7162 - Studies in Flat Wall Paint Formulations

Flat Wall Paints

The Resin Research Department submitted three special (4113) varnishes - RC 5201, RC 5214 and RC 5447 for evaluation in Flat-Tone. These liquids were developed with the idea of reducing the cost of (4113). RC 5201 is similar to (4113) but the oil is 25% (3019), 75% (1273) and 2/3 Abitol content of (4113). RC 5447 is similar to (4113) but the oil is 20% (3019), 80% (1273) and 1/2 Abitol content of (4113). RC 5214 has no P.E. and no Abitol. The oil ratio is 1/2 (3017) and 1/2 (1273). The characteristics are:

	Resin	Oil	Body	Cure	A. V.	Color
RC 5201	Glyceryl + P. E. Phthalate (Abitol)	(1273) (3019)	X-Y	14"	11.9	3 +
RC 5447	"	(1273) (3019)	W -	15"	14.2	3 -
RC 5214	"	(1273) (3019)	U +	20"	10.2	

When these varnishes are made into flats it appears that the use of part dehydrated castor oil in place of soya improves the uniformity over porous surfaces. However, RC 5214 made without P. E. and Abitol was very poor in uniformity. It appears that a better varnish could be made by using dehydrated castor for part of the soya but no reduction should be made in the percentage of P. E. or Abitol. Work will be continued on this problem.

The Varnish-Resin Laboratory submitted a sample of CTV 7338 (P.E.-Rosin-Dehydrol varnish) for evaluation in Flat-Tone.

CTV 7338

Resin - P. E. Rosin
Oil - (2325)
Body - 10 minutes #5
Color - Milky

Flat wall paints made from CTV 7338 had good flow and very free brushing properties. However, paints made with this varnish were too poor in uniformity of tint, when applied over spackle, to be of interest.

A number of tests have been made to determine the compatibility characteristics of the alkyd Flat-Tone with the previous Flat-Tone formulation, Semi-Lustre, Paintercraft One Coat Flat #10, and several competitive flat wall paints. Three different blends were made and the viscosities of each blend are reported in the following chart.

Viscosity on #5 Orifice of Products and Blends

Material Intermixed	Original Viscosity on Each Material	75% New Flat-Tone 25% Product as Listed		50% New Flat-Tone 50% Product as Listed		25% Flat-Tone 75% Product as Listed	
	As Received	At Once	24 Hrs.	At Once	24 Hrs.	At Once	24 Hrs.
Flat-Tone - Rex 810 C 3629 B (Alkyd)	12.8"	-	-	-	-	-	-
Flat-Tone - Rex 810, C 569	8.4"	6.8"	7.8"	7.4"	7.8"	7.2"	6.8"
Wall Primer and Sealer Rex 25 - C 3539	13.8"	7.0"	7.6"	6.8"	7.0"	7.0"	7.0"
Semi-Lustre White Rex 210 - C 3559	9"	10.4"	8.8"	10.0"	7.2"	7.6"	6.4"
Paintercraft O. C. Flat #10 Rex 630, reduced 12-1/2% with (348)	9.2"	9.4"	7.8"	8.4"	7.0"	8.8"	6.8"
Sani-Flat (Benjamin Moore)	13.8"	11.8"	12"	12.8"	15"	14.8"	-
Wallhide White (P.P.G. Co.)	9.0"	8.4"	7.0"	7.0"	6.8"	6.2"	5"
OJ 669 N - Special Flat-Tone (Aroflat #3010)	3.2"	5.0"	4.6"	4.2"	3.8"	3.6"	3.4"
OJ 835 N - Special Flat-Tone (Syntex 131)	9.6"	7.8"	8.0"	7.0"	8.2"	6.8"	8.4"
Dutch Boy Wonsover	17.0"	8.0"	8.0"	7.6"	7.8"	8.8"	7.7"

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Most of the blends were lower in consistency than the two original products that were intermixed. There may be certain products that have a tendency to body the new material. However, we do not believe that complaints on incompatibility of the new alkyd Flat-Tone with other types of formulations should be numerous or serious.

Kensington production of Rex 810 - Flat-Tone White was rechecked for viscosity and the findings were as follows:

Standard viscosity when fresh - 8 - 11 seconds #5 orifice.

" " 2nd day 11 - 15 " " "

Cap Date	Date	Rex No.	Viscosity as Passed	Rechecked Viscosity #5 1-12-50
C 3539	12-19-49	810 White	10" #5	11-1/2"
C 3579	12-23-49	810 White	9" #5	11-1/2"
C 3619	12-27-49	810 White	9" #5	13"
C 3619 A	12-27-49	810 White	11" #5	13-1/2"
C 3619 B	12-27-49	810 White	7" #5	17"
C 30	1-3-50	810 White	8" #5	10"
C 40	1-4-50	810 White	9" #5	11"
C 40 B	1-4-50	810 White	10" #5	12"
C 40 A	1-4-50	810 White	8" #5	10-1/2"
C 60	1-6-50	810 White	9" #5	10"
C 60 A	1-6-50	810 White	10" #5	10"
C 40	1-4-50	800 Petal Rose	8-1/2" #5	7-1/2"
C 100	1-10-50	800 Petal Rose	8" #5	9"
C 40 A	1-4-50	803 Seafoam Green	9" #5	8"
C 100	1-10-50	844 Sunglow Yellow	8" #5	9"
C 60	1-6-50	844 Sunglow Yellow	11" #5	9"

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Tests were made to check the reactivity of heat bodied linseed oil (324) and Advance Puffing Agent when added to alkyd Flat-Tone. Both could be used to increase the viscosity of thin batches.

Material	Agent Added Per 100 Gals. Paint	Viscosity - #5 Fresh	3 Days	12 Days
1. Flat-Tone 805 N (Alkyd formula)	None	7.6"	7.6"	7.6"
2. "	1-1/4 gals. Advance	Too hvy	Too hvy	Too hvy
3. "	9/16 " "	" "	" "	" "
4. "	4/16 " "	32" + 1/8 cup	38"	34.4"
5. "	7/32 " "	21.8"	25"	20.0"
6. "	3/32 " "	16"	20"	16.6"
7. "	1-1/4 " (324)	Too hvy	Too hvy	Too hvy
8. "	9/16 " "	24"	34"	27"
9. "	4/16 " "	21.6"	21"	22"
10. "	7/32 " "	16"	17.4"	16.2"

A sample of Dryfol B-70 from Werner G. Smith was evaluated for performance in their flat wall paint formulation No. 1357-1. The flat had good flow and brushing properties but was poor in uniformity and washability tests.

Porch and Floor Enamels

A gallon sample of Porch and Floor Enamel OJ 777 N, made with an ether resin varnish RC 4915, was sent to Cleveland for test. The new formulation has slightly more feel in brushing characteristics with slightly less flow but it is more resistant to such agents as 1% soap solution, 5% acetic, citric or oleic acid. The scrub resistance of the ether resin enamel is approximately four times greater than regular Porch and Floor Enamel.

A further effort will be made by the Resin Research Department to improve the flow and brushing characteristics of their ether resin varnish RC 4915.

#177 - Pigment Studies

Panels 8635-9 F, C were examined after 48 months at Florida, vertical south, regular cedar siding panels primed with Rex 450 Undercoater shaded gray. Chicago panels (south) were exposed only 36 months. The basic (guide) formula is essentially that of Rex 471 SWP Gloss White of 1-22-43, earliest bodied oil type, all 2173 dry rutile titanium. The following extended titaniums are tested, the main purpose being to circumvent the titanium shortage existing at the time of preparation:

(a) 271 pounds of 2132 Titanox RC-HT, rutile titanium-calcium. Performance characterized by low chalk, rather high dirt collection, but good film integrity. Very little erosion at Chicago. (All tests now satisfactorily clean.)

(b) 135 pounds each of 2132 and 1271 anatase titanium-calcium. Tends to chalk a little more freely, clean-up sooner, without a significant increase in failure.

(c) 75 pounds of 2132, and 100 pounds each of 1271 and 1897 titanium-barium. Poorest film at both locations, eroded at Chicago and checking and cracking at Florida. However, this film was cleanest in the early years.

(d) As preceding but 100 pounds each. Appearance at least as good in past as (c), and noticeably less failure, but hardly as durable as (a), (b) and guide.

2177 - Pigment Studies

Considerable work has been done on the testing of mix-in pigments which have been processed by the Dispersion Laboratory through the Fluid Energy Mill. It is too early in this program to draw conclusions regarding pigments processed in this manner, but to date chrome yellows and greens appear to be particularly suited for this type of treatment while other pigments offer more of a problem.

Panels 11521-9 F, C were examined after 24 months exposure at Florida, vertical south and 27 months at Chicago, north and south. These are cedar bevel siding panels, primed with regular Rex 450 Undercoater. The guide and basic formula is Rex 471 SWP Gloss White of 6-13-46, using all titanium dioxide as 1403 dry anatase. The purpose is to determine the practicability of using some of the chalk-resistant titaniums in Rex 471. None are used 100%, however, but all blended with 1403 at what was considered to be the maximum percentage that could be tolerated from the standpoint of dirt collection.

The main finding so far is that all the blends used are quite satisfactory at two years, but all showed trends toward excessive dirt at Chicago, north, up to about 20 months, especially those specified below. All tests continue on exposure. The materials used are listed below, with brief notes on results. There is no noticeable yellowing at present. Our past experience with these chalk retardant forms of titenium indicates that the policy of blending with at least 50% of anatase has done a great deal to decrease dirtiness and yellowing, but that there is still a slight tendency to be dirty.

50% anatase with 50% 2269 dry Titanox RA-10-MO. Slight gray cast, possibly dirt.

50% anatase with 50% 2173 dry Ti-Pure R-200. Same at present, past record slightly better.

50% anatase with 50% 2030 T dry Titanox AA. Good now, but apparently early dirt at Florida.

75% anatase with 25% 2147 dry Titanox A-24. Very much like 2030 T, also early dirt at Chicago, north.

75% anatase with 25% 2228 dry Ti-Pure R-110. Slight dirt now; dirty first year at Chicago, north.

75% anatase with 25% 2229 dry Ti-Pure R-510. Ditto, but better than R-110 on Chicago north past record.

75% anatase with 25% 2174 dry Ti-Pure R-610. Good now, but record of serious early dirt at Florida, and at Chicago north.

#162 - Studies in Flat Wall Paint Formulations

Flat Wall Paints

Work has been under way to set up a specification for sheen on the new One Coat Flat-Tone by use of the Photovolt 85 degree Glossmeter. Several production batches of Flat-Tone made on the pebble mill and roller mill were used in the evaluation. The Flat-Tone samples were brushed on Kem-Glo paper and over a smooth Upson board previously coated with Wall Primer and Sealer - Rex 25. These paint-outs were compared with 0.003 inch draw-down films on glass.

The results of the tests indicated that a specified sheen of 7 to 11 would be representative of the sheen characteristics of this formulation. The sheen readings across the brush marks on paper and over Wall Primer and Sealer are very close to the sheen reading of films applied on glass. We believe the sheen should be determined on 0.003 inch draw-down films on glass as this type of film is free from brush marks that will affect Photovolt readings.

Photovolt 85° Glossmeter Readings

Sample Tested	Kem-Glo Paper		0.003 inch Films on Glass	Upson Board Primed With Wall Primer and Sealer	
	Across Brush Marks	With Brush Marks		Across Brush Marks	With Brush Marks
OJ 850 N - Rex 810 Roller Mill	10.4	11.8	9.2	-	-
OJ 851 N - Rex 810 Roller Mill	8.8	11.5	8.3	-	-
Rex 800 - C 260	10.0	13.6	10.0	10.1	13.2
Rex 803 - C 40	8.3	10.5	8.9	8.4	10.7
Rex 804 - C 190	8.8	12.3	8.0	8.7	11.3
Rex 805 - C 310	9.8	12.1	10.2	-	-
Rex 808 - C 100	9.7	11.6	9.3	-	-
Rex 823 - C 180	8.0	9.8	8.3	-	-
Rex 835 - C 180	6.3	8.3	6.8	6.6	8.7
Rex 839 - C 250	8.6	10.7	7.4	-	-
Rex 844 - C 60	10.0	13.1	9.2	-	-

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The Resin Research Department has submitted six special (4113) varnishes for evaluation in Flat-Tone.

	Resin	Oil	Body	A. V.	Cure	Color	NVM
Blend (1/2 RC 5458 (1/2 RC 5229	Glyc. P.E. Phthalate, Abitol.	(1273) 75% (3019) 25%	V	10.8	10-12"	3	30%
RC 5233	"	Soya 50% Castor 50%	W	17.0	12"	3-4	"
RC 5215	"	Safflower Seed Oil	T-U	8.5	12"	3	"
RC 5238	"	1/2 Soya 1/2 Dehydrol	U +	9.2	10"	2 +	"
RC 5476	"	"	X-Y	13.0	10-11"	3	"
RC 5245	"	"	Paste	7.4	10-11	3 +	"

It was stated in the January report that (4113) made with part dehydrated castor and part soya appeared to be somewhat better in uniformity than regular (4113) when used as a flat wall paint vehicle. However, further tests on vehicles such as RC 5233, RC 5238, RC 5476, RC 5245 and the blended alkyd listed above do not show sufficient improvement to warrant the use of dehydrated castor if there is any premium in raw material cost.

The RC 5215 made with safflower seed oil was not as good as (4113) in uniformity.

A sample of Keystona Odorless Flat Wall Paint, manufactured by the Keystone Paint and Varnish Company and a sample of Pratt and Lambert Lyt-All Flowing Flat White were compared for drying odors with One Coat Flat-Tone White (card 14). The three flats were brushed on panels which were placed in odor boxes and checked for odor during the drying period. In the laboratory tests, Flat-Tone (card 14) formulated with only 1/4 gallon (5026) per 100 gallons is equally as good in odor as the two competitive flats. However, we believe that tests of this type should be conducted by painting rooms with each material.

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On January 6 some room painting tests were conducted on the new alkyd Flat-Tone and the so-called Kem-Vel Flat at F. J. Kessler's home in Homewood, Illinois. The walls were painted by Bob Bruhn and Otto Jagd and the ceilings were painted by F. J. Kessler. The ceilings were primed with Wall Primer and Sealer - Rex 25 and recoated with Flat-Tone Ivory - Rex 805. One bedroom was also a two coat job of Wall Primer and Sealer and Kem-Vel shaded to a fairly deep blue. Another bedroom was given only one coat Flat-Tone (shaded rose) applied on new plaster.

The general appearance of both rooms was excellent after they were dry. The Flat-Tone applied on the new plaster brushed very well over this type of surface but showed considerable brush marks when wet. However, when the film had dried out it was very smooth and uniform in sheen as well as in tint. No laps or shiners were evident on any of the walls.

Due to the two gallons (5026) originally introduced to prevent skinning, we found the new Flat-Tone to be somewhat objectionable from an odor standpoint. However, the formula has now been revised as we have found that 1/4 gallon (5026) is sufficient to prevent skinning under average conditions of usage, and the product has been improved considerably from an odor standpoint.

The Esso Laboratories, Standard Oil Development Company, Linden, New Jersey, submitted three hydrocarbon polymers (C oils) coded 526 - 129 - 1, 2 and 3.

Sample	Non-Volatile Content	Viscosity (Poise)	Viscosity (Gardner)
526 - 129 - 1	70%	0.5	Q - R
526 - 129 - 2	50%	1.0	D
526 - 129 - 3	47.3%	26.0	Y

An experimental batch of Flat-Tone was made with sample 526 - 129 - 3 by introducing the same vehicle solids as contained in the regular formula. The "C Oil" produced a very heavy bodied flat that was bad in odor and very sticky in brushing characteristics. A definite improvement should be made in the odor of this oil as it cannot be used as is in trade sales interior finishes.

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Porch and Floor Enamel

The Resin Research Department has submitted several more ether resin varnishes for test in Porch and Floor Enamel Medium Gray - Rex 152.

	Body	Cure	A. V.	Color	Solids
RC 4915	W +	70 sec.	9.6	7	70%
RC 4910	W	41 "	10.0	12	70%
RC 4922	W - X	Over 2 min.	10.3	8	70%
RC 4925	X - Y	"	10.6	8	70%
RC 4948	X - Y	47 sec.	9.8	7	70%

These varnishes are superior to earlier developments for brushing, flow and gloss. However, they are still slightly too sticky in brushing and slightly too short in flow for Porch and Floor Enamel.

Properties of Porch and Floor Enamels

Batch	Character-istics	Viscosity #3 Fresh	Viscosity #3 O'Nite	Brush-ing	Flow	Gloss	Drying Set-to-Touch	Drying Thru
OJ 787N	Std. formula 1-28-49	22.0"	31.0"	Good	V.G.	V.G.	1 hr. 21 min.	Very good
OJ 777N	Using RC 4915 Repeat RC 4898	27.0"	28.0"	V. sl. sticky	V. sl. short	Sl. less than 787N	1 hr. 24 min.	" "
OJ 778N	Using RC 4910	26.6"	28.4"	"	Good	V. sl. less than 787N	1 hr. 17 min.	" "
OJ 807N	Using RC 4922	25.4"	--	"	V.sl. short	Sl. less than 787N	1 hr. 7 min.	" "
OJ 814N	Using RC 4925	27.0"	--	"	"	"	1 hr. 15 min.	" "
OJ 884N	Using RC 4948	32.8"	36.4"	"	"	V. good	-	-

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Properties of Porch and Floor Enamels

16 Hour Spot Tests

Batch	1% Soap 3 hrs.	5% Acetic Acid	5% Citric Acid	2% Iodine	95% Alcohol	1% NaOH
OJ 787N	Def. whitening.	Def. - blistering	Trace whitening	Very bad stain	No gloss, film dull.	Paint off of board
OJ 777N	Def. - whitening	Trace whitening	"	"	Film sl. dull	Sl. whitening
OJ 778N	Def. - whitening	Trace whitening	"	"	Trace blistering	Trace blistering
OJ 807N	Def. white stain	Trace whitening	"	"	O. K.	Sl. stain
OJ 814N	"	Trace blistering	"	"	Trace blistering	Def. blistering
OJ 884N	-	-	-	-	-	-

Panels 12009-17 F, C were examined after 19 months at Florida and 28 months at Chicago. These are 8" x 24" yellow pine panels, exposed 45 degrees south. They test (a) varnishes made from Standard Oil Company's "A" resin, (b) a full phthalate alkyd varnish, (c) an ether resin varnish from Resin Research and (d) two regular formulas of Rex 153 Porch and Floor Enamel Dark Gray, the latter being the basic formula of the series (based on 2188-2174 dry).

Due to the poor uniformity of the yellow pine, accurate evaluation of durability was difficult, and only a rough estimate can be presented here. Most of the failure was cracking and subsequent flaking. Briefly, the appearance characteristics are good except in the cases noted (dirtiness or fading). General summary:

(See next page.)

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OJ No.	Varnish	Durability
152 L	(6173)-(2841)G, regular formula 7-2-47.	Fair (good at Chicago). Fading tendency.
211 L	(6173)-(4950)G, alternate liquids.	Poor. Serious dirt and fading.
184 L	(4100)-(4103), full phthalate alkyd.	Very good.
210 L	Ether resin from Resin Research.	Very good.
153 L	(48) - "A" resin (linseed)	Good. Fading tendency.
154 L	(44) - "A" resin (linseed)	Poor. Serious dirt and fading.
155 L	(3017) - "A" resin (Dehydrol)	Less than fair. Serious dirt and fading.
156 L	Kettle dehydrated castor - "A"	Very poor. Fading tendency.
157 L	Solvent process castor - "A"	Poor. Serious dirt and fading.

86 - Leaded Zinc Pigments

A sample of 412 dry Leaded Zinc Oxide which had been treated for color improvement was tested in Rex 471 SWP Gloss White. No color improvement could be noted.

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#177 - Pigment Studies

The program on resin coated pigments was planned to evaluate six pigments with each of four coating materials. These are as follows:

Pigments

D-2941	Iron Blue
11834	Chrome Green
Green blend	12147/11086 dry
12311	Chrome Orange
10189	Toluidine Red
1583	Carbon Black

Resin Coating Materials

2172 dry	Pentalyn G
(3141)	Soya Alkyd
(3107)	Cocoanut Alkyd
RC 4707	Abitol Phthalate

Results of these tests may be summarized as follows:

D-2941 - Iron Blue

The resin coated samples would not disperse to full strength, gloss, and color in any of the formulas tested. The best results were obtained in the Ken Transport formulation. There is a definite advantage shown for the non-oxidizing type of resin coatings. Only in the case of the Lustral 67 formulation was the 2172 Pentalyn G considered suitable.

There is evidence that the lack of strength and color is not inherent with this pigment and further work may develop a method of processing to improve these properties.

11834 Dry - Chrome Green

This pigment processed through the fluid energy mill with non-oxidizing type resins disperses readily in any of the formulas tested. As previous tests have illustrated chrome green appears to be a "natural" with advantages of gloss and strength showing up in several of the tests performed. It should be understood that for optimum results the mix-in technique could possibly be further refined.

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Green Composite: 12147 Dry - 11086 Dry

Results with this pigment generally parallel those obtained with the 11834 dry Chrome Green.

12311 Dry - Light Chrome Orange

This pigment was the first processed through the "new" pilot mill at lower pressures. Judging from earlier work done with similar pigments it is concluded that the milling treatment was faulty. Dispersions in Lacquer and Ken Transport are of interest, however, for the characteristic high gloss and lack of haze. Lustral 67 and Kemclad evaluations have not been completed.

10189 Dry - Toluidine Red

This pigment was also processed through the new pilot mill at low pressure (60#). Results are totally unsatisfactory and further work in development of the mill procedure is indicated.

Resin Coating Comparison

To summarize, the preferred resin coating materials in each formulation type are as follows:

Formulation	Preferred	2nd Best
Lacquer	(3107)	RC 4707
Ken Transport	(3107)	RC 4707
Kemclad*	RC 4707	(3107)
Lustral 67*	RC 4707	2172

*Tests with all pigments not yet completed.

1162 - Studies in Flat Wall Paint Formulation

Attempts have been made to reduce the raw material cost of the Flat-Tone line. Formulas were developed with a five to six cent lower cost by a slight reduction in hiding and vehicle solids. The formulations were discussed at the last Trade Sales Technical Board meeting at Cleveland. A 300 gallon batch of Flat-Tone White will be made in the factory on the lower cost formula. No further work is contemplated except to determine whether a reduction can be made in the raw material cost of (4113). This work is being undertaken by the Resin Research Department. They submitted the following alkyd varnishes for test in Flat-Tone.

	RC 5510	RC 5512	RC 5513	RC 5514	RC 5264
Resin	Glyc.-P.E.-Phthalate-Fumaric	P.E.-Glyc.-Phthalate-Abitol	Glyc.-P.E. Phthalate-Hercolyn	Glyc.-P.E.-Phthalate-Abitol	Glyc.-P.E.-Phthalate-Abitol
Oil	(1273) Acosix	Acosix	Soya	Acosix	(1273)
Body	Z_4 +	W	U	U	Y
Cure	10	10	10	20-30	10
A. V.	17	20	18	5.6	8.7
Color	4	5 +	5	4	3 +
Solids	30%	30%	30%	30%	30%
Solvent	(5027)	(5027)	(5027)	(5027)	Shell 8230 Base

RC 5510, RC 5512, RC 5513 and RC 5264 were too high in consistency properties for use in Flat-Tone. The results to date on the use of Acosix (Tall oil) in (4113) are not satisfactory.

Room painting tests conducted in and around Chicago indicated that an improvement should be made in the odor of One Coat Flat-Tone. The formula was checked to see whether the anti-skinning agent could be reduced. Work indicated that the (5026) could be reduced from two gallons to 1/2 gallon and a revision was sent through specifying this change.

Odor tests were conducted more recently on Flat-Tone that contained 20 cc (3082) per 100 gallons. It was found that a further improvement could be made in the odor of this product.

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	Drying Odor
Pratt and Lambert Lyt-All Flowing Flat	Best
Present Flat-Tone (20 cc (3082)/100 gals.)	2nd
Keystona Flat (Keystone Varnish Co.)	3rd
Old Flat-Tone	4th

Properties of Flat Wall Paints

Batch	Characteristics	Viscosity #5 Orifice Fresh	Viscosity #5 Orifice O'Nite	Brushing	Flow	Wet Edge
OJ 922 N	Reg. Rex 810 + 20 cc (3082) per 100 gals.	10.2"	11.0"	V. G.	G	O.K. at 14 minutes
Keystona Flat	"Odorless" - Sample from Cleveland	-	Too hvy	Sticky (High body)	G -	Short
Pratt and Lambert Lyt-All	Pure White "Odorless" From Detroit	-	15.6"	V. G.	V. G.	O.K.

Batch	Uniformity of Tint On Porosity Panel	Uniformity of Tint On Lap	Uniformity Sheen on Lap	Washability Over Glue Size	Stain Removal*	Drying Odors
OJ 922 N	V. G.	V. G.	G	757	Best	2nd
Keystona Flat	G.	G -	G -	586	Worst	3rd
Pratt and Lambert Lyt-All	V. P.	V. G.	G -	834	2nd best	Best

*See chart on following page.

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*Stain Removal

Batch	Lead Pencil	Red Wax Pencil	Blue Ink	Dust	Mercuro-chrome	TT-P-47
OJ 922 N	113	165	Cons. stain	50	Sl. + stain	Slight stain
Keystone "Odorless"	160	210	Cons. stain	65	Cons. stain	Slight stain
Pratt and Lambert Lyt-All	190	V. sl. stain	Bad stain	88	Slight stain	Trace

The good performance of (4113) in flat wall paint formulations has prompted us to formulate three deep colored flat wall paints. We selected the blue, dark green and burgundy pigmentations of Rexes 963, 967 and 964 in the Flat-Tone Colormix line and revised the vehicle over to (4113). The experimental batches based on (4113) are all much superior to the regular formulas in all respects. In our development work we found it necessary to reduce the Atomite 2247 dry to a lower poundage, due to the higher body of the new vehicle, in order to obtain a suitable paint viscosity. Samples of our experimental paints and copies of the formulations were sent to Mr. Oxley, in Detroit, for his inspection.

Work has been under way to revise Heavy Duty Flat Wall Paint #666, C78 W 16, to an alkyd vehicle. The present work indicates that a satisfactory formulation can be worked out with a vehicle composed of (4113) and (4103). However, a slight reduction in pure TiO_2 will be necessary to maintain the same cost as the present formula. Work is to be continued on this project.

As a matter of general interest we recently tested a sample of Stipple Flat Wall Paint #688, C78 W 5, for general performance. We have found it to be a fairly good product. The product stipples very nicely with a regular stipple brush or Kem-Tone Roller Koater. However, it is less uniform than the One Coat Flat-Tone when applied over tight and porous surfaces. C78 W 5 is typical in general performance to the average stipple paint, but we believe a superior product could be made with the new alkyd vehicle (4113).

#162 - Cont.

Samples of Texshel WD-9 C from Agrashell, Inc. and No. 50 Metro-Nite from the Metro-Nite Company are being investigated as possible ingredients for dry wall construction primers and flats. A formulation similar to Flat-Tone containing 200 pounds Texshel WD-9 C per 100 gallons was found to produce a texture similar to plaster on dry wall panels. An effort will be made to use these two ingredients in a wall primer and sealer formulation, also to be used on this type of construction.

Special

A cooperative evaluation of the Hunter Color Difference Meter and the PPG-IDL Color Eye has been made with the Cleveland Technical Service Department. Results of this comparative study are being issued as a special cooperative report which should be in the mails within a short time.

786 - Leaded Zinc Pigments

1. Panels 7380-7 F, Cof, were examined after approximately five years' exposure, vertical south, at Florida and Coffeyville. The series tests the SWP Tint Base of 7-21-43, regular using 1526 dry leaded zinc against a stock sample of 414 W from Coffeyville and a special composite sample of "Canadian fume 414" representing batches made at Coffeyville from July 7 to September 13, 1943. As indicated in earlier progress reports, all these materials have shown good durability although there is some evidence against the two 414 samples in the form of microscopic checking at Florida. In appearance, the differences are a little more readily noticeable but not outstanding. 1526 is favored because of less white chalk-mask, although the 414's in some cases seem slightly less dirty. No choice is apparent between the regular and composite 414.

2. Exposures 10518-39 F, C were examined after 36 months' exposure at Florida, vertical south, and 40 months at Chicago, north and south. These are cedar bevel siding primed with regular Rex 450 Undercoater, except for a part of the group in which special undercoaters are tested. The plan of these tests cannot be presented fully in this limited space but essentially the tests cover:

(a) White lead comparisons, in Rex 471 SWP Gloss White, both on a regular co-fumed leaded zinc basis using a 25% and a 30% zinc oxide level, and also on a mechanical-mix basis at 24% zinc oxide. The white leads are:

1. 9 dry basic sulfate
2. 18 dry basic carbonate
3. National Lead's 45 X basic silicate.
4. Eagle-Picher's #202 basic silicate.

(b) Rex 450 Undercoater versus MW-401 zincless type primer with the special pigments, using Rex 471 top coat both as regular and with the silicate pigments.

Results can be presented here only in general terms: satisfactory or "average" performance may be assumed for all tests not specifically mentioned, although there are minor variations throughout.

Eagle-Picher's #202 shows the least failure of the four white leads in most cases. However, this material has been found to gel badly on storage in 1/2 pint cans for four years at 85° F. average. The others were not all perfect on the storage test, but showed no serious gelation.

#86 - Cont.

Both 18 and 9 dry samples rate as somewhat more durable in these exposures than National's 45 X, but all three are on the same general level slightly below #202.

Both the silicate leads have a better clean-up record than 9 or 18 dry, but the differences are comparatively minor.

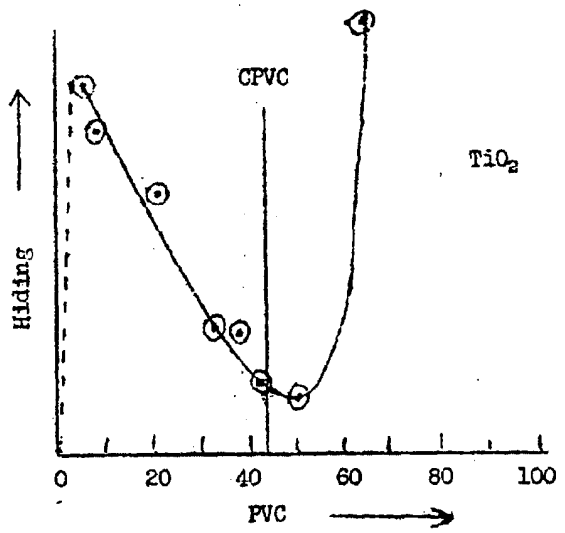
In the primer tests, MW-401 types are slightly inferior, and there is no choice as to the type of white lead, the silicates being fully satisfactory.

#177 - Pigment Studies

Paint Research Bulletin RC 81, issued November 29, 1946 described the hiding characteristics of various white pigments in the pigment volume range from 10 to 40%. To determine the point at which high dry hiding first occurs and the slope of the dry hiding curve, work has been done with 1403 dry, titanium dioxide, at pigment volume concentrations well into the high dry hiding range.

It is interesting that the point where high dry hiding occurs is well above the CPVC of the paint system. This confirms our expectations based on flat wall paint experience and is important as our first direct measurement of this phenomenon.

Preliminary data and results of the study of hiding power as a function of PVC give the following graphic relationship:



From this preliminary work, the following tentative conclusions can be drawn:

1. Maximum hiding efficiency is attained at some very low PVC between 0 and 7%.

2. The effects of high dry hiding appear at a point beyond the CPVC of the system.

177 - Cont.

In the March, 1949 issue of Industrial and Engineering Chemistry (41, 523-526) A. E. Jacobsen discusses chalking behavior of titanium oxide pigments. By means of reflectance measurements after definite periods of arc-lamp exposure, Jacobsen has found a correlation between photochemical reactivity and chalking. As a result, he explains chalking of titanium oxide-bearing paint films as a "breakdown of the film caused by disintegration of the organic binder due to the cyclic reduction and oxidation of titanium compounds present in the paint film." A partial verification of his work confirms his results with wet systems. The project will be continued.

#162 - Studies in Flat Wall Paint Formulations

Flat-Tone

The Chicago plant has manufactured an 800 gallon batch of Flat-Tone White - Rex 810, C 1110 on the lower cost formula (973 N) and samples were sent to Cleveland for test.

The suggested revision is superior in stain removal and flow characteristics. The sheen and, rather surprisingly, the hiding, are also slightly higher than the present regular formula. A further check will be made on package condition and viscosity after several weeks' storage.

Properties of Alkyd Flat-Tones

Batch	Characteristics	Viscosity #5 Cup at 75° F.	Brush	Flow	Wet Edge at 14 Min.
Rex 810 C 830	Regular Alkyd Flat-Tone Card 15	13.6"	G	G	O.K.
Rex 810 C 1110	Suggested Revision OJ 973 N 5¢ lower cost	14.0"	V. G.	V.G.	O.K.

Batch	Characteristics	Uniformity of Tint Lap	Uniformity of Sheen Lap	Hiding C.R.	Sheen 85°	Scrub Resistance Cycles
Rex 810 C 830	Regular Card 15	Exc.	Good	96.1%	11.2	840
Rex 810 C 1110	Proposed 5¢ reduction	Exc.	Good	96.9%	15.0	860

Stain Removal*

Batch	Characteristics	Dust	Blue Ink	Mercuro-chrome	TT-P-47 Compound	Wax Pencil	Lead Pencil
Rex 810 C 830	Regular Card 15	55	Slight stain	Slight stain	115	170	90
Rex 810 C 1110	Proposed 5¢ reduction	45	Trace stain	Cons. stain	90	180	95

*Panel scrubbed 250 cycles with Bon-Ami. Reading given is either cycle number where stain disappeared or amount of stain remaining after 250 cycles scrubbing.

#162 - Cont.

The Varnish-Resin Laboratory has submitted samples of filtered and unfiltered (4113) for evaluation in Flat-Tone. Laboratory batches of Flat-Tone made with these samples were found to be identical in general performance. The tests to date would indicate that it should not be necessary to filter this liquid for flat wall paint usage. A further check will be made to watch reactivity and package condition after several weeks of storage.

Properties of Test Paints

Batch	Characteristics	Viscosity - #5 Fresh	O'Nite	8 Days	Brush	Flow	Wet Edge
OJ 63 P	Flat-Tone Card 15 A Unfiltered (4113)	9.4"	11.0"	11"	Good	Good -	O.K.
OJ 64 P	As OJ 63 P, but filtered (4113)	9.6	11.0	11.6	"	"	"

Uniformity of Tint

Batch	Characteristics	On Lap	On Porosity Panel	Uniformity of Sheen	Grind	Sheen 85°
OJ 63 P	Flat-Tone Card 15 A Unifltered (4113)	Exc.	Good +	Good -	4 H	8.4
OJ 64 P	Flat-Tone Card 15 A Filtered (4113)	"	"	Good	3-3/4 H	10

The Resin Research Department has submitted four additional variations of (4113) for test in Flat-Tone.

Resin	RC 5298 Glyc.-P.E. Phthalate Abitol	RC 6173 P.E.-Glyc. Phthalate Abitol	RC 5527 Glyc. P.E. Fumaric Phthalate Abitol	RC 5524 Glyc. P.E. Phthalate Abitol
Oil	(44)	(44)	Acosix	Acosix
Body	Z_2	Z_6 +	U +	W
Cure	17	10	11 - 12	12
A. V.	8.7	5.5	17.8	17
Color	3-4	6	3-4	5
Solvent	(5027)	Shell's 8230 Odorless Kerosene	(5027)	1% Abitol 2% (4048) 67% Amsco Odorless

#162 - Cont.

Laboratory batches of Flat-Tone White made with RC 5527 and RC 5524 were satisfactory except for washability when applied over glue size. RC 5298 was rated only fair in washability when used as the vehicle in Flat-Tone White. Flat-Tone made with RC 6173 was very high in body and no tests were run except for odor. In this respect RC 6173 was much superior to (4113).

Acme has reported that their production of No-Lustre has a slight tendency to skin when made with 1/2 gallon (5026). We therefore recommended that they use one gallon (5026) as a temporary measure until they have had an opportunity to check this problem. Laboratory batches of Flat-Tone White made with Acme (4113) coded DV 300 and (4113) from Chicago production using 1/2 gallon (5026) per 100 gallons produced no skinning after 48 hours in partially filled quart cans.

Gallon samples of Flat-Tone taken from the Chicago warehouse were also inspected for skinning after being in storage for a period of 18 - 25 days. These samples were all in excellent condition, free from any skin formation. Cleveland has been advised to have our plants make a check on their production.

Heavy Duty Flat Wall Paint #666 C78 W 16

Titanox RA-50 has been found suitable as a replacement for 2269, 2273 or 2174 titanium oxides in this rex. Viscosities were relatively low but this is in keeping with previous experience. Chicago production gives a thinner bodied paint than Cleveland. While this may lie in the (3880)E it may also come from heavier paste mixing at Chicago. Brushing, flow, wet edge, sheen uniformity and tint uniformity on laps were all good, but uniformity tested on the porosity panel was poor for batches made with either 2269 or RA-50. Other test data follows:

Batch	TiO_2 Used	Viscosity #5 Reduced 12-1/2% Fresh	Viscosity #5 Reduced 12-1/2% Overnight	Contrast Ratio
0J 20 P	2269 dry	5.2"	7.0"	94.1%
0J 21 P	RA-50	5.0"	6.6"	94.0%

Some work has been done to see what improvement could be made in Heavy Duty Flat Wall Paint #666 through the use of (4113). A new formula was developed and arrangements made to manufacture 300 gallons on the proposed formula 50 P. 50 P appears superior in all respects, and raw material cost is $122.83 at Kensington compared to $124.00 per 100 gallons for the current formula.

Laboratory comparisons were as follows:

#162 - Cont.

Properties of Flat Wall Paints

Batch	OJ 20 P	OJ 50 P
Characteristics	Reg. Heavy Duty Flat Wall Paint #666	Alkyd Formula 57-1/2 gals. (4113) 775 pounds 2132 150 pounds 312
Viscosity - #5 (Reduced 12-1/2%)		
Fresh	5.2"	7.0"
Overnight	9.8"	13.6"
Brush	Very good	Very good
Flow	Good	Good
Wet Edge	Good	Good
Overnight Drying	Soft compared to 50 P	Excellent
Sheen - 85°	17	21
Hiding Contrast Ratio	95.2%	98.2%
Scrub Resistance Over Glue Size - Cycles	410	750
Stain Removed at Cycles Indicated		
Dust	70	55
Blue Ink	Bad stain at 250 cycles	Trace stain 250 cycles
Mercurochrome	Bad (-) stain 250 "	Slight stain 250 "
TT-P-47 Compound	90	70
Red Wax Pencil	165	140
Lead Pencil	90	65
Uniformity of Tint (Porosity Panel)	Poor	Very good
Uniformity of Sheen	Good	Very good
Raw Material Cost	$124.00	$122.83

#162 - Cont.

Primer for Dry Wall Construction

Some time was spent on the development of a primer and sealer for dry wall construction. In connection with this problem we have tested two inerts recommended for texture type of paint. The Metro-Nite Company recommend their No. 50 Metro-Nite for this purpose but we have found that a product called Texshel WD-10.5C supplied by Agrashell, Inc., Los Angeles, California to be much superior in suspension properties and more desirable in texture.

Quart samples of a special wall primer and sealer coded 67 P were sent to R. G. Landis, at Oakland and S. F. Carlson, at Cleveland for their inspection.

Porch and Floor Enamel

The Rosin Research Department submitted a higher bodied ether resin varnish for test in Porch and Floor Enamel. The purpose was to obtain a satisfactory enamel body with lower vehicle solids and reduce raw material cost.

RC 5001

(348) reduction	Infinite
Body	W
Cure	108
A. V.	9.8
Color	8
Solids	60%

The Porch and Floor Medium Gray made from RC 5001 was satisfactory in body, sticky in brushing and low in gloss. Apparently no reduction in solids can be made without lowering gloss, and a lower bodied varnish base must be used to obtain brushing properties.

162 - Studies in Flat Wall Paint

Flat Wall Paints

Another evaluation has been made of Titanox RC HT 2132 dry, Ti Cal R 22 and Ti-Cal R 27 in Flat-Tone Shadow Blue Rex 835. The three pigments were introduced at the same poundage in Rex 835 and the paints were ground in laboratory pebble mills under identical conditions. The hiding properties were determined on the shaded and unshaded white base.

The results of the tests indicate that Ti-Cal R 22 and Ti-Cal R 27 are both slightly lower in opacity than Titanox RC HT. Ti-Cal R 27 was too low in hiding and sheen to be considered as an alternate for 2132 dry in Flat-Tone White or tints. However, Ti-Cal R 22 has less color change from wet to dry and would be preferred to 2132 dry in this respect, discounting its slightly lower hiding properties. If Ti-Pure R 22 was approved for the tints it should not be used interchangeably with 2132 dry.

For the sake of brevity the chart lists only those characteristics which differed. Brushing, flow and uniformity over varying porosity were standard for all, with R-27 being the best on uniformity of sheen on the lap.

Experimental Flat-Tones

Batch	Characteristics	Viscosity - #5 Orifice Fresh	O'Nite	5 Days	Sheen 85°	Hiding C.R.	Scrub Resistance Over Glue Size
OJ 99 P	Regular Rex 835 Tint Base Stock 2132	10"	12"	12.6"	10.0	99.5% tinted 92.7% in white	646 cycles
OJ 100 P	Using Ti-Cal R-22 for 2132	12"	14"	14.0"	10.0	98.7% tinted 92.3% in white	690 cycles
OJ 101 P	Using Ti-Cal R-27 for 2132	12"	13"	13.2"	6.6	98.5% tinted 92.2% in white	640 cycles

1162 - Cont.

Stain Removal
(Cycles Required to Remove Stain)

Batch	Dust	Blue Ink	Mercurochrome	TT-P-47 Compound	Wax Pencil	Lead Pencil
OJ 99 P	40	250 cycles Trace	250 cycles Cons.	100	170	70
OJ 100 P	40	250 cycles Trace	250 cycles Cons.(-)	80	140	50
OJ 101 P	40	250 cycles Very slight stain.	250 cycles Slight (+) stain.	90	145	50

A sample of Ward's Super One Coat Flat Wall Paint was compared with One Coat Flat-Tone White Rex 810 for general performance. The Ward's flat was slightly better than Flat-Tone in stain removal but lower in hiding and scrub resistance over glue size. Ward's flat was poor in uniformity of tint when applied over spackle whereas Flat-Tone was rated good (see chart for data).

Comparison of S-W One Coat Flat-Tone and
Ward's Super One Coat Flat Wall Paint

Sample	Rex 810 - C 830	Ward's 75-3101
Characteristics	Regular Alkyd Flat-Tone Card 15	Super One Coat Flat White 820 - S 200
Viscosity #5 S-W at 75°	14.6"	28" + 1/8 cup
Brush	Very good	Very good
Flow	Good (-)	Good
Wet edge at 14 minutes	O.K.	O.K.
Uniformity of Tint		
On Lap	Excellent	Good (-)
On Various Surfaces*	Good	Poor

*Tested over sealed and unsealed spackle, sealed and unsealed wallboard,

0007-SWP-045667

1162 - Cont.

Comparison of S-W One Coat Flat-Tone and
Ward's Super One Coat Flat Wall Paint

Sample	Rex 810 - C 830	Ward's 75-3101
Characteristics	Regular Alkyd Flat-Tone Card 15	Super One Coat Flat White 820 - S 200
Sheen - 85°	10.8	15.0
Hiding - C. R.	96.0%	94.6%
Scrub Resistance**	757 cycles	595 cycles
Stain Removal***		
Dust	55	35
Blue Ink	Slight	Trace
Mercurochrome	Slight (+)	Trace
TT-P-47 Compound	115	55
Red Wax Pencil	170	100
Lead Pencil	90	65

**On Gardner Model 105 scrub machine.

***Stains scrubbed 250 cycles. Readings given are either cycle where stain was removed, or amount of stain remaining after test.

Enameloid

Resin Research has submitted several styrene vehicles for evaluation in enamel formulations. The enamels will be compared with samples of styrene enamels submitted by Lewis Berger for inspection and test.

Chart follows.

162 - Cont.

Enameloid - Cont.

	RC 5409	RC 5411	RC 5413	RC 5416	RC 5414	RC 5417
Resin	Styrene	Styrene	Styrene	Styrene	Styrene Rosin	Styrene
Oil	(44)	(3019)	(1273)	Aliphat 16A (140)	(140) (2325)	(1273) (140)
(548) Red.	300%	200%	>2400%	200%	>1000%	200%
Body	J-K	E	G	T	W	T-U
Cure	10"	10"	10"	6"	11"	10"
Lbs./Gal.	7.60	7.95	7.55	8.00	7.65	8.2
A. V.	16.6	6.4	18.5	12.0	3.05	20.4
Color	7 +	7	6 - 7	4 - 5	10	5 -
Solids	50%	50%	50%	50%	60%	50%
Solvent	25%(4026) 25%(348)	50%(1257)	25%(4026) 25% (348)	50%(1257)	38% (348) 2%(2049)	50%(1257)
Type	CV 5106	CV 5123	CV 5106	Experi-mental	Experi-mental	CV 6123

The styrene vehicles were pigmented similar to Enameloid White Rex 71C, card No. 41, and the enamels were compared with Enameloid White for general performance characteristics. They were checked for brushing, flow, drying, gloss, etc. (see data in chart below). These enamels will also be evaluated along with the samples of styrene enamels from Lewis Berger. However, it was decided that any enamels that are too high in body are to be reduced further with extra thinner for this evaluation.

The styrene varnishes that produced high bodied enamels were not revised as time would not permit. Dr. Sample was of the opinion that any changes that he could make in these vehicles to lower body would require a change in composition and this was not desired as the various varnishes represent specific types.

7162 - Cont.

Enameloid - Cont.

Properties of Various Enameloid Whites

Batch	Characteristics	Viscosity Fresh	Viscosity O'Nite	Viscosity 3rd Day	Brush	Flow	Wet Edge
OJ 138 P	Rex 710 regular Card 41 (3109) - (4100)	33"	37.2"	42"	Std. (G)	Std. (G)	Std. (G)
OJ 139 P	RC 5409	43"	50"	35" Reduced 6-1/2% (5027)	Sticky	G (-)	Short
OJ 140 P	RC 5411	18"	17.8"	17"	V. G.	Fair	Short
OJ 141 P	RC 5413	25"	28"	28.5"	Sl. sticky	G (-)	Short
OJ 142 P	RC 5414	54.2"	59"	41.5" Reduced 6-1/2% (5027)	Good	Good	Good
OJ 143 P	RC 5416	1' 32"	1' 42"	39" Reduced 18-3/4%*	Very sticky	Good	Short
OJ 144 P	RC 5417	1' 40"	2' 14"	47" Reduced 20%*	Very sticky	Too high	Short

*Reducer composed of 1/3 (1257) - 2/3 (5027)

Batch	Drying Set-to-touch	Drying Through	Color	Gloss
OJ 138 P	75 minutes	Std. (G)	Std. (G)	Std. (V.G.)
OJ 139 P	18 "	Very good	Very good	Very good
OJ 140 P	24 "	Brittle	Yellow	Very good
OJ 141 P	21 "	Sl. brittle	Good	Very good
OJ 142 P	71 "	Very good	Sl. yellow	Very good
OJ 143 P	20 "	Very good	Very good	Very good
OJ 144 P	22 "	Very good	Very good	Very good

177 - Pigment Studies

Working with existing formulations for Flat-Tone White - Rex 810 pigment volume concentration relationships are under scrutiny. It has been found that Rex 810 formulated with magnesium silicate has a CPVC of 67%, while the actual, or formulated PVC is approximately 67% PVC. In reformulating this material to use calcium carbonate 566 dry the actual PVC employed was 71% and the CPVC was 61%. Inert system paints based on 566 dry were formulated at 67, 71, and 75% PVC, and were tested for opacity, stain removal and sheen to determine the effect of pigment volume variations. Results showed that increase in pigment would result in equal opacity, higher sheen, and more staining. Lower pigment volume would result in lower opacity, lower sheen and poorer stain removal.

Comparative test data on the 566 dry batches are as follows:

Paint No.	P.V.C.	Contrast Ratio 0.003"	0.005"	0.007"	Sheen (85° Photovolt)
RB 2862	67%	90.3	95.5	96.6	9.0
RB 2863	71%	92.2	95.9	97.4	11.5
RB 2864	75%	93.0	96.9	97.5	14.0

Stain Removal Test

Paint No.	Dust	Ink	Mercurochrome	TT-P-47 Compound	Red Wax	Pencil
RB 2862	75	200	Least	100	180	75
RB 2863	50	140	Intermediate	100	75	75
RB 2864	40	-	Most	125	180	120

This work will be pursued further to determine whether such results are also obtained with a coarse inert such as diatomaceous silica.

#86 - Leaded Zinc Pigments

Panels 11611-28 F, C were examined after 2 years' exposure vertical south in Florida, and 2-1/2 years in Chicago. The paints were designed to study the use of zinc oxides and to determine whether amount used and particle size or reactive surface area could be balanced to give equivalent performance. SWP Gloss White was used as the base formula, increasing lead contents as zinc oxide contents were reduced. Zinc oxide was introduced at 32%, 21% and 10% levels using Ozlo 35/65 leaded zinc, XX 592 New Jersey zinc oxide 108 dry, XX 50 1707 dry, XX 503 2059 dry, or Azo ZZZ-33 2295 dry. St. Joseph Lead Company's zinc oxides #17 and #46 were used at the 32% level only.

Only the Florida panels show significant film failures, with the co-fumed samples showing slightly to definitely less failure than any of the mechanical mixtures. Failure is very slight at the 32% level, somewhat more advanced at the 21% and 10% level. St. Joe's #17 and #46 oxides at the 32% level show advanced failure, thus the former cannot be considered as an alternate for XX 503, 2059 dry, and the St. Joe oxides should not be used in exterior formulas.

Although mildew growth has not progressed much during the second year of exposure, the co-fumed leaded zincs continue to show an advantage over mechanical mixes in mildew control.

787 - Physical Properties of Pigments

Some assistance was given the Chicago Technical Service Department in assembling a laboratory set-up to study the effect of various factors on the performance of paints in electrostatic spraying. This consists of a 50,000 volt D.C. generator having an output of 200 μA and the possibility of varying the voltage between 5,000 volts and maximum. The electrodes are held in a large, wooden cage to preclude accidental contact by the operator and can be held at various distances and positions by heavy insulating rods.

The process of electrostatic spraying consists briefly of placing an electrical charge of one sign, usually negative, on the sprayed paint particles. The object to be coated is held at the opposite potential, thus attracting the paint fog. The charges produced on the paint fog originate through the ionization of the gas between the electrodes. These gaseous ions attach themselves to the paint particles, thus imparting to them the same charge as they possess. As it is possible to produce a preponderance of gas ions of one sign at one of the electrodes by giving this a high surface curvature, the paint particles can be charged easily to the same sign by being bombarded with these ions.

From this simple consideration it is obvious that a number of factors will influence the efficiency of the electrostatic spraying method. Any factor producing more ionization of the gas between the electrodes, such as increase in voltage as close to the sparking potential as practicable, as well as shape and position of the electrodes will affect the results. The maximum sparking voltage varies approximately directly as the density of the gas, and consequently nearly inversely as the temperature. The surface conductivity of the sprayed material also affects the efficiency of the process markedly, as do the vector velocities of paint spray and electrostatic attraction.

The work is in its preliminary stages and it is felt considerable practical and theoretical information can be gained from the set-up.

A number of graphs and slides have been prepared in connection with a paper to be presented at the Gordon Research Conference, July 17 - 21 on the electrokinetic properties of dispersed pigment systems.

A number of CPVC determinations have been carried out for other departments to determine possible differences in the behavior of apparently the same formulations of paints.

#177 - Pigment Studies

Testing of pigment hiding in the range of pigment loading in the vicinity of the Critical Pigment Volume Concentration (CPVC) would indicate that the dry hiding curve for opacity pigments breaks very sharply whether the pigment be of the high or low opacity type. It has been noted that 1403 dry Titanox A TiO_2 is at a minimum hiding efficiency at the CPVC and this extends to slightly higher pigment loadings. In contrast 2132 dry, Titanox RC HT, reaches its minimum efficiency at lower loadings than the CPVC and some degree of dry hiding is accomplished at the CPVC. This work is being continued to extend our knowledge of the mechanism of pigment hiding.

An extensive review of A. E. Jacobsen's work on the chalking behavior of titanium dioxide pigments (Ind. and Eng. Chem; March 1949; pp 523-526) has been completed. Jacobsen explains the chalking of titanium oxide-bearing films as a "breakdown of the film caused by disintegration of the organic binder due to the cyclic reduction and oxidation of titanium compounds present in the paint film." In the presence of actinic rays, the pigment is said to be reduced by the vehicle, with a corresponding darkening of pigment. In darkness, the reverse reaction takes place - accompanied by a re-whitening of the pigment. In Jacobsen's experiments he used an arc lamp as a source of actinic rays, and a Hunter Multipurpose Reflectometer to measure changes in reflectance.

A summary of results obtained in our review of the work follows:

1. In the wet, rapid reflectance decreases were noted with various pigment-vehicle combinations.

Pigment	Vehicle	Minutes for 5% Refl. Decrease
1403 dry	Linseed	9
"	34% Glycerol/H_2O Sol'n	7
"	Alkyd	9
"	H_2O	25
"	H_2O + $SnCl_2$ (Reducing Agent)	16
"	H_2O + H_2O_2 (Oxidizing Agent)	2235 (for only 3% decrease)

2. The rate of the reverse reaction in the wet is extremely slower than the rate of the forward reaction.

3. In the dry film state comparatively slow reflectance decreases were noted.

Pigment	Vehicle	Time for 1% Refl. Decrease
1403 dry	Alkyd	875 minutes

#177 - Cont.

4. An attempt to measure the chalking resistance of four different titanium pigments by this method gave the following rating:

TiO_2 in Dried Paint	Time for 1% Reflectance Decrease
2174 Dry R-610	12-1/2 days
2269 dry RA 10 MO	7 "
1403 dry Titanox A	3/4 "
2030 dry Titanox AA	1/4 "

Hence 2174 dry and 2269 dry chalk considerably slower than do 1403 dry or 2030 dry. This rating is somewhat in the order anticipated from experience, but RA 10 MO appears to be more chalk resistant than expected, and the order of Titanox A and AA is reversed.

It should be pointed out that although this mode of evaluation appears to work fairly satisfactorily it would be entirely possible to "poison" any such evaluation by the inclusion of a small amount of an oxidizing agent in the pigment.

Phthalocyanine Blue

A practical test of the solvent resistance and color stability of a series of six phthalocyanine blue pigment samples submitted by Mr. O'Neal, of the C. P. Department, has been completed. BL 44 type shading bases were prepared from each of the samples and these in turn were used to shade samples of stock Enameloid White - Rex 710 to the approximate shade of Enameloid Pastel Blue. Shaded wet samples were aged at 77° F., 110° F., and 135° F. for a 6-month period and inspected periodically. This was a blind test but at its conclusion the samples were identified as follows:

E-1 Improved S-W procedure.
E-2 CPX 483 Origin - du Pont.
E-3 du Pont BNC press cake ground dry.
E-4 du Pont BT 284-D Origin - du Pont
E-5 BNC or CP 1037 From du Pont Press Cake.
E-6 General Dyestuff's Heliogen Blue BNC

E-1 represents a substantial improvement over previous S-W preparations. Its performance level was well within the range of competitive materials.

#177 - Cont.

The pattern of color change established by all samples was a general bleaching during the first month of aging, followed by a progressive deepening of color that more than offset the initial color loss by the end of the test. A tendency to redden in cast at the elevated temperature remained constant through the 110° F. series and decreased with aging at the 135° F. level.

E-1 reddened less at 110° F. and deepened less than all but E-5 by the end of the 6-month period. The reflectance values of film cast from 6-month aged material from those two samples were very near to their original values.

BATES LABEL 0007-SWP-045677

NOT USED IN THIS PRODUCTION

88 - Leaded Zinc Pigments

A sample of 1424 12/88 Leaded Zinc was submitted to the National Lead Company for work with their Basic Silicate White Lead. This has been made up in SWP Undercoater and Gloss White replacing the zinc oxide on an equal chemical basis and the lead on an equal volume basis with National's 45 X Basic Silicate White Lead. The paints had normal characteristics of body and color and will be compared further by exterior exposure.

#162 - Studies in Flat Wall Paint Formulation

Work has been continued on the lower cost formulation for Flat-Tone White to determine if an improvement could be made in the package condition upon storage. A further study was also made to determine the comparative performance of the different types of whiting purchased by our various plants, including 1999 dry.

As indicated by the following data, 1999 dry was found to be too reactive for this type of formulation. However, the other samples of whiting were all fairly close in consistency characteristics but varied quite widely in their degree of sheen. It appears that all 566 dry would have to be purchased from one source of supply if whiting is to be used.

Properties of Various Flat-Tones
Testing 566 Dry

Batch	566 Dry	Grind	Viscosity - #5 Fresh	Viscosity - #5 O'Nite	Brush	Flow	Sheen 85°
251 P	Albacar 43-5 C. K. Williams Co. (Los Angeles)	2 H	10"	11"	V. G.	Good	3.0
253 P	Keystone Thompson-Weinman and Lowe Bros. Co.	"	10"	11.2"	V. G.	Good	12.0
254 P	Camelcarb Terry T. Campbell and Sons	"	9"	10"	V. G.	Good	7.0
255 P	1999 Dry	"	24"	58"	G (-)	Sl. short	7.0
285 P	566 dry from Ind. Min. and Chemical (Oakland Plant)	"	12"	8"	V. G.	V. G.	4.0

Drying over night - very good on all.

Uniformity of tint on lap - very good on all.

Uniformity of sheen on lap - good on all.

#162 - Cont.

The lower cost Flat-Tone formula, OJ 973 N, was sent to Cleveland, but we have now found that it settles somewhat harder than the present formulation for Flat-Tone. The proposed formula has now been revised to improve suspension by increasing the 1826 dry from four to eight pounds per 100 gallons. Samples of the new formulation were placed in storage to check on package condition after several weeks' storage.

The Resin Research Department has submitted two (4113) type varnishes made with deodorized types of thinners

	RC 6601-A	RC 6601-B
Resin	Glyceryl P.E. Phthalate	Abitol
Oil	Soya	Soya
Body	Z_1	Z_1
Cure	17	17
A. V.	10.1	10.1
Color	4 +	4 +
Solids	30%	30%
Solvent	Deep Rock Deo Napoleum	Shell 8491 Deodorized Thinner

The two varnishes were compared with (4113) in the Flat-Tone White formulation. The two flats made with RC 6601-A and RC 6601-B were slightly higher in body but quite similar in other respects. However, from an odor standpoint the Shell 8491 and (5027) were about equal whereas Deep Rock Deo Napoleum was less desirable.

A few experimental batches of a deep blue and maroon flat wall paint were made with VM-2336 (RC 5659) a vehicle proposed by J. A. Lutz, of Titanium Pigment Corporation, for use in deep tone flats. VM-2336 is a lime treated dehydrated castor oil-fish oil-ester gum varnish having G viscosity at 50% non-volatile. It was claimed that this liquid had less tendency to mar than most varnishes that are now used in deep colored flat wall paints. However, flats made with our reproduction of their varnish (VM-2336) produced very poor uniformity of tint with very short flow and wet edge. No further work will be done with this liquid at the present time.

A considerable amount of time was devoted to an evaluation of styrene containing paints from Lewis Berger and Sons along with competitive samples and products from our own lines. A report on this investigation was made at the Research Meeting for June. In general we found the styrene paints to be bad in odor, poor in oleic acid and lard resistance, poor in washability and sticky in brushing characteristics as compared with our own products.

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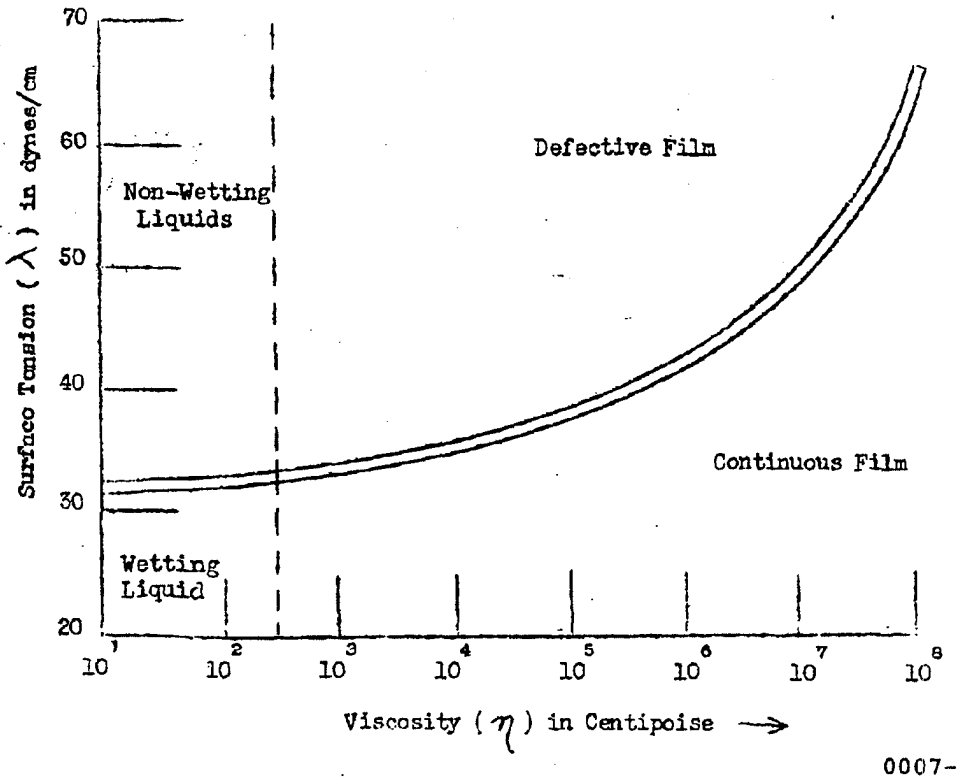
#187 - Physical Properties of Pigments

From time to time, considerable difficulty is encountered with poor spreading of a given batch of paint or varnish on a given substrate. In these cases, the wet film seems to have a very strong tendency to ball up into more or less small droplets, leaving a good portion of the substrate unprotected. In milder cases, pits and craters may be caused by a similar phenomenon.

At the recent Gordon Research Conference for Organic Coatings, a short discussion of work performed by R. Fuller of the Bakelite Division of U.C.C. showed the creation of this type of defective films to be a function of the relative surface tension (λ)/viscosity (η_i) relations prevailing in the varnish tested. The varnish was made with a phenolic type of resin. The graph shows the relationships observed for this material.



0007-SWP-045681

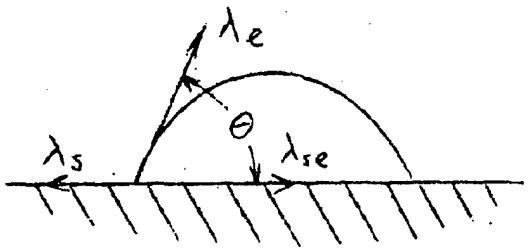
#187 - Cont.

The curve was constructed from a series of data obtained by diluting the varnish to be tested with thinners of various types and observing the surface tension and viscosity of each sample. It was found that in each case where the λ/η values crossed the curve, a film of defective character was obtained. This is also true at the high viscosity range of the graph. If, for instance, an air dried film of apparently satisfactory film characteristics is baked, and the viscosity at relatively high surface tension is reduced to the point where it lies within the defective film area, a poor film showing breaks is obtained. No fundamental explanation for this behavior of films could be given at the Gordon Research Conference.

The above has stimulated considerable thought, and from the small amount of work it has been possible to do in this field in this laboratory since the presentation of the above data, it seems that the probable mechanism of the phenomenon is as follows: If a small drop of a liquid is placed on a plane, solid surface and the viscosity or possible structure of the liquid is neglected for the time being, the forces acting on the interfaces of this system can be shown to be as indicated in the figure, where λ_e is the surface tension of the liquid; λ_s , surface tension of the solid; and λ_{se} the interfacial tension solid/liquid. From simple vector analysis these values can be shown to have the relationship:

$$\lambda_s - \lambda_{se} = \lambda_e \cos\theta$$

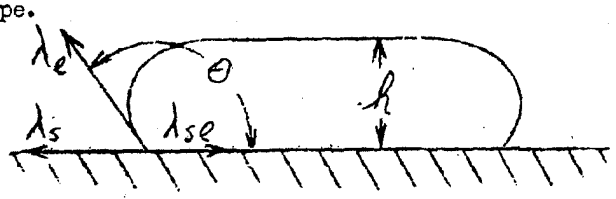
where θ is the contact angle which by convention is always measured through the liquid phase. Depending on the value of this angle, the shape



of a small drop placed on the solid surface may assume a number of forms: at zero contact angle, complete spreading of liquid on solid to a monomolecular layer takes place; at 0 to 90° contact angle, a segment of a sphere of less than or equal to half the total volume; at 90° to 180°,

#187 - Cont.

a sphere equal to or more than half the volume of the complete sphere. Consequently, as the contact angle is increased progressively from zero to 180°, the height of a small drop of a given volume above the substrate is also progressively increased from zero to a maximum theoretical value of $h = \sqrt[3]{\frac{6V}{\pi}}$, where V is the volume of the drop placed on the plate. This holds only for drops of very small diameter. As the volume of a given drop is increased, the gravitational forces acting on the liquid play a larger and larger role so that for a material of a given contact angle, the side view of the drop will assume the following shape.



Even if the volume of the drop is further increased, the height of the flat portion of the drop, h, above the substrate will not change materially and the condition of stability will be a function of the contact angle θ and the specific gravity of the liquid.

From the above, it is easy to see that, still neglecting viscosity, for any given liquid having a given specific gravity and a given contact angle with a plane solid surface, a definite value of h, the critical height, will be established. For a given system with zero contact angle, this equilibrium value is zero, for 180° contact angle, it is a maximum. For paints and vehicles, h at high contact angles is considerably larger than the usual thickness of applied films, being in the order 25 mils or more.

It is this factor of high equilibrium values of h which creates the driving force producing defective paint and varnish films. Assume, for a given paint/substrate combination, having a large contact angle, the critical height, h, is 20 mils. The film as laid down on the substrate is, however, in conformity to general paint practice, only about 2 mils thick. From the above considerations, this is obviously an unstable film condition as it must increase to 20 mil thickness before the critical height is attained. To do this, provided the film is sufficiently non-viscous, it will contract in area in order to increase its volume to the critical height. This is accomplished by "robbing" adjacent portions of the substrate of the vehicle, and consequently creating breaks and irregularities in the applied paint film.

#187 - Cont.

The force tending to counteract this phenomenon is the viscous resistance of the applied film. In highly fluid films the above action will take place with considerable rapidity. As the rigidity of the film is increased, either by increasing the viscosity of the varnish films or, further, the thixotropic structure of paint films, a point is reached where the forces of surface tension are no longer capable of moving the film against the forces of viscous resistance. As a result, any value of viscosity of the applied film equal to or higher than this value will produce a quasi-stable condition which prevails as long as these circumstances prevail. If the viscosity or thixotropy of the film is reduced below this point however, as for instance by heating or baking the film, an unstable condition results, causing the familiar breaks in the system.

The mathematical relationships enumerated above are calculable, but are rather complex, so that an empirical approach to the measurement of the various factors involved would be indicated.

The obvious method of correcting defective films produced by this mechanism is, of course, to decrease the contact angle between film and substrate to the point where the critical thickness, h, is less than the thickness of the applied film, preferably zero. Under these conditions the film will be absolutely stable. This can be implemented by absolute cleanliness of the substrate and can be promoted strongly by employing thinners which have a good wetting capacity for the substrate. Often vigorous shearing of the substrate, like hard brushing on of the paint, will decrease the contact angle sufficiently to give continuous films. As the contact angle is a function of the surface tension of the vehicle, low surface tensions are indicated as highly desirable.

Where these methods are impractical or impossible, the quasi-stable state caused by a highly thixotropic structure and high viscosity are applicable. This solution to the problem is very dangerous, however, for films which are to be baked subsequent to air dry. If the temperature of bake is high enough to decrease the viscosity of the film below the critical value, defective films will result. Often decreasing the baking temperature only slightly will remedy the difficulty.

The third alternative to the prevention of breaks in the applied films, is to increase the thickness of the cast film to be equal or greater than the critical thickness. This method usually meets technical difficulties, however. Any other miscellaneous conditions tending to create a stabilized film in conformity to the above is, of course, usable.

Discussion of this mechanism is invited.

#187 - Cont.

Apparatus to measure cohesion and the adhesion of films to substrates is being constructed. It is of the automatic recording type and should give some insight into these values for various types of paint and varnish films.

Equipment is being tried out which promises to give CPVC results in connection with the CPVC cell without knowing the formula for the paint being tested. This technique should also be applicable for the rapid determination of the specific gravity of powdered materials such as pigments.

#177 - Pigment Studies

The work on pigment hiding in the CPVC zone of pigment loading is being extended to include competitive titanium calcium pigments offered by du Pont and Titanium Pigment Corporation, as well as lithopone. This work should give an insight into the differences in performance of the various titanium calcium pigments as they are revealed in use in various types of formulations. The pigments included in this study are as follows:

2132 dry	Titanox RC HT
2140 dry	Titanox RC
1201 dry	Titanox RC HT X
	Ti-Cal R 22
	Ti-Cal R 25
1202 dry	Ti-Cal R 27
	Ti-Cal R 31
461 M	Permolith

This work is under way and results should be available during the next month.

The work on photo-chemical effects as a measure of chalking rate has been discussed with A. E. Jacobsen, of the Titanium Pigment Laboratory. It was his comment that although the method may serve adequately most of the time it is a method which may be affected considerably by chemical impurities. He felt that as a control test the results would be too easily nullified and might possibly be very misleading.

#162 - Studies in Flat Wall Paint Formulation

Enamels from West Coast

The Oakland Technical Service Department has submitted quart samples of Sinclair Bagdad High Gloss Enamel 1001 White and BHO - 22 E.B. Gloss Enamel made with OW 653 vehicle (Dehydrated Castor P.E. Rosin Ester) for our inspection. The two enamels were compared with Paintercraft Gloss White Enamel #821 (F82 W 1 - C 3549) and Enameloid White (Rex 710 - C 3499 A) for general performance. Sinclair-Bagdad High Gloss Enamel was slightly sticky in brushing. The gloss was very similar to F82 W 1 but not as high as Rex 710. The Oakland Enamel BHO-22 was better in brushing properties than the Sinclair enamel but it was lower in gloss. However, we found the Sinclair and Oakland Enamel BHO-22 about equal in chemical resistance.

Enamel Tests

Sample	Viscosity #3 S-W Cup	Brush	Flow	Gloss 60° Photo-volt	Drying Set-to-Touch	Drying O'Nite	Wet Edge 10 Min. Lap
Sinclair-Bagdad High Gloss En. 1001 - White	56.4"	Sl. sticky	Very good	94	3 hr. 20 min.	Very good	Short
Oakland Lab. BH 0-22 E. B. Gloss Syn. En. Made with OW 653	89.0"	Good	"	80	2 hr. 4 min.	"	"
Paintercraft Gloss White Enamel #821 F82 W 1 - C 3549	34.0"	Good	"	95	1 hr. 40 min.	"	"
Enameloid White Rex 710 C 3499 A	26.0"	Very good	Sl. too high	99	1 hr. 1 min.	"	"

Cont.

#162 - Cont.

Enamel Tests
(Cont.)

3 Hour Spot Tests

Sample	2% Iodine	1% NaOH	Oleic Acid + Lard Oil	95% Alcohol	1% Soap	5% Acetic Acid (24 Hours)	5% Citric Acid
Sinclair-Bagdad High Gloss En. 1001 - White	Bad stain; sl. soft film.	Sl. blis., very soft film.	Soft film.	Very soft film, bad blister.	No visible effect	Cons. blistering, very soft.	OK
Oakland Lab. BH 0-22 E. B. Gloss Syn. En. Made with OW 653	"	Very bad blister, very soft film.	Sl. soft film.	"	"	Bad blister, very soft.	Soft film.
Paintercraft Gloss White Enamel #821 F82 W 1 - C 3549	"	Cons. blister, very soft film.	Very soft film.	"	"	Very sl. soft, bad haze.	OK
Enameloid White Rex 710 C 3499 A	Bad stain, soft film.	Very bad blister, very soft film.	OK	"	"	"	OK

#162 - Cont.

Porch and Floor Enamel

The Resin Research Department has submitted two ether resin varnishes - RC 6355 and RC 6358 for test in Porch and Floor Enamel

	RC 6355	RC 6358
(348) Reduction	Infinite	Clear up to 15 - 20 parts (348) to 1 part resin-ester.
Body	W	V
Cure	Over 2 minutes	82"
Wt./Gal.	7.83	7.64
A. V.	8.4	7.9
Color	16	10
Solids	70%	60%
Solvent	(348)	(348)

The Porch and Floor Enamel made with RC 6355 was similar in viscosity and brushing to regular Porch and Floor Enamel but that made with varnish RC 6359 was too high in consistency and too sticky in brushing. Both ether resin varnishes developed lower gloss than the regular Porch and Floor vehicle. Additional paints will be made with 566 dry as the inert to improve gloss.

#187 - Physical Properties of Pigments

A wooden model of an automatic recording adherometer working on the principle of the manual Interchemical adherometer has been completed. The rough preliminary tests it has been possible to perform with this equipment indicate that the theory behind it is sound. The new device has the advantage over the Interchemical type in that it draws a complete graph of the adhesion and cohesion characteristics of the paint or varnish film being tested in a single run. From this, the absolute values for the adhesion of the film to the substrate as well as the cohesion of the film can be extrapolated.

A number of small changes in the design, mostly to increase the over-all rigidity of the machine are contemplated after which more test runs will be made.

Work on the electrokinetic properties of pigment dispersions is continuing, mostly with the object of determining the reason for mobility in a strong electric field. From the additional work done with potentials of up to 50,000 volts, it appears more and more probable that this mechanism is of a space-charge type. Experiments are being set up to further clear up the questions surrounding the subject.

A progress report on the work so far completed on the electrokinetic properties of pigment dispersions has been prepared and will be circulated to interested parties.

#177 - Pigment Studies

The work on pigment hiding in the CPVC zone has been delayed due to a temporary shortage of cellulose acetate sheet. In addition we have been involved with the hiding of several samples of enamel submitted for test by the Dispersion Laboratory. Work on Titanox RC HT, RC, and RC HT X is completed but the reporting will be delayed until the Ti-Cal pigments have been tested.

#162 - Studies in Flat Wall Paint Formulations

Flat Wall Paints

A sample of Aroflat 3025 - P - 40% from U. S. Industrial Chemical, Inc. was compared with our alkyd varnish (4113) for general performance in Flat-Tone.

Aroflat 3025 - P - 40%

Viscosity	J - P
A. V.	5 - 10
Wt./Gal.	7.2 - 7.3 pounds
Color	8 - 10
% Solids	39% - 41%

At equal solids the Aroflat 3025 - P - 40 alkyd produced a lower bodied flat than (4113) with inferior hold-out over porous surfaces compared with One Coat Flat-Tone. The flat wall paint made with Aroflat 3025 - P - 40 likewise was not as good as (4113) in uniformity of tint over surfaces of this type.

The shortage of titanium dioxide and titanium calcium pigments has prompted an investigation to determine whether part of the titanium calcium could be replaced with lithopone without decreasing the quality or performance of our present Flat-Tone formulation. In connection with this problem the Auxiliaries Research Laboratory obtained two samples of lithopone 461 L with low P.C. factors from the Coffeyville plant for our tests. The initial batches of Flat-Tone made with one and two hundred pounds of lithopone 461 M for part of the titanium calcium showed a definite increase in viscosity after five days' storage. However, the 461 L batches appear to be much less reactive. (September 6. Formula sent to A. B. Holton and S. F. Carlson. Details will be available in the September report or in advance to those who express interest.)

The Paint Research Department was requested by Cleveland to evaluate a number of vehicles being prepared by the Resin Research Department for use in a new toner base that is to be formulated similar to our Color Mix line. The new toner bases are to be formulated so they can be used as deep colored flats or intermixed in any proportion with Flat-Tone, Semi-Lustre and Enameloid.

#162 - Cont.

The Resin Research Department has prepared a number of varnishes for this investigation. The varnishes prepared to date have been more or less incompatible with the vehicle combinations of the above rexes, except for RC 5726. RC 5726 is a (4113) type varnish based on a higher percentage of Abitol. The initial work has indicated that it may be possible to formulate a satisfactory toner base with a varnish of this type which will blend with the products selected. Work will continue on this problem. (September 8. Formula and sample to Cleveland.)

The Resin Research Department has submitted a sample of RC 6645, special (4113), reduced with Shell's Deodorized Thinner 410 - Code 8316, to be compared with Hi Flash Mineral Spirits (5027) in the Flat-Tone White formulation. The RC 6645 flat is similar to that made with regular (4113) and (5027) in practically all respects, but from an odor standpoint we are unable to decide from laboratory tests which thinner is the least objectionable. It was decided that a further check should be made by painting rooms, comparing the drying odors over a 24 hour period. These tests have been arranged and the results will be reported next month.

A sample of O'Brien's Liquid Velvet Flat Wall was compared with Flat-Tone White for general characteristics. This flat is advertised as being exceptionally good in washability. However, we found O'Brien's flat to be poor in washability compared with Flat-Tone - Rex 810 when applied over glue size.

	O'Brien's Liquid Velvet White	One Coat Flat-Tone White - Rex 810
Brushing	Good	Good
Flow	"	"
Drying	"	"
Uniformity of Tint and Sheen	Equal to Flat-Tone	Standard
Washability (Over glue size)	250 cycles	750 cycles

#162 - Cont.

Primer Tests on Wet Plaster and Wet Cement

Several tests were made to determine the comparative performance of a new product called Water-Pel Enamel for priming wet plaster and cement surfaces. Water-Pel is manufactured by Water-Pel Paints, Inc., 907 Terminal Sales Building, Portland, Oregon. According to their claims, this product can be applied on any surface whether dry, damp or wet, resists growth of mold and mildew. It is claimed that Water-Pel Enamel can be applied on cement, concrete, brick, plaster and wood walls without neutralizing.

In order to check some of the manufacturer's claims we have conducted tests for adhesion to wet plaster and will also test on wet cement when the panels are available. Samples of regular Wall Primer and Sealer - Rex 25, Enameloid White, Lowe Brothers' Dura-Craft White and du Pont's Elvacet (Polyvinyl Acetate Emulsion) were included in this evaluation. As indicated by the data below, Water-Pel is outstanding in adhesion characteristics when applied to wet plaster or concrete. However, the film becomes very brittle after the surface is dry. Lowe Brothers' Dura-Craft White - Rex 41137 also did a good job on both surfaces.

Properties of Wet Surface Paints

	Viscosity #3 SW Cup	Brushing	Flow	Elasticity	Tests Over Wet Plaster (1)	(2)
Rex 25 C 740	27.0"	Very good	Very good	OK	Fair adhesion, good general performance.	Poor adhesion, could be ripped off in sheets.
Rex 710 C 3499 A	33.4"	Good	"	OK	Very poor adhesion, could be ripped off.	"
Lowe Bros. Dura-Craft White - 41137	44"	Sl. sticky	"	OK	Fair adhesion, good general performance.	Exc. adhesion, no brittleness, good sealing.
Water-Pel Wet surface Red. 25% (348)	13"	Very easy	"	Brittle	Good adhesion, good general performance.	Very brittle, good adhesion, good sealing.

(Cont.)

#162 - Cont.

Properties of Wet Surface Paints
(Cont.)

	Viscosity #3 SW Cup	Brushing	Flow	Elasticity	Tests Over Wet Plaster (1)	(2)
du Pont Elvacet - Polyvinyl Acetate	Too heavy	Sticky (Dries too quickly.)	Very good	Very brittle	Very poor adhesion, rips off in sheets.	Very poor adhesion, very brittle.
Above + 5% Dibutoxy-Glycol Phthalate	"	"	"	OK	"	Very poor adhesion, no brittleness.
Elvacet + 2% Glyoxal	"	"	"	Very brittle	"	Very poor adhesion, very brittle.

(1) Brushed out after plaster had set for two hours.

(2) Recoated with Semi-Lustre Green over night.

Porch and Floor Enamel

We have continued our investigation of ether resin varnishes for use in Porch and Floor Enamel. During the month the Resin Research Laboratory submitted RC 6389 and RC 6374. Their characteristics are:

	RC 6389	RC 6374
Resin	New Formulation	CV 4016
(348) Reduction	Infinite	Infinite
Body	W -	W
Cure	80	90
Wt./Gal.	7.83	7.81
A. V.	9.6	10.0
Color	10	10
Solids	70%	70%
Solvents	(348)	(27% (348) (3% (4048)

#162 - Cont.

The laboratory batch of Porch and Floor Enamel made with RC 6389 was satisfactory in brushing, flow, gloss and drying characteristics. The enamel made with RC 6374 was similar to RC 6389 but slightly lower in gloss than standard. RC 6374 and RC 6355 (see July report) will be tested further to determine if some improvement can be made in the initial gloss by the use of a softer inert such as calcium carbonate, 566 dry.

Properties of Porch and Floor Enamels

Batch	Characteristics	Viscosity #3 Fresh	Viscosity #3 O'Nite	Brush	Flow	Gloss	Set-to-Touch	Thru	Scrub Resistance Cycles
320 P	Reg. Porch and Floor Enamel Medium Gray Card 8	20"	30"	Std. (Good)	Std. (Good)	Std. (Good)	56 Min.	V.G.	9,550
321 P	Using RC 6374	22.4"	24.0"	"	"	Sl. lower than std.	61 Min.	"	No failure at 100,000
364 P	Using RC 6389	25"	27"	"	"	As 320 P	63 Min.	"	133,000

Spot Tests

Batch	3 Hour Tests: 1% Soap	2% Iodine	95% Alcohol	1% NaOH	Oleic Acid + Lard Oil	24 Hour Tests: 5% Citric Acid	5% Acetic Acid
320 P	Def. (+) whitening	Bad stain Soft	Bad blister Very soft	Film completely off.	Sl. soft	Sl. fade Sl. haze	Bad blister Very soft
321 P	"	"	Sl. blister Very soft	Sl. (+) fade	"	"	Sl. soft
364 P	Definite whitening	"	"	"	Soft film	"	Sl. blister Soft

#187 - Physical Properties of Pigments

Further work on the electrokinetic properties of pigment dispersions has indicated the probability that a space charge type of mechanism is responsible for the movement of well dispersed pigment particles in a strong electrical field. Evidently very little work has been done previously on the passage of D. C. current through highly insulating liquids such as the normal vehicles and thinners employed in the paint industry. By analogy to some of the known factors influencing electron passage through non-conducting gases however, the following qualitative derivation may be obtained:

When two points are at different electrical potentials, electrons will flow through a conductor from the lower to the higher potential. In a metallic conductor this flow occurs readily, and is attributed to the fact that metals can be regarded as containing a perfect gas of electrons in a lattice of positive ions with unoccupied electron levels above the filled ones. It is this presence of unoccupied electron levels which distinguishes a metal from a non-conductor. Only if there are unfilled levels available directly above the filled ones can an electrical field accelerate the electrons and produce current flow. Since, in metallic conductors this acceleration is produced without any opening up of electron levels, no energy of activation is necessary to dislodge the electrons from their equilibrium position of rest.

A liquid electrolyte will also permit easy flow of electrons. The ions of the electrolyte form a mobile medium, free to transport electrons from one electrode to the other. Again there is no interference with an electron level, and no minimum activation energy is required to permit electron flow.

In the case of an un-ionized gas, a different phenomenon takes place. Here there are no ions free to move between electrons, nor are there unfilled electron levels above filled ones. Consequently, to obtain unfilled electron levels it is necessary to create them before current flow will take place. If a high potential difference is applied across a gas, electrons emitted from the negative electrode will remove electrons from filled shells in the gas atoms. To do this, the bombarding electron must possess sufficiently high energy to exceed that of the energy level of the electron being expelled from the gas. As a consequence, it becomes obvious that in case of gases, a minimum potential difference between the electrodes is required before conduction can take place.

#187 - Cont.

Projecting this effect upon non-dissociating liquids, such as the normal paint vehicles, it is obvious that much greater difficulty in electron activation will be encountered. The proximity of neighboring molecules causes each molecule to exert considerable force upon its neighbor. Furthermore, the molecules are in a very much lower energy state than the gas molecules. When a cathode electron does succeed in removing an electron from an atomic orbit, the chance that that electron will dissipate its energy due to rapid collisions before removing a further electron is very great. Also, a considerable part of the energy due to the electrodes goes into polarization and orientation of the dipolar liquid molecules. It is this polarization/orientation phenomenon which causes the dielectric effect of non-electrolytes.

In a previous report (May, 1950) it was shown that in a well dispersed pigment/vehicle system, the pigment particles are surrounded by a shell of large, highly dipolar molecules adsorbed from the vehicle in such a way that all of the poles of one sign face the inside of the particle. These adsorbed molecules, because of the electrical relationships resulting from their adsorption have induced dipoles, considerably stronger than those of the unadsorbed molecules. Although still strictly neutral, the particles now display a surface possessing a relatively strong surface polarity. The electrons emitted from the electrode upon application of a high potential difference will act in either of two ways, depending upon the sign of the outside surface. In the case where the outside end of the adsorbed molecules is positive in polarity, a simple electron capture takes place, and the whole particle assumes a negative charge proportional to the number of electrons captured and the particle will migrate to (+) electrode. In the case of the particles with the opposite molecular orientation at their surfaces, the distortion of the charges in the adsorbed molecules causes a state of high excitation in the valence electron. These valence electrons, already pushed away from their normal location by the adsorbing pigment particle, are particularly vulnerable to being removed by the oncoming plate electron. If, therefore, the applied potential is sufficiently high, the energy of the oncoming electrons will suffice to strip a valence electron from the molecule, and the particle will assume a positive charge. Consequently movement to the negative electrode will take place.

A current flow of the order of 10^{-9} amperes (1/1,000,000,000) is about equivalent to 10^{10} electrons (10,000,000,000) flowing, so that the above equilibrium condition will take place very rapidly even with a relatively high concentration of pigment particles present.

177 - Pigment Studies

Work on the opacity of the various titanium calcium pigments is not complete as yet, therefore reporting will be delayed until complete results can be given. It is interesting that the products of the Titanium Pigment Corporation and those of the du Pont Pigment Division seem to be different as regards their critical pigment volume concentration (CPVC). However, these will be rechecked to be sure that the data is correct.

Results of the first run on the CPVC measurements are as follows:

Paint No.	Titanium Calcium Pigment	CPVC
RB 2904	Titanox RC HT	56.7%
RB 2905	Titanox RC	62.7
RB 2906	Titanox RC HT X	61.5
RB 2907	Ti Cal R 22	51.3
RB 2908	Ti Cal R 25	66.2
RB 2909	Ti Cal R 27	68.0
RB 2910	Ti Cal R 31	65.0

#162 - Studies in Flat Wall Paint Formulation

Work was continued on the new toner bases. These bases are to be formulated as deep colored flats and also so they can be intermixed in any proportions with Flat-Tone, Semi-Lustre or Enameloid. Our work has been based on RC 6687, a (4113) type varnish high in Abitol, developed by the Resin Research Department. This varnish is similar to RC 5726 which was reported last month.

RC 6687

Resin - Glyceryl-P.E.-Phthalate-Abitol
Oil - (1273) soya
Body - S
Cure - 37
A. V. - 6.0
Color - 6
Solids- 40%
Solvent - (5027) Mineral Spirits, Hi Flash

A quart sample of our initial toner base development OJ 428 P was submitted to S. F. Carlson for his inspection. Various panels and paint-outs of this toner base were also sent to A. B. Holton. The new toner base is much superior to Rex 964, one of the regular Color Mix colors, in uniformity of tint and sheen when applied over spackle. It also intermixes with Flat-Tone, Semi-Lustre and Enameloid in all proportions. The new base has more feel under the brush than Flat-Tone White, due to the higher solids required to decrease the tendency to mar, which is typical of deep color flats. However, from a washability standpoint it is much better than the present Color Mix Burgundy - Rex 964.

Work is being continued on the new toner base with an effort toward improving the uniformity of tint and sheen as well as decreasing the tendency to mar. Lorite WG (National Lead Co.) appears to be a very interesting inert from the standpoint of lowering gloss while even increasing flow. Other inerts will be tested, such as Metronite, quartz silica, mica, etc. to decrease mar resistance.

The Resin Research Department has submitted RC 2920 and RC 7322 as possible flat wall paint vehicles. These are intended for general conservation of glycerol, P.E., phthalic and Abitol, should conditions require.

#162 - Cont.

	RC 2920	RC 7322
Resin	637 Dry W. W. Rosin	637 Dry
Oil	(44) linseed	SO_2 blown (44) linseed
Body	Y	U
Cure	10	10 - 12
Wt./Gal.	7.35	7.38
A. V.	28	6.0
Color	Black	17
Solids	50%	50%
Solvent	(5027) Mineral Spirits Hi Flash	(5027)

The experimental flats made with these liquids were poor in uniformity of tint and sheen over spackle and poor in color.

Primer Tests on Wet Cement

Additional tests were made to determine the comparative performance of a new competitive product called Water-Pel Enamel being sold for the priming of wet plaster and cement surfaces. Water-Pel is manufactured by Water-Pel Paints, Inc., 907 Terminal Sales Building, Portland, Oregon. The priming tests on wet plaster were reported in the August Monthly Report. As indicated at that time, Water-Pel had quite good adhesion when applied to wet plaster but became quite brittle upon aging. Lowe Brothers' Dura-Craft White - Rex 41137 had good adhesion but also became quite brittle after several days. From the standpoint of alkali resistance Water-Pel and Dura-Craft White were much superior to the other priming coats.

The results over wet cement were as follows:

See next page.

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Performance of Primers over New Cement

	(1)	(2)	(3)
Wall Primer and Sealer Rex 25 - C 740	No adhesion, film very soft, cheesy.	Poor adhesion; could be rubbed off with the fingers.	Poor adhesion; poor alkali resistance.
Enameloid Rex 710 - C 3499 A	Poor adhesion; film cheesy.	Poor adhesion; film soft.	Poor adhesion; poor alkali resistance.
Lowe Bros. Dura-Craft White 41137	Fair adhesion; fair general performance.	Good adhesion; good general performance but brittle.	Good alkali resistance; good performance but brittle.
Water-Pel Wet Surface Red. 25% (348)	"	"	"
du Pont Elvacet Polyvinyl Acetate	"	"	Very poor adhesion; film very soft; rips off in sheets.
Above + 5% Dibutoxy Glycol Phthalate	"	"	"
Elvacet + 2% Glyoxal	"	"	"

(1) Brushed out after cement had set 16 hours.

(2) Recoated with Semi-Lustre Green over night.

(3) Soaked with water for one week.

#187 - Physical Properties of Pigments

The derivation for the equation relating the dispersion and agglomeration forces involved in pigment dispersions has been completed. It is based on the fundamental assumption that well dispersed pigment particles have highly polar molecules adsorbed on their surfaces. These are essentially all oriented in the same direction with respect to the pigment surface. Thus, the system can be regarded as consisting of a pigment particle surrounded with pairs of charges derived from the adsorbed dipolar molecules. In the case of spherical particles, this would be equivalent to two concentric spherical condensers of opposite charge with the charges substantially fixed in position, a charge of one polarity being opposite that of the other on each of the two concentric spheres.

Under this assumption, the vectorial force exerted by the concentric spheres of radius r and r + d of opposite polarity can be calculated for a point a distance h away from the center of the sphere. The value d is the effective dipole length of the adsorbed molecule having a dipole charge q. If a number of molecules (n) are adsorbed, the integral equation for this system, using Coulomb's law, for the force between one sphere of charges and a point becomes:

$$F = 2\pi nqh\int_{-r}^{+r}(h^2 - 2hx + r^2)^{-3/2}\,dx - 2\pi nq\int_{-r}^{+r}x(h^2 - 2hx + r^2)^{-3/2}dx$$

Upon integration this yields, for the total force between two spherical particles of radius r and R a distance h apart and having n and N molecules respectively of charge q and length d adsorbed on their surfaces:

$$F_{total} = 4\pi nq\left[\frac{(r+d)^2}{h^2(h+r+d)} - \frac{r^2}{h^2(h+r)}\right] +$$

$$4\pi Nq\left[\frac{(R+d)^2}{h^2(h+R+d)} - \frac{R^2}{h^2(h+R)}\right]$$

As would be expected, the function becomes discontinuous where (r + d) or (R + d) equals h, as at this point the two particles would touch.

The equation allows the quantitative calculation of dispersion and is fundamental in nature. It indicates that the force of dispersion is directly proportional to the magnitude of the dipole charges and the number of active molecules adsorbed on pigment surfaces. It decreases as

#187 - Cont.

a linear function of the particle size, indicating that for the same system, small particles agglomerate more readily than large ones, and that the force tending to keep particles in a dispersed state increases inversely as a function of the cube of the distance the particles are separated.

A plausible explanation for the agglomerating effect of water and an electric potential on some pigment/binder systems has been postulated and will be explained more fully as soon as a few remaining points have been cleared up experimentally.

#177 - Pigment Studies

Flooding of Phthalocyanine Blue

The flooding characteristics of a non-flocculating copper phthalocyanine blue pigment Heliogen Blue BNC were evaluated. A roller mill BL 44 type dispersion of the pigment was prepared to tint an alkyd type formulation of Enameloid White Rex 710. Heliogen Blue BNC is a toner type pigment prepared by General Dyestuff Corp. and offered as an easily dispersible xylene stable pigment possessing non-flocculating characteristics similar to du Pont's non-flocculating laked pigment BL 282-D. Our experience does not support the manufacturer's claims for ready dispersibility. The pigment required six passes through the 3-roll Lehmann mill to establish a satisfactory 6 H dispersion in the zinc resinate - Dehydrol vehicle BL 44.

Enameloid White Rex 710 tinted to the approximate depth of Enameloid Pastel Blue flooded white when pigmented with Heliogen Blue BNC. When the surface of the wet film is disturbed by wiping the finger tip lightly across its surface, a strong blue band of color was exposed. On closer examination it became apparent that the surface so exposed had acquired a deeper blue than the interior of the film and that the paint to glass interface under the disturbed area also acquired a deeper blue.

This suggests that flooding is not a simple movement of portions of a pigment system toward the exposed film surface, but to all or both surfaces of the film simultaneously. The change in color brought about by wiping across the surface of the film may be explained by the fact that the mechanical force applied to the film has forced a wetting back of the migrant or flooding constituent into the body or interior of the film. This re-establishes the true average color of the system to contrast with the color of the undisturbed area. Similarly, it can be explained that the color change occurring directly under the disturbed area results from the wetting in of migrant pigment due to the effect of pressure through the film.

The extent of contrast established by each disturbance on both surfaces increased with time during the early setting period for the film. This follows as the concentration of the migrating constituent of film interfaces is directly proportional to time, and the component of force applied perpendicularly to the film surface by a wiping motion increases as the film acquires body while setting up.

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The reference sample used in this study was a standard Enameloid White Rex 710 tinted to the approximate depth of Enameloid Pastel Blue, using du Pont's phthalocyanine blue lake HL 282-D. Its behavior was similar to that of the Heliogen BNC tinted enamel with the exception that it flooded blue. The disturbed areas on this film became lighter than the undisturbed surface and the contrast between these areas was substantially less than on the Heliogen BNC tinted film. The color change again was observable on both sides of the film. It too is covered by the explanation of the behavior of the Heliogen BNC tinted film described above.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

Some work was done on the proposed toner bases which could be used as deep colored flats or for inter-mix purposes with Flat-Tone, Semi-Lustre or Enameloid. An effort was made to lower the sheen of our initial development, OJ 428 P, submitted to Cleveland in September. However, when the sheen is reduced, the tendency to mar is increased. A number of inerts such as mica, blanc fixe, barytes, silica (1937 dry) have been tested, also lake colors, wax, etc., but we have obtained no improvement in mar resistance. Work will be continued.

Samples of Guai-A-Phene, Glidcol Regular, and Glidcol WW from Glidden were compared with regular anti-skins (5026) and (1767) in Flat-Tone White. The results indicated that Glidcol WW was the most desirable from an odor standpoint and equally as effective in anti-skinning properties as (5026) or (1767). All agents were introduced at equal cost to (5026). The order of preference from the standpoint of odor would be Glidcol WW (least odor), Glidcol Regular second, (5026) third, (1767) fourth, and Guai-A-Phene with the most odor. This information was passed on to Cleveland.

West Coast Painter Enamel

Some time was spent on the development of an enamel for the west coast painter trade. One formulation carried 290 pounds rutile titanium calcium, 160 pounds pure anatase TiO_2 1403 dry, and 25 pounds Kadox zinc oxide 1302 dry in the pigmentation. The vehicle carried the soya maleic varnish (6100), Dehydrol (2325), and zinc resinate solution (3071), plus driers and thinners. Later, the zinc oxide was removed because of after-body. If package stability of the latest enamel is satisfactory, the formula and a sample will be sent to Oakland for their comments.

Porch and Floor Enamel

The Resin Research Department has prepared a modified ether resin varnish RC 6429 (similar to RC 6389) for test in Porch and Floor Enamel. RC 6429 is a 70% NVM varnish in (348) mineral spirits, at a body of W. The experimental batch of Porch and Floor Enamel 503 P made with this varnish was satisfactory in brushing, flow, gloss and drying characteristics. The film has a tendency to mar slightly more than regular Porch and Floor Enamel after drying over night. However, Sward Hardness Rocker reading indicates only small differences in film properties. Further batches will be made to check the effect of more cobalt drier and less anti-skinning agent.

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Batch	Varnish	Viscosity - #3 Fresh	Viscosity - #3 24 Hrs.	Brush	Flow	Gloss	Drying Set	Drying O'Nite
503 P	RC 6429	21"	25"	Good	Very good	Very good	75 Min.	Good
320 P	(6110) (4950)G	20"	4 days 30"	Good	"	"	105 "	Good

Sward Rocker Readings

Batch	Varnish	Age of Film 24 Hrs.	2 Days	5 Days	6 Days	7 Days	8 Days
503 P	RC 6429	10	18	20	24	28	30
320 P	(6110) (4950)G	8	18	24	28	30	30

A sample of Special Deck Red F50 R F2 mentioned in the Gibbsboro Technical Service Report for July and August was compared with regular Porch and Floor Enamel Rex 152, card 8 and a special ether resin enamel OJ 321 P made using RC 6374. F50 R F2 was slightly sticky in brushing but had good flow and very good gloss. On the scrub test it did not equal Rex 152 and was definitely inferior to the ether resin enamel.

Properties of Various Porch and Floor Enamels

Sample	Characteristics	Viscosity #3 Cup	Brush	Flow	Gloss
OJ 320 P	Regular Rex 152 Card 8	30"	Good	Good	Very good
OJ 321 P	Rex 152 using RC 6374	24"	Good -	Def. short	Sl. low
F50 R F2	Special Deck Red - Lucas	23"	Def. sticky	Good	Very good

(Cont.)

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Properties of Various Porch and Floor Enamels
(Cont.)

Sample	Character-istics	Drying Set-to-Touch and Through	Scrub-ability	Spot Tests: Soap	Spot Tests: 1% NaOH	Spot Tests: Oleic Acid + Lard Oil
OJ 320 P	Reg. 152 Card 8	56 minutes Very good	10,000 cycles	Film very soft, bad fade.	3 hours Film com-pletely off.	Film soft.
OJ 321 P	Rex 152 using RC 6374	58 minutes Very good	Over 100,000 cycles	Cons. blister-ing, film soft.	V. sl. haze - excellent condition.	Film soft.
F50 R F2	Special Deck Red Lucas	31 minutes Very good	3,900 cycles	V. bad blister-ing, film very soft.	Film com-pletely off.	Film soft.

#187 - Physical Properties of Pigments

Work on the theory of dispersion and the electrokinetic mobilities of pigment particles has continued. The work has progressed to the point where most of the questions remaining in the research bulletin covering this subject can be explained and the mathematical derivations checked with the data obtained.

The reasons for the agglomerating effect of water and potential on some dispersions has been determined, and also why polymeric dipoles adsorbed on the pigment particles are less affected than straight chain monomeric dipoles.

A supplement to the original bulletin on the electrokinetic properties of pigment dispersions describing these effects in detail will be prepared.

A paper on the relationship between oil absorption and critical pigment volume concentration has been prepared. This amplifies the theory of oil absorption by application of the concepts of CPVC. A new, much more highly reproducible method for measuring the equivalent of oil absorption by use of the CPVC technique is described. The paper will be circulated.

Work on the separation of some of the constituents of drying oils by the method of urea adducts as described by T. F. Bradley in "Some New Developments in Drying Oil and Varnish Technology," Official Digest 310, 795, (Nov. 1950) has been started. It is hoped to be able to learn more about the dispersive capacity of various constituents of paint vehicles by use of these separated products.

#177 - Pigment Studies

Flooding of Phthalocyanine Blue

In the study of the flooding characteristics of phthalocyanine blue tinted enamels detailed in the last monthly report, it was observed that the toner tinted specimen developed streaks of blue when disturbed by wiping in the flooding test. From this it was apparent that the original dispersion of the toner in the tinting base had been unsatisfactory or it had reagglomerated. To check this a fraction of the tinted enamel was redispersed in an Oster mixer and set aside to observe the stability of the new and deeper color.

Microscopic examinations of films cast from the regular tinted and Oster mixed fractions showed numerous large agglomerates of phthalocyanine in the regular tint and fewer as well as smaller agglomerates in the Oster mixed fraction. The flooding characteristics of the material were not changed by the increased dispersion.

Reflectance data was taken on films of the freshly prepared enamels and has now been obtained from films cast from two month old enamels. This shows that both samples have become darker during this aging period and that the extra dispersed sample has retained its relatively deeper blue character. There has been no reagglomeration in this sample.

Reflectance values were determined by means of the Hunter Multipurpose Reflectometer. Data follows:

	Reflectance Values					
	Green		Blue		Amber	
	Fresh	2 Mo.	Fresh	2 Mo.	Fresh	2 Mo.
Heliogen blue tinted Rex 710	378	362	683	677	293	277
H.B. tinted Rex 710 dispersed	359	348	683	678	272	258

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

In line with the program of cobalt conservation, a number of drying tests were conducted on Flat-Tone White made with and without cobalt naphthenate drier. Other tests were also made to check the effects of Activ-8 and (2231) as drier promoters. Drying tests were conducted at room temperatures (72 - 77° F.) and also at approximately 40° F. on .003 and .005 inch draw-down films on glass. The results of our tests would indicate the cobalt naphthenate drier can be reduced from 3/4 gallon to 1/4 gallon without decreasing unduly the apparent drying properties of the Flat-Tone line. It was suggested to Cleveland that this revision be made effective at once. No improvement in drying could be detected with (2231) or Activ-8 in this formulation, as the drying properties of the vehicle are quite good.

Sears' One Coat Self-Sealing Flat 8313 White and Ward's Super One Coat 75-3101 White were compared with Flat-Tone White - Rex 810 for general performance. The flats were checked for brushing, flow, wet edge, drying, uniformity of tint and sheen and scrub resistance over glue size. The Sears and Ward flats were similar to Flat-Tone in general performance as indicated by the data below. The competitive flats were somewhat better than Flat-Tone in flow but they were shorter in wet edge time and not as good in uniformity of tint and sheen over surfaces that vary in their degree of porosity. Flat-Tone is much better in scrub resistance (over glue size) than either Sears' or Ward's One Coat Flats.

Sample	Viscosity #5 S-W at 75° F.	Brushing	Flow	Wet Edge	Drying Time Set	Drying Time O'Nite
Rex 810 C 2150	11.6 sec.	Very good	Good	Good	35 min.	Very good
Sears One Coat Self-Sealing Flat 8313 White	9 sec. reduced 6-1/4% with (348)	Very good	Very good	Good -	25 min.	Good
Ward Super One Coat Flat 75-3101 White	16 sec.	Very good	Very good	Good -	25 min.	Very good

(Cont.)

#162 - Cont.

Sample No.	Uniformity of Tint On Lap	Uniformity of Tint On Various Surfaces	Uniformity of Sheen	Scrub Resistance	Degree of Sheen
Rex 810	V. G.	Good	Good	670 cycles	Standard
Sears	V. G.	Good -	Good	210 "	Slightly higher than Rex 810
Ward	V. G.	Good -	Good	230 "	Slightly lower than Rex 810

Heavy Duty Flat Wall #685 - C78 W 8

The Chicago Paint Testing Department has reported that the present formula on C78 W 8, card No. 2, is lower in flow than the old C78 W 16 which was manufactured previously. These reports have prompted a recheck of C78 W 8 and C78 W 16 for general performance. Laboratory batches of C78 W 16 and C 78 W 8, card No. 2, were made and compared with a production batch of C78 W 8 taken from tank 20 on November 20. The three samples were shaded green and brushed out by R. Weidenaar, of the Chicago Paint Testing Department.

In general it was agreed that the laboratory batch of C78 W 8 was equal or slightly better in flow than C78 W 16 and definitely better than the factory batch of C78 W 8 taken from tank 20. The C78 W 8 has slightly more feel than C78 W 16 but this characteristic is not objectionable from the standpoint of brushing properties.

The difference in flow between laboratory and plant production apparently is a problem of the mixing and grinding technique used in the plant. A test batch will be run in the plant using the same procedure found satisfactory in the laboratory. The paste will be mixed for a longer period to obtain better wetting of the pigment. Results on these tests will be reported when available.

An effort was made to revise the present formula for C78 W 8, card No. 2, to obtain better flow by the introduction of alkyd (4101) for (4103). A proposed revision, OJ 566 P, based on this change, was sent to Cleveland for their approval and distribution.

#162 - Cont.

West Coast Painter Enamel

Work was continued on the development of a West Coast Painter Enamel. The initial development, 546 P, showed a progressive increase in body as reported by Mr. Landis, and further work has been undertaken to reduce the reactivity. Several changes were made in pigmentation and vehicle composition. Some titanium calcium was replaced with lithopone and the anatase titanium dioxide was replaced with rutile titanium dioxide on a hiding basis. In the vehicle the zinc resinate solution was replaced with an ester gum solution and the suspender base BI 336 was eliminated to obtain better package stability. A quart sample of the new development, OJ 581 P, was sent to Oakland and Cleveland for their inspection.

Porch and Floor Enamel

In the monthly report for October it was reported that laboratory batches of Porch and Floor Enamel made with the ether resin varnish RC 6429 were satisfactory for brushing, flow, gloss and drying, but the enamel had a tendency to mar slightly more than the regular formula. It was also indicated that further batches would be made to check the effect of more cobalt drier and less anti-skinning agent. More recent batches of Porch and Floor Enamel made with RC 7753 (repeat batch of RC 6429) were similar in all respects except for gloss. RC 7753 appears to be slightly lower in gloss characteristics than RC 6429 but similar in all other characteristics. The mar resistance of these batches appears to be similar to the regular formula. A quart sample of Porch and Floor Enamel made with RC 7753 was sent to Cleveland for their inspection.

Aroplaz 1395-M 70 obtained from U. S. Industrial Chemicals, Inc. was compared with RC 7753 for general performance. Porch and Floor Enamel made with this vehicle was slightly sticky in brushing and slightly low in gloss. However, Aroplaz was equal to our ether resin varnishes in scrub resistance.

Panels 13804-12 F, C were examined after nine months' exposure at Chicago and at Florida, 45° south. These are 8" x 24" yellow pine panels, and all paints were applied two coats self-primed. The following tests of Porch and Floor Enamel Gray were made:

#162 - Cont.

(a) Using 2174 dry Ti-Pure R-610 and 2188 dry Micro Velva - (6173)/(4950)G maleic-rosin-linseed/linseed-tung-modified phenolic; RC 0621 and RC 1199 ether resin-soya, 1.2 acid value; and RC 0579 ether resin-soya fatty acids, 3.0 acid value.

(b) Using 2140 dry rutile titanium calcium in place of 2174 dry. RC 1211 and RC 1214 ether resin soyas (the four RC batches of this type were all alike except for slight modifications of the cook); (6110)/(2841)G, long oil linseed-P.E.-maleic-rosin/medium Dehydrol-modified phenolic; and Ampruf vehicle, a dialkyl maleate-vinyl acetate copolymer.

(c) Pene-Treat #300 Floor-Armor, a competitive material advertised as "acid-proof, 100% synthetic plastic."

The most striking differences, especially at Florida, are in fading, due in some cases to a whitish (normal) chalk mask and in others to a yellowish mask. The regular (6173)/(4950)G is one of the worst examples of the latter, and also shows bad mildew and the most film failure, in the form of tiny microscopic checking. The Chicago panel, however, is about average in all respects. Other tests showing serious yellow discoloration are the ether resins RC 0621, RC 1199 and RC 1211, with (6110)/(2841)G and RC 1214 only slightly yellowish and RC 0579 the only ether resin sample not showing yellow chalk. A study of the formulas and stored paints failed to yield any explanation of this yellow chalk; it does not seem to be due to titanium type, vehicle type or shading. Ampruf is quite seriously faded but clean. Pene-Treat is very badly faded, and seems to be eroding but not checking. There are noticeable differences in gloss, but not tied in with either vehicle or pigment type.

Painting of Wet Plaster and Cement

Supplementing findings covered in the August report on the painting of wet cement and plaster, a similar comparison was made of Water-Pel, Damar Solution (32), Lowe Brothers' Dura-Craft White - 41137 and samples of Clear Lustrex Latex Coating #126,986-3 and Clay-loaded Lustrex Latex Coating #124,245-3 submitted by Monsanto Chemical Company.

The results of tests on wet plaster and cement indicate that Damar Solution is quite similar in performance to Water-Pel. The Damar Solution had better hold-out than Water-Pel but both films became very brittle in a few days. The Lustrex pigmented primer did not have as good hold-out or gloss as the clear Lustrex coating. This may be due in part to the high pigment loading. Further tests will be run on these coatings and further reports will be made at some later date.

#162 - Cont.

Wet Surface Paints

Sample	Brushing	Flow	Gloss	Cement Tests* Adhesion	Brittleness	Enamel Hold-Out
Wet surface - Water-Pel Paints, Inc.	Very good	Very good	Poor	Fair	Bad	Fair
(32) Damar Varnish	Good	Very good	Excel-lent	Fair	Bad	Very good
Dura-Craft No. 41137 Lowe Bros. Co.	Good	Very good	Good	Fair	Bad	Excel-lent
Clay Primer Surfacer #124245-3 E Monsanto Co.	Good	Fair	Flat	Very good	Very slight	Very poor
Short Clear Lustrex Latex Coating #126986-3 N Monsanto Co.	Good	Very good	Good	Very good	Slight	Fair

Sample	Plaster Tests* Adhesion	Brittleness	Enamel Hold-Out
Wet surface - Water-Pel Paints, Inc.	Fair	Bad	Poor
(32) Damar Varnish	Fair	Bad	Excellent
Dura-Craft No. 41137 Lowe Bros. Co.	Fair	Bad	Very good
Clay Primer Surfacer #124245-3 E Monsanto Co.	Very poor	Slight	Very poor
Short Clear Lustrex Latex Coating #126986-3 N Monsanto Co.	Very poor	Slight	Good

*Recoated with Green Semi-Lustre over night.

#187 - Physical Properties of Pigments

The paper on the "Electrokinetic Properties of Pigment Dispersions" circulated earlier has been re-written and revised. It now includes the answers to the questions still remaining at the time of the presentation at the Gordon Research Conferences last summer. It has been found that the dispersive capacity of given vehicle/pigment systems, although related to the electrokinetic mobilities of the same system, is not directly measurable through electrophoretic determinations. This is because of a number of secondary effects resulting in substantially non-ionizable systems such as paints. The movement of the dispersed pigment particles through the vehicle phase is due to a specialized case of zeta-potential, which in most cases behaves very differently from the true classical derivations for ionizable media.

The study has given a detailed insight into the mechanism of the stabilization of pigment dispersions. The information so gained should have a considerable effect in our practical thinking on what can and what cannot be done in paint formulation to obtain a given effect in the dispersion and settling characteristics of paints.

The completed report will be circulated later.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

Resin Research submitted three variations of (4113) for test in Flat-Tone:

RC 8077 - A P.E.-glyceryl-phthalic-fumaric-diglycolic-Abitol-Acosix varnish. Body T-U, solids - 32 to 33%.

RC 8372 - P.E.-glyceryl-phthalic-Abitol-ethylene glycol-soya varnish. Body - T, solids - 33%.

RC 8355 - P.E.-phthalic-rosin modified-soya varnish. Body - T to U, solids - 40%.

The flat made with RC 8077 is better in brushing and flow than regular Flat-Tone, but inferior in scrub resistance. The paint made with RC 8372 is slightly more sticky in brushing and produced a higher bodied flat than (4113). The flat made from RC 8372 was shorter in flow than that made from RC 8077 but it was a little better in washability over glue size. The flat made with RC 8355 was too sticky in brushing due to the higher solids required to obtain standard body.

The Albemarle Paper Mfg. Company submitted a sample of their Albatol, P.E.-tall oil ester for our inspection. An experimental flat made with this material is very thin in body and poor in uniformity of tint and sheen. This vehicle is similar in performance to other tall oil liquids in that it is poor in flow, brushing, drying, etc.

Wall Primer and Sealer

In line with our program of phthalic conservation, work was undertaken at the Martin-Senour Company to develop a wall primer and sealer liquid for Rex 25. They submitted two quarts of an experimental wall primer and sealer to this department for our inspection. The new primer was based on MV (1595) as the principal constituent in the vehicle. This liquid is a 25 gallon Pentalyn X-chinawood-castor-linseed varnish.

The experimental wall primer and sealer was practically equivalent to regular Rex 25 (card No. 12) in sealing characteristics. When brushed on an unsealed side of a 4' x 4' Upson board, the uniformity and degree of gloss are not quite equal to our present formula, but when recoated with Semi-Lustre Green the enamel hold-out appeared equal on both primers. Similar tests made on Transite panels gave results identical to those obtained on the Upson board. Brushing, flow and drying were satisfactory.

#162 - Cont.

Porch and Floor Enamel

Resin Research submitted a mixture of RC 7763 and RC 7768 coded RC 7770, which represents an ether resin varnish made without epichlorohydrin, for test in Porch and Floor Enamel. RC 7770 has a body of W at 70% solids, and takes infinite reduction with mineral spirits. A laboratory batch of Porch and Floor Enamel made with RC 7770 compared quite favorably with regular Porch and Floor Enamel for brushing, flow, gloss and drying properties as well as scrub resistance. Using a cost of $203.00 per 100 gallons for RC 7770, the raw material cost on the special porch and floor enamel is $160.98 compared with $116.30 per 100 gallons for the present formula, which is based on (6110) and (4950)G. An effort will be made to use a higher bodied varnish and less vehicle solids to reduce the cost.

A quart sample of Porch and Floor Tile Red - OJ 645 P made with RC 7770 was sent to R. G. Landis for test. A sample of this enamel will also be exposed with regular Porch and Floor Enamel Tile Red - Rex 158 (card No. 8) at Chicago and Florida this spring.

#86 - Leaded Zinc Pigments

Exposures 11656-61 F were retired after 36 months at Florida vertical south, cedar bevel siding panels. The tests involved two samples of 414 dry co-fumed leaded zinc submitted by Auxiliaries Research in 1946. One purpose was to determine the general suitability of these materials, AURL-397 "minimum standard" and AURL-398 "average standard," the terms having reference to color of the pigments. Otherwise, they are essentially alike at approximately 90/10% zinc oxide/BSWL. Another purpose was stated at the outset -- "how much lead ... is needed to exhibit co-fumed durability characteristics?" However, this question could be answered only in a very limited way by this series, as the only comparison was with regular 412 35/65 leaded zinc used in the guide formulas. The special samples were used in Rex 450 SWP Undercoater, Rex 471 SWP Gloss White and Rex 496 SWP Ivory, prime coat and top coat using the same sample in each case.

There was little failure at Florida on the whites, but the "average" sample showed a little slower flaking-off of surface dirt. The 412 looked noticeably cleaner and whiter than the other two, and it was possible to distinguish slightly more grayness on the "minimum" than on the "average" sample. The tints showed fairly serious microscopic checking, with the "average" sample having a greater number of checks but smaller in size. Our general conclusions were: (a) the "minimum" is not satisfactory in color, (b) the "average" is none too good and (c) the durability with 10% lead is possibly slightly inferior to that of 35/65, but quite satisfactory as far as can be judged from these few tests. It should be remembered that the 414 used is not typical of present day quality, which is considerably better.