with one pint of Cold Weather Reducer per gallon. After 24 months' exposure there is very little difference between the two paints, although on the south side the paint with the special reducer added appears slightly cleaner.

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#177 - Pigment Studies

Luminescent Pigments

In continuing the study of luminescent coatings our efforts have been directed toward the selection of a suitable vehicle. Most of the vehicles showing promise are critical as regards availability. Acryloid vehicles have been used with some success. Nitrocellulose lacquers, although providing good brushing materials, fail to hold the pigments in suspension and on aging tend to liver so that re-dispersion of the pigment is practically impossible. Aluminum naphthenate was tried as a suspending agent but spoiled application properties.

When ethyl cellulose was pigmented with the sandy textured phosphorescent pigment, the brushing properties were very poor, and the binder did not have sufficient elasticity or adhesion.

Flat Wall Paint Specification TT-P-51a and E-TTP-51a

Following the line of thought suggested in the last report an investigation was started to study the use of Atomite and Limeolith as extenders. Maintaining the specification requirements for vehicle and total solids, etc., for TT-P-51a, the following dry hiding values were obtained:

Formula	Ti-Cal Pounds	Extender	Brightness	Spreading Rate Sq.Ft./Gal. at 98% C.R.
RB 50	530	566 Mineral Whiting	88.2%	228
RB 58	450	(25% Limeolith N (75% Atomite	89.25%	266
RB 59	450	(40% Limeolith N (60% Atomite	89.5%	278

None of the above batches were tinted down to minimum brightness. Limeolith N is a low sheen calcium carbonate used to reduce the high sheen obtained with Atomite.

Reflectance measurements were made on three paints to compare wet and dry opacities. The measurements were made on films applied with the draw-down gauge having 0.005" clearance.

			Wet Films		Dry Films	
Formula	Ti-Cal Pounds	Extender	Brightness	Contrast Ratio	Brightness	Contrast Ratio
LB 25305	435	566 Mineral Whiting	87.5%	94.3%	86.25%	93.1%
RB 50	530	" " "	89.25%	95.5%	88.5%	91%
RB 59	450	(40% Limeolith N (60% Atomite	87.75%	92%	88.75%	93.5%

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Flat Wall Pt. Spec. TT-P-51a and E-TT-P-51a - cont.

It is apparent that the brightness of the two paints made with 566 dry Mineral Whiting dropped off about 1% on drying, while the Limeolith N - Atomite combination increased by 1%, with parallel changes in contrast ratios. A discrepancy appears in the above table in that RB 50 has lower dry hiding than LB 25905. This is reversed in the more accurate opacity brush-outs.

The experimental batches will be tinted down to 85% brightness and RB 59 sent to Cleveland for evaluation.

Krebs and Titanium Pigment both recommend approximately the same amount of titanium calcium pigment in their suggested TT-P-51a formulas as is used in the regular Rex 64736 paint. The A. C. Drubel Company is circulating a TT-P-51a formula calling for 410 pounds of titanium calcium using a surface treated whiting as the extender and tinting with raw umber. Our approximate duplication of this formula gave us the following characteristics:

Brushing - Poor, sticky.
Brightness - 85.65%.
Hiding - 304 sq. ft./gal. at 98% C. R.
Sheen - Excessively high, equal to or higher than Semi-Lustre.

While the hiding produced is very interesting, it is doubtful that the sheen and brushing could be corrected without radical changes in the formula.

#112 - Fire Retardant Paints

An examination of the fire retardant paints on exposure at one month revealed that there were only very minor changes in appearance of the film as reported last month.

During the month we received a Maritime specification for a fire resistant paint containing 100 pounds of antimony oxide. To check the action of the antimony oxide, batches were made up of the fire resistant specification, and the regular specification 52-P-22 with and without 100 pounds of antimony oxide. These were painted out on metal panels. When thoroughly dry the fire resistance of the coatings was checked by placing the unpainted side of the panel next to the heat of a muffle furnace at about 1900° F. Both of the panels coated with 52-P-22 with and without antimony oxide flashed over, whereas the fire resistant specification coated panel did not. The fire resistant specification had a p.v.c. of 58.7% against 40.6% for the 52-P-22 specification which probably accounts for the fact that it did not flash over. The fire resistant batch will be repeated without antimony oxide and checked to see what properties can be ascribed to antimony oxide in a fire resistant film.

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#164 - Cont.

The oils tested include straight linseed (5091), Kastolene dehydrated castor, P5XL Pittsburgh extracted soybean, a blend of 60% Archer-Daniels-Midland soybean (418) and 40% Kastolene, a blend of 1/3 Kastolene, 1/3 ADM soybean (418), 1/3 linseed (5091), and also a series of pentaerythritol esters, including ARV 1979 castor-soya P. E. ester, ARV 1981 and ARV 1984 soybean P. E. esters, and ARV 1987, 1988, and 1999, all linseed P. E. esters.

The dirt collection and mildew on the above panels is not as bad at 24 months as at 12 months. All are cleaner than the guide (regular formula of 7-19-40) except the ARV 1984 soybean P. E. ester, which also shows severe checking and cracking on yellow pine. In general the other pentaerythritol ester oils equal the regular in durability and are superior to the oil blends of dehydrated castor and soybean or linseed. The linseed P. E. esters seem to perform favorably in reducing dirt collection. A combination of 60% ARV 1979 castor-soya P. E. ester and 40% Kastolene dehydrated castor shows promise. A special pigmentation using acicular zinc oxide ZZZ-22 and H.T.S. white lead to replace co-fumed leaded zinc showed definitely greater checking and cracking tendencies, although dirt collection was only slight.

#86 - Durability of Pigments with Special Reference to Leaded Zinc and White Lead

Panels 6859-6870 C and Cof. were prepared for exposure at Chicago and Coffeyville to study the behavior in SWP White and Cream of leaded zinc 1526 dry calcined to improve its color. Panels were prepared comparing the special 40/60 leaded zinc with the original before calcination and also with 35/65 leaded zinc 412 dry.

A special examination was made by Messrs. Adams and Chapin of panels 4483-98 C, Cof., and F covering exposures of the regular tint base of Rex 387, SWP Canary Yellow of 1-5-40, a special replacing the 1526 leaded zinc pound for pound with 412 leaded zinc, and the special high lead titanate formula with approximately 47% 412 leaded zinc, 25% lead titanate and 28% magnesium silicate. The Chicago and Coffeyville exposures have been out 28 months, the Florida panels 17 months.

There is surprisingly little difference between the two tint bases. The regular 1526 leaded zinc formula reaches definite chalking first, the 412 leaded zinc replacement last, and the lead titanate formula intermediate. The 412 leaded zinc produces checking somewhat earlier than the 1526 leaded zinc regular with the lead titanate formula again intermediate. The 412 leaded zinc formula is slightly superior in tint retention.

Panels 6000-89 C were examined after 12 months' exposure in Chicago covering comparisons of SWP whites and tints, regular formulas and variations with Titanium Pigment Corporation's zincless two-coat system, using both bodied oil and a resin-modified vehicle, and the New Jersey two coat system.

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#86 - Cont.

White, Colonial Yellow, and Slate tints were used. At the time the original batches were prepared, there was interest in the direction of zinc oxide conservation.

The panels are two coat jobs on cedar siding, and the SWP top coats are applied over SWP 450 Undercoaters at both 10% and 15% zinc oxide content. In the top coats of SWP zinc conservation was accomplished by reducing the zinc oxide in the white and tint base from 30% to 25% and to 20%, with the bulk replaced by basic carbonate white lead only and by lead carbonate plus magnesium silicate, respectively.

The series has been unusual since its first month of exposure due to the heavy accumulation of dirt on the zincless samples, which undoubtedly has a protective effect on chalking and fading. At 12 months SWP Gloss White and the variations using 25% and 20% zinc oxide are chalking heavily and are clean. The New Jersey Zinc two coat system is performing similarly to SWP Gloss White. In tint retention the regular SWP tint and the zincless paint seem slightly better than the lower zinc variations of our tints, while the New Jersey Zinc formula is surprisingly poor. Mildew is not especially serious although it appears as expected on the zincless formulas. Up to this point there is little effect due to the reductions of zinc oxide in the SWP formulas.

#150 - Durability Studies of Zinc Sulphide Pigment Combinations

Panels 2344-55 C were examined after 46 months' exposure at Chicago. Fundamentally the paints involved were pigmented with 65% Cryptone MS-130, 35% 412 leaded zinc, or with zinc sulphide ZS-20, mica, and magnesium silicate blended as in MS-130. All the paints were 3 coat work, self-primed, on Ponderosa Pine against the 1938 SWP Gloss White as the guide.

In general the tests show good durability at nearly four years' exposure. Micatone A, Micatone B-1000, Micatone B-2000, and Pyrophyllite show some checking and cracking. It would appear that the following materials may be used to blend with magnesium silicate and zinc sulphide to produce the equivalent of Cryptone MS-130, without fear of premature film breakdown: Aratone Mica, 325 mesh mica from English Mica Company, Alsibronz #12 from Franklin Mineral Products Company, and Micatone asbestos and Biotite Micatone. The regular 1938 SWP Gloss White and the Cryptone MS-130 and 131 panels are in excellent condition, with the SWP White having the best color.

#112 - Fire Retardant Paints

During the month there was considerable interest shown in fire retardant and fire resistant paints. As a portion of this work the following paints were prepared:

OJ 577 F Regular Navy Dept. Specification 52-P-22 (old).
OJ 578 F As 577 F, but one pound antimony oxide added per gallon.
OJ 591 F Regular Navy Dept. Specification 52-P-22 (Fire Retardant).
OJ 613 F As 591 F, but no antimony oxide.

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OJ 621 F	As 591 F, but one pound zinc borate replacing antimony oxide.
OJ 622 F	As 621 F, but borax replacing zinc borate.
OJ 614 F	Regular Flat Specification TT-P-51a.
OJ 615 F	As 614 F, but 3-1/4 pounds zinc borate (City Chemical) per gallon.
OJ 616 F	As 614 F, but 2-1/4 pounds borax per gallon.
OJ 623 F	As 614 F, but one pound antimony oxide per gallon.
OJ 645 F	As 614 F, but 3-1/4 pounds zinc borate (New Jersey Zinc) per gallon.
OJ 646 F	As 614 F, but 3-1/4 pounds zinc ammonium phosphate per gallon.
OJ 980 E	Forest Products formula - lead carbonate plus borax.

These paints were applied on metal panels and checked for flash and flame resistance at approximately 1875° F. The regular Navy Specification OJ 591 F with antimony oxide/and 613 F without antimony oxide both passed as free from flashing, and OJ 621 F and 622 F replacing the antimony oxide with zinc borate and borax respectively, also passed. 980 E, the Forest Products product showed no flashing. In the flats, the regular TT-P-51a paint OJ 614 F flashed but all the other flats containing borax, zinc borate, zinc ammonium phosphate, and antimony oxide passed the test.

Arbitrarily judging fire resistance by the deposition of a firm white film which adhered well to the metal panel and which had not blistered on the fire test, all the Navy formulas and modifications passed the test, as did special flats carrying borax and zinc borate. The remainder had blistered badly with flaking off the panel.

With regard to individual characteristics, the washability of the special flat OJ 616 F with 2-1/4 pounds of borax per gallon, and 623 F with one pound antimony oxide per gallon was not very good. 615 F with 3-1/4 pounds zinc borate per gallon was more porous than the regular 614 F.

It seems that the main value of antimony oxide is due to its low temperature of fusion, forming a slag with some of the metal oxides present in the paint film, thereby increasing adhesion. It appears doubtful that it has much fire retardance as used in the new Navy specification.

The tests seem to indicate that rather generous amounts of zinc borate should be satisfactory in many cases as a replacement for antimony oxide. It fuses at a relatively low temperature, forming a tightly adherent final film.

Zinc ammonium phosphate seems to have fire retardant properties, but the films containing it blister very badly on the metal panels so that large areas of the film flake off, giving a coating with poor fire resistance.

At the request of Mr. D. L. Thomson, an attempt was made to develop a satisfactory fire resistant paint for plaster board. When attempts were made to use paints passing the Bureau of Ships specification for resistance against flashing, they proved to be unsatisfactory. This was evidently due

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to two factors. One is that the porosity of the paint film allows the escape of inflammable gases from the paper. The second is that the paper coating on the plasterboard chars and cracks, so that the paint film has no supporting foundation and consequently flakes off.

From this work it would appear desirable for the manufacturer to impregnate the paper with flame-proofing chemicals. However, priming the paper on the plasterboard with a solution of ammonium sulfamate, then coating with a fire resistant paint showed no encouraging results.

In connection with a request from Washington for an interior fire retardant paint containing borax, a fire retardant flat CH 3869 and a fire retardant semi-gloss CH 3870 are being developed and tested. These are formulated with about 25% of borax based on the weight of the paint.

#162 - Studies of Flat Wall Paint Formulation

Work has been under way to reformulate Rex 26609 - Flat Wall Paint White #74 and Rex 26573 - Maintenance Wall Paint #73. The new formulas eliminate dehydrated castor oil and soybean oil, replacing with bodied SO_2 treated linseed oil (2394). Gallon samples will be sent to Newark for inspection. The revised formulas have improved brushing and flow properties and equal hiding, at the same costs.

In order to eliminate bodied linseed-castor (2330) from all flat wall paint formulas, Paintercraft Flat #11 was reformulated, using bodied SO_2 treated linseed oil (2394). The new formula has been turned over to the Kensington factory for a plant run, and if the results equal those in the laboratory, the new formula will be distributed.

#177 - Pigment Studies

Titanium Calcium Pigments

During the month three new titanium calcium pigments have been submitted for test:

(1) Ti-Cal R 20 Special C 1290

Krebs claim low water sensitivity, and recommend use in flat wall paints containing calcium linoleate pulp, etc.

(2) Titanox RC HT new production.

This lot represents new production of Titanium Pigments' RC HT with improved color and opacity, and is said to be representative of material which will be available for regular shipments in about two months.

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(3) Titanox RC HT - X

This is a finer particle size RC HT which should have better wetting and grinding properties.

All the above pigments have been made up into both Paintercraft Flat #10 and Flat-Tone White, and will be tested for sheen, opacity, ghosting, and other characteristics.

New Titanium Dioxide Pigments

Two new types of rutile titanium dioxides, Titanium Pigments' Titanox RA, and United's Unitane R 250, are under test. Titanox RA is said to be similar to Krebs R 110 and Unitane R 250 is said to be similar to Krebs R 200. They have been included in the test series of SWP Undercoater and Gloss White.

These two pigments have also been made up in a damar paint series to check color, brightness, and opacity. It is also hoped that some early indication of the chalking characteristics of the oxides may be obtained by exposure of the damar paints. One set of panels is on exterior exposure at Coffeyville and a second set was placed in the Weather-Ometer here. The formula used is:

320	grams	titanium oxide
690	"	(32) Damar Varnish
30	"	(293) Pine Oil

Using a draw-down gauge of 0.005" clearance giving a film thickness of 0.003", equivalent to a spreading rate of about 535 square feet per gallon, the following characteristics have been determined to date:

Paint No.	TiO_2 Pigment		% Brightness*	Contrast Ratio
RB 100	1403 T	Titanox A	89.35%	95.70%
101	2030 T	Titanox AA	89.15	94.50
102	2147	Titanox A 24	88 -	94.45
103	2031 T	Titanox A NC	86.75	95.22
104		Unitane R 250	90.70	96.60
105		Titanox RA	89.75	97.05
106	2173	Ti Pure R 200	90.40	97.35
107	50/50 blend	Titanox RA/1403 T	89 -	96.82

*Per cent brightness determined over white portion of a Morest sheet.

It should be noted that in the above the brightness values are somewhat affected by the incomplete hiding of the films. These evaluations are continuing.

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Flat Wall Paint Specification TT-P-51a and E-TT-P-51a

Sample R 59, described in the November report, and which carries 450 pounds of rutile titanium calcium per hundred gallons, with an extender blend of 40% Limeolith N and 60% Atomite, has been submitted to Cleveland for evaluation.

#179 - De-icing Paints for Aircraft

The work on this project has been limited by pressure of other matters to tests for simulating icing conditions. It was found by suspending a tin container filled with a freezing mixture in a chamber into which water is sprayed by an atomizer, that sufficient coatings of ice could be built up on the container in a relatively short time. The testing will proceed on this basis.

#103 - Metal Protective Paints

In September Mr. Mills reported comments from the trade over the apparent poor hiding of Metalastic Gray over Kromik Primer on metal sash. This is due in part to the contrast in colors, but also in part to the tendency of the Metalastic Gray to run away from sharp edges.

Rex 9550 Metalastic Dark Gray and Rex 27399 Metalastic Light Gray were revised to reduce the flow and increase build. Also a gray metal primer was developed on the pattern of Kromik Primer using blue lead for pigmentation, The vehicle was also changed to include mixing varnish (3848)E. All paints are ready for the preparation of exposure panels.

#105 - Synthetic Bulletin Colors

Panels 5081 C - 5082 C - 5084 C were sent to Cleveland for inspection after 19 months' exposure 45° south at Chicago. These panels compared regular Kem Bulletin White - Rex 45000 with Socony Finishing White and CH 2590, a special Kem Bulletin White using Socony's pigmentation and the P. E. alkyd V 15116 as the binder. The special behaves much as Socony's white on exposure, especially as to whiteness and cleanliness.

Special Studies

U. S. Maritime Commission

At the request of the U. S. Maritime Commission we are conducting exposure tests on the various barge primers and hull painting systems which have been compared in immersion tests as reported previously. Fourteen 8" x 24" yellow pine panels were sent to Miami for exposure at 45° south, to accelerate weathering attack.