#187 - Physical Properties of Pigments

In a continuation of the studies of the permeability of double draw-down systems as described in last month's report, data has been obtained for 1403 TiO_2 in (3109) and 1403 in a mixture of (2) and (48) in equal parts. The PVC's of the paints were chosen to straddle the CPVC as previously determined for the pigment/binder system involved and the draw-downs made in a manner corresponding to that of the December report. The results obtained are shown in the following charts:

Conductivity - Amperes x 10^{-4}

1403 in (2) + (48), 1:1

PVC %	Single	30	35	40	45	50	55
30	11	0	0	0	0	0	0
35	14	0	0	14	15	0	12
40	15	0	0	0	0	0	0
45	1500	13	13	49	240	790	1900
50	4300	14	14	25	300	1600	3000
55	5000	15	15	-	670	3000	4300

1403 in (3109)

PVC %	Single	35	40	45	50	55	60
35	1	1	-	5	13	16	-
40	6	1	3	9	14	35	39
45	2700	6	140	390	970	1200	2500
50	3000	420*	670*	2100	2700	3000	3700
55	3300	2300*	3000*	3300	3700	3700	3700
60	3700	3300*	3300*	3300	3700	3700	3700

*These samples were cracked and consequently show values which are too high.

#187 - Cont.

The results obtained by the use of 1403 TiO_2 with various binders correspond closely with those obtained for magnesium silicate 20 F under similar conditions. The extreme break in the porosity curve displayed by the single draw-downs at the CPVC is almost wholly absent and only at values substantially above the CPVC do superimposed films showing individual high permeability become porous. Evidently a large portion of the vehicle in the top coat is imbibed by a permeable first coat to seal its pores, forming substantially a non-porous film.

The mechanics of the transfer of vehicle from the upper to the under coat can probably be explained by the assumption that the first coat imbibes enough of the vehicle of the upper coat to seal its pores and bring its pigment to vehicle ratio to a value substantially commensurable with the CPVC. The PVC of this second coat rises correspondingly with the quantity of vehicle extracted. If the PVC of the upper coat (discounting the bound oil) reaches 100% without bringing the value of the lower coat to the CPVC, a porous coat results even with two coat application. Obviously, if the PVC of the under coat is originally below the CPVC, no transfer of vehicle from the upper to the lower coat results.

Under idealized conditions, and if the product of adhesion tension and pore size of the under coat exceeds that of the second coat, the final PVC of the upper coat, ϕ , can be expressed by the simple relationship:

$$\phi = PVC_2 + \frac{(PVC_1 - CPVC_1)t_1}{t_2}$$

Where: PVC_2 = original PVC of second coat; $CPVC_1$ = CPVC of under coat; PVC_1 = PVC of under coat; t_1 = thickness of under coat and t_2 = thickness of second coat.

When $PVC_1 - CPVC_1$ becomes negative, the second term of the equation becomes fictitious and reduces to zero.

The rate of transfer of the vehicle from the second to the under coat is related to the difference between the adhesion tension, $\gamma \cos. \theta_1$ between solid particles and liquid of the two films and some power of the differences of the pore sizes, according to the approximate formula:

$$\frac{V^2 n}{t} = K \left(\gamma_1 \cos.\theta_1 \times R_1^5 - \gamma_2 \cos.\theta_2 \times R_2^5 \right)$$

Where: V = volume of transferred liquid; t = time required for transfer; $\gamma_1 \cos.\theta_1$ = adhesion tension of vehicle for under coat; R_1 = pore size of under coat; $\gamma_2 \cos.\theta_2$ = adhesion tension of vehicle for particles of second coat; R_2 = pore size of second coat; n = viscosity of vehicle; and K = constant. Here again, if the right hand side of the equation becomes negative, the values become fictitious and no transfer takes place.

#187 - Cont.

To study the differences in degree of dispersion and CPVC for pigments in vehicles consisting of increasing amounts of volatile, a series of determinations were run on the systems 1403/(2)/(63), 1403/(48)/(63) and 20 F/(2)/(63) by the use of the CPVC cell. The samples were made by dispersing 10% by volume of pigment in liquids consisting of, respectively, 0%, 1%, 2%, 5%, 10%, 20%, 40%, 75%, and 100% of the vehicle in question in (63). The dispersions were carried out in 1/2 pint cans with steel balls by rolling over night and all samples were treated as similarly as possible. The CPVC's were determined in the usual manner in the CPVC cell, without dilution. The results obtained are represented in the following tables:

1403/(2)/(63)

% (2)	PVC	CPVC
0	100%	25%
1	91.7	27
2	85.0	28
5	69.0	-
10	52.6	32
20	35.7	34
40	21.8	38
75	12.9	36
100	10.0	37

1403/(48)/(63)

% (48)	PVC	CPVC
0	100%	25%
1	91.7	29
2	85.0	34
5	69.0	38
10	52.6	40
20	35.7	38
40	21.8	38
75	12.9	39

20 F/(2)/(63)

% (2)	PVC	CPVC
0	100%	25%
1	91.7	25
2	85.0	25
5	69.0	24
10	52.6	25
20	35.7	27
40	21.8	30
75	12.9	30
100	10.0	29

#177 - Pigment Studies

Paints have been prepared for the cooperative exposure evaluation of 414 leaded zinc oxide in conjunction with basic silicate white lead. We are working with the National Lead Company on this project.

In this program substitutions of 414 dry with basic silicate white lead are made by the following methods.

A. ZnO replacement by equal poundage.
Lead replacements by equal volume.

B. Maintain a 35/65 Pb pigment/ZnO ratio -
replacement is based on total volume.

C. Maintain 35/65 Pb pigment/ZnO ratio replacements
based on total pounds. (Adjust volume with extender.)

Further details will be given when the panels are placed on exposure.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

A sample of Pratt and Lambert's One Coat Flat White, sold under the name of Solidex, was obtained locally and compared with Flat-Tone and Paintercraft One Coat Flat #10. Solidex appears to be a calcicoater type of flat similar to Newark's Calcicoater Flat RL 114 A.

The three flats were applied over a panel painted with strips of enamel, Kem-Tone, Decotint, Flat-Tone and shellac to check the uniformity of tint and sheen over non-uniform surfaces. Other paint-outs were also made over a glue sized surface to check on washability. Solidex is similar in uniformity to Paintercraft One Coat Flat #10 - Rex 630 and Flat-Tone - Rex 810, but it is not equivalent to the S-W flats in washability over glue size. We would not recommend a flat of this type for general usage. However, it would be satisfactory for the New York metropolitan area where calcicoater flats are acceptable materials.

	Solidex E 17 7 K 356	Paintercraft One Coat Flat #10 Rex 630	Flat-Tone White Rex 810
Reduction	12-1/2% with (348)	12-1/2% with (348)	None
Brushing	Good	Good	Good
Flow	Good	Good	Good
Drying properties	Good	Good	Good
Uniformity			
(a) Tint	Very good	Very good	Good
(b) Sheen	O.K.	O.K.	O.K.
Washability (over glue size)	Very poor; break in film at 65 rubs.	O.K. at 200 rubs; no break.	O.K. at 200 rubs; no break.

Work was continued on the reformulation of Flat-Tone White to conserve titanium calcium. Work to date indicates that 100 pounds of titanium calcium can be replaced by pure TiO_2 (1403 dry) and inert. An effort has also been made to use a small amount of aluminum naphthenate for body characteristics but it was found that this material has poor compatibility with (3880)E. Work will be continued.

#162 - Cont.

Semi-Lustre

The Vehicle Research Department had submitted a solvent processed P.E.-Rosin-CWO-Dehydrol 25 gallon length varnish, CVR 981-7 for evaluation in Semi-Lustre tints. CVR 981-7 at 60% solids has a body of V-W, acid value of 6.3, and color 9-10. Semi-Lustre made with this varnish was high in body and showed considerable reactivity after 5 days. Work will be continued.

Batch	Vehicle	Viscosities, #3 Orifice Fresh	5 Days
OJ 590 L	33 gal. CVR 981-7 9 " (48), 50/30/20 type	36 sec.	65 sec.
OJ 590 LL	33 gal. CVR 981-7 9 " (48) Linseed	33 "	51 "

Enamels

The Resin Research Department submitted RB 6047, a long oil alkyd containing approximately 70% soya styrene on the non-volatile, for use in trade sales formulations. At 50% solids, RB 6047 has Y viscosity, an acid value on the base of 15, a final cure of 12, and a color of 7 +.

Enamels were made based on a blue-green pigmentation used by Dow Chemical, but with slightly more hiding pigment. It was found that it was necessary to use part (4106) in conjunction with RB 6047 to obtain a satisfactory body in the enamel. The above vehicle combination appears to be very good from the standpoint of water and soap resistance, as indicated by the data below. The enamels will be exposed at Chicago and Florida for durability characteristics this spring.

Batch	Varnish Under Test	Drying Time Set-to-touch	Drying Time O'Nite	Viscosity Fresh	Viscosity 10 Days	Water Spot Test for 24 Hrs. (Whitening)	1% Soap Solution for 3 Hrs. (Whitening)
516 LL	(3952)A	1 hr, 30 min.	Very good	24.8"	35"	Very slight	Trace
517 LL	(4106)	6 hr. -	Good	23.2"	24,8"	V. V. slight	V. slight
518 LL	(4106) RB 6047	1 hr. 31 min.	Very good	22"	28.8"	V. V. slight	V. slight

The enamel 518 LL based on RB 6047 and (4106) appears to be satisfactory for brushing, flow, drying and gloss characteristics.

Special. Spectrophotometry

On January 19, 20 and 21 R. R. Bruhn attended the Spectrophotometer Service Course offered by the General Electric Company, at Schenectady, New York. It was of interest that the persons attending the course represented a wide cross section of the chemical field with an especially heavy representation from the textile field. 90% of those attending represented firms already using the Recording Spectrophotometer, and the course gave emphasis to maintenance and trouble shooting on the instrument itself rather than the wide field of application for which the instrument is suited. Applications were touched on in the lecture by Dr. S. Q. Duntley, of Massachusetts Institute of Technology and in the lecture by Dr. E. I. Sterns, of Calco, and also in conversations with various operators.

Among the applications which might be of interest to The Sherwin Williams Company are the following:

1. Tristimulus specifications for paint colors as determined by the spectrophotometer for Federal, Army and Navy contracts. Most federal testing laboratories are now equipped.

2. Colorimetric analysis of in-process materials for various chemical processes. The instrument is being used widely for this purpose by Calco, Harshaw, General Aniline, Eastman, Harmon Color, du Pont, and others.

3. Color matching is now being done extensively in the textile field by means of the spectrophotometer.

4. The spectrophotometer has supplanted retained samples for color standards on paper products.

5. Mr. C. E. Reynolds, of the National Lead Company, reports that the spectrophotometer is very useful as a control instrument for white pigment production, both titanium and lead pigments.

6. Mr. Max Saltzman, of Harmon Color Works, remarked that the machine was not satisfactory as a control on finished colors, but that it was extremely useful as an in-process analytical tool.

7. Andrew Jergens Company use the spectrophotometer to control colors of their cream and emulsion type cosmetic preparations.

More complete details of the course will be available in a special report which is in preparation.

#187 - Physical Properties of Pigments

Continuing the study of the differences in degree of dispersion and CPVC for pigments in vehicles consisting of increasing amounts of volatile as described in the January report, the systems basic sulfate white lead - 9 dry/(2)/(63), leaded zinc - 412 dry/(2)/(63), basic carbonate white lead - 18 dry/(2)/(63), graphite - 1709 dry/(2)/(63) and magnesium silicate - 20 F/(2)/(63) were studied at concentrations of 5% and 10% pigment in total volume as well as the systems 9/(2)/(63) and 18/(2)/(63) at 20% pigment in total volume. The results obtained correlate closely with those of last month's report. All the pigment/vehicle combinations showed low CPVC for low concentrations of the oil (high PVC), rising rapidly in the low to medium range and remaining essentially constant for concentrations of oil in thinner from about 10% to 30% upward, depending on the pigment.

The PVC's of the 5%, 10% and 20% suspensions vary from low values where 100% of the oil is employed, to 100%, where only thinner is used. Values for this complete range are easily obtainable with the CPVC cell. The PVC's corresponding to the 5%, 10% and 20% pigment in total volume as related to the ratio of (2) to (63) are tabulated below.

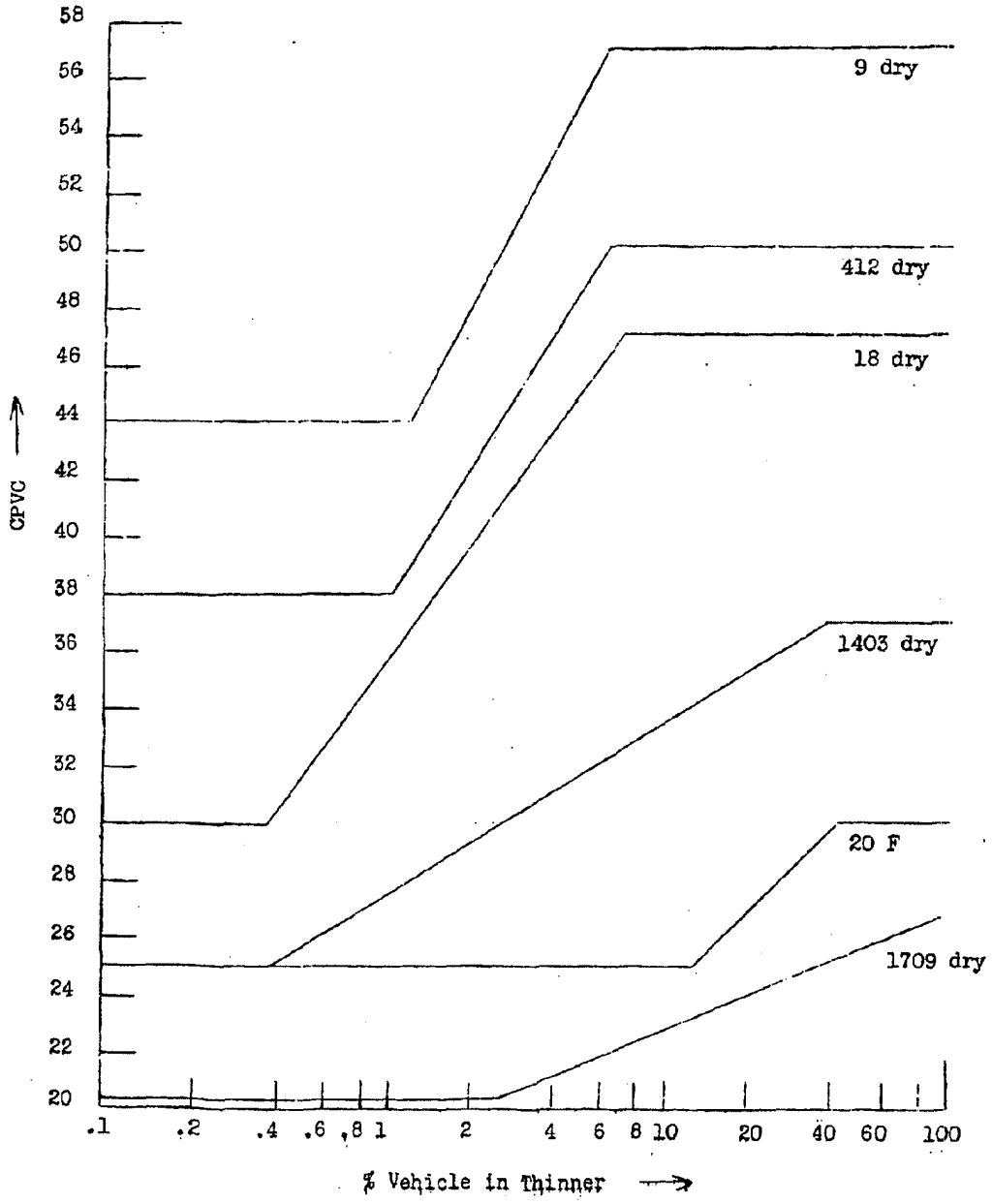
% (2) in (63)	P.V.C. 5% Pigment	10% Pigment	20% Pigment
0	100	100	100
1	84.0	91.7	96.0
2	72.5	85.0	92.6
5	51.5	69.0	83.4
10	34.5	52.6	71.4
20	20.8	35.7	55.5
40	11.6	21.8	38.4
75	6.6	12.9	25.0
100	5.0	10.0	20.0

The typical results obtained for the series of pigments against the various combinations of oil and thinner are tabulated for the system 18/(2)/(63) at pigment concentrations in total volume of 5%, 10% and 20% corresponding to the PVC's as listed above.

% (2) in (63)	P.V.C. 5% Pigment	10% Pigment	20% Pigment
0	29	28	-
1	34	36	35
2	42	40	43
5	45	42	47
10	45	45	47
20	50	48	47
40	45	48	46
75	50	50	48
100	50	50	50

#187 - Cont.

The rapid rise of CPVC at low concentrations of oil (high PVC) is apparent from the data. From the results so far obtained it is difficult to determine whether the PVC or the ratio oil/thinner or a combination of both are the chief factors involved in the determination of the CPVC. A graphical representation of the data is shown below for the various pigments in the system (2)/(63).



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#187 - Cont.

In an attempt to explain the reason for this behavior of the pigment/vehicle combinations, a series of determinations of the interfacial tensions of the vehicles against water were made. Although a rough parallelism between these interfacial tensions and the specific packing volume (reciprocal of CPVC) was found, other factors than simple wettability seem to be involved. Further work in this direction is planned and will be reported when more data is available.

In a circular obtained recommending "Metronite" for certain purposes the following claims were made for this material:

> "Metro-Nite (or Micron Grade Metro-Nite) is an excellent extender to use in Exterior Trim Paints to minimize the blistering and peeling tendency of these deep colors. It also is one of the most economical inerts to use and may be used in relatively large proportions without detracting from durability as some inert pigments do.
>
> "The paint industry has practically discarded the use of linseed oil, long oil varnish or mixtures of the two in house paint trim colors because of the poor dry obtained with these deep colors. The long oil alkyds have taken their places and with these liquids good dry and excellent durability is obtained. These liquids, however, do produce hard drying, tight, water impermeable films which may blister and peel if moisture conditions in the walls are bad.
>
> "By using Metro-Nite together with a small percentage of diatomaceous silica, it is possible to obtain films which can 'breathe'; that is, films which allow the water vapor to pass out without disrupting the film.
>
> "Metro-Nite's low oil absorption makes possible the inclusion in the paint of a sufficient quantity to obtain these desirable properties without adversely affecting the body, brushability and gloss."

The accompanying formula describes a trim paint of about 19% PVC. This seemed very low to produce the "breathing" film which would be necessary to prevent blistering, especially since it seemed improbable that the CPVC would be as low as this value from the general formulation of the paint. Consequently, a batch of this material was made up and the CPVC determined by means of the CPVC cell. It was found to be 61%. From this value and the PVC (19%) it was predicted that the paint film would be relatively impermeable and consequently subject to blistering. A paint film with 42% excess oil is not of the "breathing," permeable type.

Subsequent determinations of the permeability of cast films of this paint both by the static-electrolytic method as well as the moisture-permeability method showed it to be, as predicted, impermeable to a high degree.

#86 - Leaded Zinc Pigments

Because of the plans to substitute combinations of 414 and 511 leaded zincs for 412 dry in current house paint production, test batches of SWP Gloss White were made using available samples as representative of the new practices as possible. The 414 dry used was Lot 3207, the 511 dry was Lot 2555. A blend of extenders 2201 - 2203 was substituted for the 20 F extender to emphasize the texture characteristics of the leaded zincs.

The results of the tests may be tabulated as follows:

	RB 2264	RB 2265
Leaded Zinc Used	412 dry	414/511 dries
Texture	O.K.	O.K.
Grind Time	6' 10"	6' 2"
Fineness	3 H	3 H
Gloss	Good	Good
Color	Standard	Very slightly gray
Viscosities #3 orifice		
Fresh	27"	33"
1 day	29"	40"
20 days	27"	34.5"
Wt./Gal.	14.80#	14.84#

The color and viscosity characteristics of the 414/511 combination occasion some concern.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

A proposed revision, OJ 649 L, for Flat-Tone White was sent to Cleveland for distribution. This formulation is identical in pigmentation to H 8900, which was suggested for the Color Mix line. The vehicle combination of OJ 649 L, however, was revised slightly to improve the flow and brushing properties.

In connection with this work, a survey was also made of the comparative hiding and raw material costs of the various institutional flats.

Flat Wall Paint Hiding and Cost Comparisons

Formulation	Opacity Pigment 2132	2228	461	1403	Holley Units	Raw Material Costs Pigment	Vehicle	Total
Rex 810 Flat-Tone White Formula 3-12-47	495				18,315	$39.58	$65.24	$104.82
Rex 810 - Similar to H 8900; as 649 L	490	80			24,210	53.86	66.88	120.74
Rex 622 - Mellotone White	539				19,943	42.25	59.21	**101.46
Rex 622 - Mellotone White Alternate #1	295		196	74	19,212	51.16	58.32	**109.48
Rex 675 Neu-Tone Flat			700	100	19,610	62.80	65.63	128.43
Rex 675 Neu-Tone Flat			700	100	19,610	64.20	66.21	130.41
Rex 2652 Nu-Hue Flat (Alternate formula)	650				24,050	49.23	65.39	*114.62
Rex 2652 Nu-Hue Flat (Alternate formula)	650				24,050	50.83	65.86	116.69
	1271 dry							
Rex 2652 Nu-Hue Flat (Regular formula)	560			90	21,170	58.42	65.75	*124.17
	1271 dry							
Rex 2652 Nu-Hue Flat (Regular formula)	560			90	21,170	59.97	66.24	126.21
	2132 dry		2173 dry					
Rex 630 Paintercraft One Coat Flat Wall Paint #10	550			100	27,950	62.91	73.29	136.20

*Martin-Senour Company raw material costs.

**Lowe Brothers raw material costs.

#162 - Cont.

For several months the Chicago paint plant has been unable to manufacture Paintercraft Flat Wall Paint #7, Rex 26607, that could be considered satisfactory for the painter trade based on formula card #13. As a result an effort has been made by Cleveland and this department to check on the manufacturing procedure and raw materials used in the production of this rex. Arrangements have been made with the Chicago factory to manufacture eight batches of Rex 26607 as indicated below.

Batch	Date	Formulation	(3880)E	Mill Used	Size
1	C 568	625 L (Proposed)	A. V. 3-6	Roller mill	300 gallons
2	C 588 A	Regular 6-13-47	" "	" "	300 "
3	C 548	625 L (Proposed)	" "	Pebble mill	700 "
4	C 548 A	Regular 6-13-47	" "	" "	700 "
5	C 618	625 L (Proposed)	" 2-3	Roller mill	300 "
6	?	Regular 6-13-47	" "	" "	300 "
7	C 568 A	625 L (Proposed)	" "	Pebble mill	700 "
8	C 588	Regular 6-13-47	" "	" "	700 "

The above batches are to be checked for general performance and all future production will be made on the most suitable formula and on the type of mill that produces the most desirable flat.

Semi-Lustre

The Resin Research Department has submitted three P.E.-Rosin-CWO-Dehydrol 25 gallon varnishes made by the solvent process for evaluation in Semi-Lustre tints. An effort was made to make the three varnishes identical in body, acid value, solids, etc. due to inconsistencies in viscosity reading on Semi-Lustre made with previously submitted samples of this varnish.

	Body	A. V.	Color
RB 8522-1	S-	9.2	9-10
RB 8522-2	T	6.8	9-10
RB 8522-3	T-	8.5	9-10

#162 - Cont.

The three batches of Semi-Lustre Cream (formula 8-12-47, Alternate A) made with these varnishes varied somewhat in viscosity but were all considered satisfactory in sheen and brushing characteristics.

Batch		Viscosity #3 Fresh	Viscosity #3 O'Nite	Brushing	Flow	Sheen (Photovolt Reading)
657 L	CV 7038	32"	49.4"	Good	Good	60
658 L	RB 8522-1	22"	39.2"	"	"	51
659 L	RB 8522-2	24"	31"	"	"	48
660 L	RB 8522-3	27"	37"	"	"	49

Enamels

The Resin Research Department has submitted three of Cook Paint and Varnish Company's styrene alkyds for enamel formulation.

	Solids	Body	Color	A. V.
RC3473N6 (45% Styrene - 55% Castor)	50%	R-S	6-7	4.8
B3424N6 (50% " - 50% (CWO-1 Soya-4)	90%	$>Z_6$	10-11	3.5
RC3372 (45% " - 55% Castor)	100%	>30"	6-7	<1

Two enamel formulations were developed, based on a pigmentation of 290 pounds 2030 T dry with a vehicle composed of RC3473N6 and B3424N6 or RC3372. These enamels compared favorably with Enameloid made from (2848)E or (3109) and (4100) with respect to drying, flow, brushing, gloss, etc. The enamels will be exposed at Chicago and Florida and draw-down films will also be checked for embrittlement and after-yellowing characteristics.

#162 - Cont.

Data on Styrene-Alkyd Enamels

Batch	Vehicle Used	T. Wt.	A. Wt.	Viscosity #3 Orifice Fresh	24 Hrs.	6 Days	Drying Properties Set-to-touch	O'Nite
664 L	RC3372 RC3473N6	9.53	9.58	26.8"	31.6"	33.6"	1 hr. 8 min.	Very good
669 L	B3424N6 RC3473N6	9.53	9.58	33.2"	-	45"	1 hr. 5 min.	"
665 L	(2848)E	9.53	9.55	65"	78"	84"	1 hr. 42 min.	"
666 L	(3109) (4100)	9.47	9.58	58.2"	74"	74"	1 hr. 6 min.	"

Batch	Vehicle Used	Brushing	Flow	24 Hr. Tack	Gloss	Color	Whitening 1% Soap 3 Hours	Whitening Water 24 Hrs.
664 L	RC3372 RC3473N6	Good	Good	VVS	Very good	Whiter than 665 L	Very slight	Slight
669 L	B3424N6 RC3473N6	Similar to Enameloid	"	"	"	"	Trace	"
665 L	(2848)E	Sticky	"	"	"	Very slightly yellow	"	VVS
666 L	(3109) (4100)	"	"	"	"	"	Very slight	Slight

#187 - Physical Properties of Pigments

The results obtained in a continuation of the studies of the differences in degree of dispersion and CPVC for pigments in vehicles consisting of increasing quantities of volatile constituents, showed a close correlation for the binder system bodied linseed (48)/naphtha (63) to the results obtained for raw linseed (2)/(63). As would be expected, the final CPVC for the (48)/(63) system is higher than that for the (2)/(63) system, but the same characteristic break in the CPVC/% Oil in Thinner curve is obtained as described in the February report. In this case, too, the use of different pigment concentrations, namely 5%, 10% and 20% by volume of pigment in the total system (including thinner), showed no major average differences in the CPVC for any particular vehicle to thinner ratio.

To test the effect of increasing the grinding period, the CPVC of the 10% pigment concentration 1403 TiO_2/(2)/(63) system was determined after 1 hour, 4 hours, and 18 hours of grinding in ball mills consisting of 1/2 pint cans loaded with steel balls. The whole series showed low CPVC for the one hour grind period. The values for four hours and 18 hours were higher and substantially the same, varying only within the average error of the method. Additional grind beyond the 18 hour period would subsequently leave the CPVC of a given combination of pigments and binders unaltered.

This is in direct correlation with previous experiments carried out on dispersion rate for various vehicles. Here it was found that at 4 hours of grind in the mills in question, about 85% of the ultimate grind would be obtained and that after 8 hours grind, the curve becomes substantially flat. As all the samples in this series of experiments were run over night (16 hours), it can safely be assumed that the ultimate dispersion for the pigment/binder combination was achieved in each case.

A number of commercial paint samples were tested for correlation between CPVC and other properties.

Special

A review of ultrasonic methods and technique was presented at the March 10 Research meeting at Chicago. A modification of an ultrasonic super-siren described by Penn State University was designed and a cost estimate submitted.

#177 - Pigment Studies

This department has been interested for a long time in the properties which lead titanate contributes to a paint film. The cancelation of this item by the Titanium Pigment Corporation dealt a rather serious blow to the One Coat House Paint test program and the development of light colored vinyl pigmented paints. The cessation of manufacture made it even more imperative that we establish the structure of lead titanate, so that we could see whether there was any possibility that we might substitute other materials for it.

R. E. Kottemann, Jr., of the Auxiliaries Research Laboratory, reports his X-ray diffraction analysis of Titanox L (lead titanate) as follows:

"In the case of Titanox L, no published x-ray data was available on lead titanate, and it was necessary to establish its presence by showing that its pattern was not one of a mixture of PbO and TiO_2. This was accomplished by comparing, both directly and by measurement, the pattern of Titanox L to those of anatase and rutile for TiO_2 and red and yellow litharge for PbO. In doing this, no evidence was found of the presence of any of these materials in the pattern of Titanox L, showing that $PbTiO_3$ possesses a characteristic diffraction pattern and therefore a unique crystal structure.

"It is entirely possible that the Titanox L contains either one or both of the materials PbO and TiO_2 in uncombined form, but if so, they are present in small amounts.

"Since Titanox L supposedly contains about 7% $PbSO_4$, an attempt was made to detect this by comparison to a pattern of $PbSO_4$, one bright line of which was found in the pattern of Titanox L. Ordinarily, one line is not sufficient to identify a compound, but in all probability this is a line of lead sulfate. This could be verified only if a pattern of pure $PbTiO_3$ were available."

A second material which was evaluated by X-ray analysis was National Lead Company's Tribase which many like to describe loosely as a "white litharge." The Auxiliary Research Department reports as follows on this material:

"Comparison of the Tri-Base pattern to patterns of $PbSO_4$, both forms of PbO_2 and a mechanical mixture equivalent to $3PbO.PbSO_4$ using yellow litharge showed no corresponding lines, indicating that if these materials are present as PbO and $PbSO_4$, the amount is small.

"The Tri-Base pattern was also compared to a pattern of $3PbO.PbSO_4$ found in the A.S.T.M. file of x-ray diffraction patterns. These patterns were quite similar and although some discrepancies were found in line intensities, it is reasonable to assume that Tri-Base is predominantly $3PbO.PbSO_4$ which exists as a compound."

#177 - Cont.

In the January Report of Investigations, page 23, it was reported that paints had been prepared for the evaluation of 414 leaded zinc used in conjunction with National's basic silicate white lead. Panels 12510-44 CS, CN, Cof. and F were prepared to expose these paints south and north vertical at Chicago, and south vertical at Coffeyville and Miami. The basic plan for the series and the paints used are as follows:

Substitutions of 414 dry with basic silicate white lead are made by the following methods:

A. ZnO replacement by equal poundage.
Lead replacements by equal volume.

B. Maintain a 35/65 Pb pigment/ZnO ratio - replacement is based on total volume.

C. Maintain 35/65 Pb pigment/ZnO ratio replacements based on total pounds. (Adjust volume with extender.)

Paints listed below follow this pattern.

White Paint Variations

No.	Description
RB 2177	Base formula Rex 471, card 47.
2178	412 dry replaced using Method A.
2179	412 dry replaced using Method B.
2180	412 dry replaced - Method C.
2181	412 and 18 dry replaced - Method A.
2182	412 and 18 dry replaced - Method B.
2183	412 and 18 dry replaced - Method C.
2184	Rex 471 modification - 25% ZnO.
2185	412 + 18 dry replaced in RB 2184, Method A.
2186	Rex 471 modification - 20% ZnO.
2187	412 + 18 dry replaced in RB 2186, Method A.
2188	As RB 2181 using Azo 33 plus Basic Silicate White Lead.
2189	As RB 2185 using Azo 33 plus Basic Silicate White Lead.
2190	As RB 2187 using Azo 33 plus Basic Silicate White Lead.
2191	Rex 465 base formula card #4.
2192	412 + 18 dry replaced. Method A.
2193	412 + 18 dry replaced (25% ZnO variation). Method A.
2194	412 + 18 dry replaced (20% ZnO variation). Method A.
2195	412 dry replaced Azo 33 plus 9 dry.
2196	412 plus 18 dry replaced - Azo 33 plus Basic Silicate White Lead. Method A.

Rex 450 Undercoater is used as the undercoater for all exposures except for one variation following Method A substituting 414 plus basic silicate for the leaded zinc plus BCWL normally contained. Rex 450 carries 45% BCWL and 10% ZnO.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

Work continued on the reformulation of Flat-Tone White to reduce cost. An effort was made to use Lowe Brothers' Mellotone vehicle LV-3600 but it was slightly more expensive on an equal solids basis and not equal in washability to the (3880)E and (2396) combination. An effort was also made to reduce the vehicle solids in the present Flat-Tone formula. The body was adjusted by the introduction of additional inert and thinner. The resulting flat was not satisfactory for flow or washability. Work will continue on the reformulation of Flat-Tone to use soybean and tall oils as partial substitutions for Dehydrol. The Resin Research Department was asked to prepare two (3880)E type varnishes based on these oils.

At Dr. Van Stone's request, a special Flat-Tone formulation was developed based on the use of 5% D.D.T. along the lines of earlier and current tests. The proposed formulation was satisfactory for brushing, flow, drying and uniformity of tint and sheen. The D.D.T. content appears to improve the washability over glue size.

An effort was also made to use an overstock on Pestroy 6% in Flat-Tone, but this material produced sticky brushing and an undesirable odor during the drying period.

According to an article by S. C. Stokes (Paint Mfr. 17, 261, 1947) reference is made to the depolymerization of rubber by the addition of 2-1/2% cobalt linoleate (6% solution) and milling the rubber and cobalt linoleate until the two materials are incorporated. The rubber mix is then transferred to a solution tank and dissolved in an equal amount of mineral spirits until a homogeneous mass is obtained. The solution will mix readily with all natural oils but is not compatible with resins or varnishes containing them. The rubber solution was used to the extent of 9% based on the vehicle solids in conjunction with (2302) in a flat wall paint formulation. The flat was sticky in brushing and no improvement in washability was evident due to the depolymerized rubber.

Semi-Lustre - Enameloid

The Resin Research Department submitted three solvent processed P.E.-Rosin-Dehydrol-C.W.O. 25 gallon varnishes for evaluation in Enameloid tints.

	Body	NVM
RB 8522-A	I	55%
" B	H-I	"
" C	I -	"

#162 - Cont.

The three duplicate varnishes were made and tested due to the inconsistencies in viscosities obtained in the initial evaluation of similar varnishes made by this process. The solvent processed varnishes appear to be quite satisfactory for Enameloid and Semi-Lustre tints compared with (2848)E or CV 7038. However, we would not recommend these varnishes for whites based on the after-yellowing tendency of the chinawood oil present.

The experimental data covering the various tests is reported below for the Enameloid Ivory batches.

Batch	Varnish Under Test	Brushing	Flow	Gloss	Drying Set-to-touch	Drying O'Nite	Viscosity - #3 Fresh	Viscosity - #3 O'Nite	Viscosity - #3 4 Days
715 L	(2848)E	G	G	G	1 hr. 20 min.	G	33"	36.6"	43"
716 L	RB 8522-A	G	G	G	1 " 25 "	VG	34.4"	35.3"	44.2"
717 L	" B	VG	G	G	1 " 15 "	VG	33.4"	32"	39"
718 L	" C	VG	G	G	1 " 5 "	VG	33. 8"	33.5"	37.8"

Note: All four enamels above showed bad whitening with a 1% soap solution for a period of 3 hours and slight whitening was evident due to a water spot test for 24 hours.

Further work has been under way in the evaluation of three styrene alkyds, RC 3473N6, B3424N6 and RC 3372. See the February Report for additional data. Panels were prepared from enamels based on these liquids, and the various films were checked for resistance to oleic acid, lard oil, 95% alcohol, 5% acetic acid, 1% NaOH, 5% citric acid, 1% soap solution and water.

In general the styrene-alkyd enamels were fairly resistant to all agents except oleic acid and lard oil. It would appear that these varnishes should be satisfactory for second grade enamels where lard oil and greases are not an issue.

The various enamels will be exposed for exterior durability versus regular Enameloids based on (2848)E and (3109) and (4100).

Chart follows.

16 Hour Spot Tests on Enamels, Based on the Styrene-Alkyds - RC3473N6, B3424N6 and RC 3372 Using the Agents as Listed Below

	Varnish Tested	Oleic Acid and Lard Oil	95% Alcohol (330)	5% Acetic Acid	1% NaOH	5% Citric Acid	1% Soap Solution	Water
664 L	RC 3372 RC 3473 N 6	Very soft film - bad whitening.	Hard film	V. slightly soft - no whitening.	V.V. slightly soft - bad whitening.	Hard film, no whitening.	V. slight softening and whitening.	V. slight softening, slight whitening.
665 L	(2848)E	Sl. softening, def. whitening.	"	"	Def. softening, bad whitening.	"	"	Sl. softening, trace whitening.
666 L	(3109) and (4100)	Hard film, trace of whitening.	"	Sl. soft, no whitening.	Sl. softening, def. whitening.	"	"	Hard film
669 L	B 3424 N 6 RC 3473 N 6	Very soft film, bad whitening.	"	"	Hard film, sl. whitening.	"	"	Hard film, slight whitening.

		Solids	Body	Color	A. V.
RC 3473 N 6	(45% Styrene - 55% Castor)	50%	R-S	6-7	4.8
B 3424 N 6	(50% " - 50% (CWO-1 Soya-4)	90%	$>Z_6$	10-11	3.5
RC 3372	(45% " - 55% Castor)	100%	>30"	6-7	<.1

The four enamels were checked for abrasion resistance on the laboratory scrubbing machine. The time required for the enamel film to wear through is reported below:

Batch 664 L - 3 hrs. 15 min. Batch 666 L - 17 hrs.

Batch 665 L - 12 hrs. Batch 669 L - 12 hrs.

#162 - Cont.

Drier Absorption

A study was initiated of drier absorption of carbon blacks using the technique developed by Ferro Chemical Company. Their method involves the use of sufficient drier, in excess of that required for normal drying, to satisfy the adsorptive capacity of the carbon black as determined by the diphenyl-guanidine adsorption test. The pigment thus adsorbs this excess drier (lead naphthenate) but leaves the regular amount of drier available to bring about normal drying of the film.

By this method, the most effective drier combination for our alkyd type Rex 729 Enameloid Black should be as follows (compared with Card #22):

Driers	Gal./100 Gal.	Card #22
(2236)	5/8 gal.	1 gal.
(4230)	4-3/4 "	2 "
(4231)	9/16 "	1-1/8 "
(4232)	1-3/8 "	1-1/8 "
Dry to touch	1-1/2 hours	1-1/2 hours
Dry to handle	3-1/3 hours	4 hours

Tests on ball mill dispersions of freshly prepared Enameloid Black Rex 729 systems carrying the above drier combinations dried to touch in equal time intervals, but the special blend dried to handle 40 minutes ahead of the standard formulation.

These materials will be studied further after aging in the package.

#187 - Physical Properties of Pigments

During the course of the investigations on the CPVC of paint systems, the request has been made on a number of occasions for data on standard pigments from which the packing volume of combinations of these at various percentages could be calculated without making a CPVC determination.

There are a number of reasons why it is extremely difficult, if not practically impossible, to predict the packing behavior of systems of mixed pigments, even if the packing characteristics of the individual components are known. Aside from the possibility of a larger or smaller degree of agglomeration possible with the use of various vehicles in conjunction with the CPVC determinations on the pigments, the following factors should be considered:

Assume an idealized condition of a pigment of absolute spherical shape where all the particles possess the same diameter. Under these conditions, and if no agglomeration takes place, a number of packing systems are possible. The cubic, or "most open" packing is that in which the spheres are piled in such a way that each layer lies immediately above the other on a square base arrangement. The rhombohedral or "closest packing" represents a complicated type of stacking of the spheres where the greatest density of the packed system is achieved. The volume of voids of such systems can be calculated readily and is, for the cubical packing, 48% (CPVC = 52%) and for the rhombohedral system 18% (CPVC = 82%). Any value between these two can be achieved by haphazard packing. It is to be noted that these packing characteristics are independent of the absolute particle size, and require only that the particles all be of the same size and spherical shape. Three different systems consisting of spherical particles of, say 1μ, 10μ and 100μ diameter consequently would all have the same CPVC if monodisperse and stacked in the same packing system. If these were all packed in the cubic system, they would all contain 48% voids despite the differences in diameters of the particles in the individual systems.

Consider a system of uniform sized spheres as above packed in the cubic system, where the CPVC is 52%. Between each four of the particles there will be a space for another sphere of diameter d, equal to d $(\sqrt{3} - 1)$, where d is the diameter of the original spheres. The voids will consequently be:

$$V = d^3 - \frac{\pi d^3}{6} - \frac{\pi d^3 (\sqrt{3} - 1)^3}{6} = .27\, d^3$$

or 27% making the CPVC 73%. By introduction of a spherical particle .732 times the diameter of the basic component, the CPVC has been raised 21%, from 52% to 73%. Similarly, eight still smaller spheres can be introduced into the spaces left between the two component system as above, the diameters required in this case, d_2, being about .24 d. The CPVC now would be 79%. There will now be 24 spaces which can be filled with spheres of .08 d. Thereafter there will be 72 spaces, and so on.

#187 - Cont.

Had a rhombohedral packing been used in the first place, the increase of CPVC with the addition of the first smaller sphere would not have been as great as in the case of the cubic system. Further filling of the remaining spaces with still smaller spheres would have resulted in about the same effect as before. It is to be noted that the increase in CPVC with the addition of finer particles is not very marked unless they are small enough to fill the finest interstices. Also, had the original voids been filled with fine particles of one size, the increase in CPVC would not have been as great. It must be mentioned that no practical method of achieving any one of those individual packings has been devised.

From these considerations it is apparent that mixing systems of pigments of larger or smaller individual sizes or size distribution will markedly change the CPVC of the mixed system from the values obtained for the individual constituents. The CPVC will be higher than that of the component having the lowest CPVC. On the other hand, mixing two or more systems of the same particle shape and size distribution will result in a final CPVC the same as that of the original components. When the possibility of a greater or lesser degree of agglomeration of one or all of the components is considered, and that particles of different shape characteristics will have differing packing tendencies, the over-all difficulty of predicting CPVC of a mixture of pigments from a knowledge of the CPVC of the original constituents becomes quite apparent. It is much easier to determine the CPVC of a mixture of pigments in the particular vehicle in which the particles are to be dispersed under the desired conditions of grind by the relatively simple and rapid method of the CPVC cell.

When the CPVC's of a number of extender pigments are listed below, it is only with a full consideration of the above factors that these values can be used for a very approximate calculation of the CPVC for these pigments in combinations with each other or appropriate hiding pigments. The CPVC's were determined in a fairly highly dispersing vehicle, namely 4 parts (48) and 6 parts (2), with (63) used as thinner.

	Material	CPVC, in %
20 L	Magnesium Silicate	41
306	Barytes	63
566	Calcite	59
1817	Surfex	72
1989	Microne Talc	30
2188	Micro Velve A	36
2201	Metronite	61
2247	Atomite	52
20 F	Magnesium Silicate	49
45	Calcium Sulfate Hydrate	49
2209	Multifex MM	39

The CPVC of a number of commercial paints were determined as an aid to formulation.

#86 - Leaded Zinc Pigments

The Auxiliaries Department submitted for examination three blends of 414 dry with 511 dry which approximate the chemical composition of 412 dry, 35/65 leaded zinc oxide. These blends were prepared using 511 dry of standard color in conjunction with 414 dry samples which had been rated 70, 60, and 50, respectively. These were substituted in Rex 471 SWP Gloss White for the 450 pounds 412 dry currently being used.

In summary it was reported that all batches were normal as regards viscosity, gloss, grind, and color. The color differences, although perceptible, were very small so that it was generally agreed that it would not cause concern. From the standpoint of color, blends of 414-511 dry equal to or better than the sample submitted under the code No. AURL 931 are satisfactory for use in Rex 471. This sample was prepared with 414 of 50 color. Approval of sample AURL 931 does not constitute approval for all blends made with a 414 of 50 color. Composited color must also equal this standard.

A review of outstanding house paint exposure tests of 414 dry again showed that this pigment performs in a manner typical of a cofumed leaded zinc oxide. In these tests the 414 dry has been substituted on an equal zinc oxide basis, making up the difference in composition by adding either basic carbonate or sulfate white lead. The review included the following series:

1. Exposures 5539-46 C were examined after 5 years' vertical south at Chicago, Ponderosa pine beveled siding primed with Rex 450 Undercoater. Baghouse and Economizer oxides (early 414 types) were tested in Rex 471 SWP Gloss White of 7-11-41 and Rex 462 Cream of 8-7-41, the regulars being used as guides. The specials are made both with regular (5091) and with (3015) non-break linseed oil. The durability of all the whites was satisfactory: (3015) seems slightly inferior due to erosion, but with (5091) both test pigments are fully as good as the regular 412 dry. In Cream, both specials show noticeably more dirt but less fading than the regular.

2. Series 6126-35 C, Cof. (4-1/2 years at Chicago and also at Coffeyville) tested the use of Economizer (15% leaded) as (a) a replacement for 40% of the 412 dry, and (b) as 100% replacement in SWP White and Cream, on cedar beveled siding with Rex 450 Undercoater. One Rex 471 formula is high in TiO_2, low in basic carbonate white lead, another vice-versa, as we were interested in using a minimum of white lead at the time. With fairly uniform exposure results at both locations, slight inferiority due to the special pigments is shown, but since the higher quantities of Economizer (and lowered BCWL) are not particularly poorer than the others there is little to say against the use of the special pigment. However, this slight inferiority carries over into the tints, especially at Chicago.

#86 - Cont.

3. Series 6192-9 C, Cof. (4-1/2 years Chicago, 6 years Coffeyville) tests, in SWP Gloss White, only 25% 414 in the relatively high TiO_2 formula of 10-27-41, plus a reduction of oil content in the vehicle. Neither location shows any appreciable difference due to the 414 or vehicle change. In the Cream shade, 50% and 100% 414 are tested, with both regular and lower oil (increased p.v.c.) With quite advanced failure at both locations, the 100% 414 sample seems slightly best, but the 50/50 sample is not quite as good as the regular (1526 dry).

4. 414 dry is tested in series 6186-91 C, Cof., the purpose being to use the new pigment in a lead-zinc paint. Before general formulation details were finally worked out, "standard" 414 W was developed and this series represents its earliest test on our exposure fences. These tests were exposed on beveled cedar siding, with Rex 450 Undercoater, 4-1/2 years at Chicago and 6 years at Coffeyville, vertical south. Because of the current lack of interest in lead-zinc paint and the fact that the set-up is not suitable for testing 414 W as such, only a brief statement of results is presented. A 45/40/15% BCWL/414/magnesium silicate special and another with slightly higher ZnO (due to 414 W) and 7% mica gave mediocre results as compared to regulars. With still higher 414 W, 4-1/2% of mica and about 4% of TiO_2, there was a considerable improvement. Poor clean-up was a more important shortcoming than general failure.

#162 - Studies in Flat Wall Paint Formulation

Flat-Tone

Considerable time has been devoted to the reformulation of Flat-Tone White and tints. The proposed formulations will be made with a vehicle combination of (3880)E and LV 3600 (Mellotone limed oil liquid). Six new colors are to be added that will be similar in shade to the present Kem-Tone colors such as Cameo Rose, Cascade Green, Willowick Blue, Avalon Blue, Midland Green and Pale Jonquil.

The new formulations have been sent to Cleveland for distribution. 300 gallon batches on each color are being made at the Chicago plant and standard samples will be distributed to all plants within the near future.

The proposed formulas compare as follows for raw material cost:

			Pigment	Vehicle	Total Cost
OJ 876 L	Flat-Tone White		$46.44	$55.49	$101.93
OJ 882 L	"	Cottage Ivory	48.92	56.45	105.37
OJ 885 L	"	Hollywood Cream	44.37	56.65	101.02
OJ 881 L	"	Sunglow Yellow	53.10	56.29	109.39
OJ 887 L	"	Petal Rose	44.04	56.43	100.49
OJ 889 L	"	Shadow Blue	40.45	56.65	97.10
OJ 888 L	"	Seafoam Green	43.74	56.59	100.33
OJ 890 L	"	Spring Green	40.35	56.65	97.00
OJ 891 L	"	Dawn Blue	45.14	56.57	101.71

The average cost on the above formulas is $101.59 per 100 gallons.

Work is being continued by the Varnish Department to increase the acid value of (3880)E by the introduction of 2 to 4% rosin and the addition of linseed fatty acids. Samples of the special (3880)E varnishes are to be checked for general performance against Cleveland and Newark production and a batch of standard (3880)E made with Dehydrol. It appears that 2229 and 2273 titanium oxides compare quite favorably with 2228 dry and could be used as an alternate TiO_2 for 2228 dry in Flat-Tone White and tints.

#162 - Cont.

Enameloid

A factory batch of CV 4553, Lot #1 (Pentalyn A 50/50 CWO/Dehydrol 25 gallon varnish) was compared with (2848)E in Enameloid Ivory. CV 4553 is similar to CVR 981, except that it was made in the open kettle without solvent. The two enamels are about equal in brushing, flow and gloss, but the enamel made from CV 4553 is somewhat slower in drying.

				Drying		Viscosity	
Batch	Varnish	Brushing	Flow	Set-to-touch	O'Nite	Fresh	O'Nite
OJ 821 L	CV 4553	OK	Good	1 hr. 20 min.	Slightly soft	33.6"	36.8"
OJ 820 L	(2848)E	OK	Good	55 min.	OK	35"	37.2"

A test of the drying rates of the Rex 729 Enameloid Black drier absorption study samples described in last month's report showed no appreciable change in the dry-to-touch time and a substantial increase in dry to handle time after 7 weeks' aging in package. The material prepared by the Ferro Chemical Corporation method shows the least loss of effective drier.

	Drier Combination	
	Special Blend	Card #22
Dry to touch - fresh:	90 minutes	90 minutes
7 weeks:	80 "	80 "
Dry to handle - fresh:	3-1/3 hours	4 hours
7 weeks:	5 hours	6-1/4 hours
Loss of drier potential	50%	56%

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#187 - Physical Properties of Pigments

Preliminary experiments were carried out to determine the roles played by the "passive" and "active" constituents of vehicle systems in paint dispersions. The "passive" portion of a vehicle is the chemically and physically inert portion in relation to pigment surface activity and is generally considered to consist of molecules of low polarity. The "active" portions of a vehicle are the chemically and physically strongly reactive constituents having strong free fields of force, a high degree of polarity and large dipole moments. Molecules with such end groups as -COOH, -OH, $-NO_2$, $-NH_2$, etc. have been found to be endowed with exceptionally strong fields of force. The experiments are designed to show that it is these portions of the vehicle which are strongly preferentially adsorbed to the surfaces of the pigments. They are responsible for such characteristic behavior of paints as dispersion and agglomeration with all accompanying phenomena, such as differences in CPVC, thixotropy, flooding, etc.

One of the most active and strongly polar constituents of raw and bodied linseed oils is the free fatty acids portion. These acids can be easily determined quantitatively by titration with NaOH as in an acid number determination. If the above conclusions concerning polarity and preferential adsorption are correct, the acid constituents of the linseed oils should be more strongly adsorbed than the other more non-polar portions.

To determine this, a 5% solution of (48) was made up in (63). The acid number of this solution was then determined. 200 cc of the original solution were "ground" in a glass jar and steel balls with 50 g. 1403 TiO_2 for about two hours. The pigment was removed from the liquid by centrifugation, and the acid number of the supernatant liquid determined. From the differences in acid number, the quantity of the free fatty acids adsorbed to the surface can then be calculated readily. The pigment chosen for this determination, 1403, can be considered chemically unreactive with the free organic acids.

The results obtained indicate that about 80% of the free fatty acids present in the original solution are preferentially adsorbed to the surface of the pigment. Assuming an average molecular weight of 280, this would indicate that about 25% of all the adsorbed molecules are linseed fatty acids, while in the original solution the concentration of the acid is only about 1% of total oil. Despite this low solution pressure, the major portion of all the acid constituents present have been adsorbed. The determination of more complete adsorption isotherms, on which work is now in progress, will probably indicate the minimum amount of vehicle required to completely cover various pigments with "active" constituents from various oils.

#187 - Cont.

Work of a preliminary nature has been done on the determination of electrophoretic mobility of various pigment suspensions. A cell is under construction in which the zeta potential of pigment/vehicle systems can be measured directly. It is expected that measurements of this nature will throw considerable light on such subjects as the mechanics of paint system dispersions and agglomerations.

Studies are under way to determine the effect of particle size on the degree of dispersion. The data has not been completed at this time and will be reported when available.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

Work continued on the reformulation of Flat-Tone and Paintercraft One Coat Flat #10. (3880)E as manufactured at Cleveland, Newark and Chicago was checked for general performance. The laboratory batches of Flat-Tone made from Cleveland (3880)E were better in brushing qualities than those made from Newark or Chicago (3880)E. The Newark varnish made paint low in washability. As reported previously, Chicago production made with some rosin and fatty acids caused sticky brushing. Plant production of (3880)E made on the standard formula was quite similar to Cleveland (3880)E in performance in paint.

(2287), a limed linseed-soya-chinawood oil based on Lowe Brothers' LV-3600 was compared with two specials: CTV 5055, a limed linseed-chinawood oil and CTV 5056 limed linseed. The special oils produced paints very similar to that from regular (2287) in brushing, flow, drying, etc. The tests are not complete but so far it appears that the two special oils may be used to replace regular (2287).

Three tall oil liquids were submitted by Resin Research for evaluation in Flat-Tone. They were as follows:

RB 8463 - Sorbitol - P.E. Tall Oil Varnish
Body - Very, very heavy
A. V. - 9.7
Color - 18 +

RB 8464 - Tall Oil - P.E. Ester
Body - Very heavy
A. V. - 9.3
Color - 18 +

RB 8465 - Glycerol - Tall Oil
Body - 45 minutes
A. V. - 9.5
Color - 18 +

The tall oil varnishes were introduced for the solids of (3880)E and (2287) in Flat-Tone White and the paints checked for brushing, flow, drying, etc. As indicated by the data below, these liquids have a tendency to wash out and produce very thin bodied flats. Considering the heavy body of the tall oil varnishes, it does not appear practical to try to body varnishes of this type any higher.

#162 - Cont.

Flat Wall Paints - Cont.

Batch	Vehicle	Viscosity - #3 Fresh	Viscosity - #3 O'Nite	Brushing	Flow	Drying O'Nite	Washability over Glue Size
OJ 955 L	(3880)E (2287)	6.6"	8.4"	OK	OK	OK	Good - 200 rubs.
OJ 951 L	RB 8463	2.6"	3"	Poor - too thin.	OK	Soft	"
OJ 952 L	RB 8464	3"	2.6"	"	OK	OK	"
OJ 953 L	RB 8465	2.4"	3"	"	OK	Soft	"

In Paintercraft Flat #10 an effort was made to replace Linogel (2396) with (2287) and/or (2302). Further work must be done on this phase.

Three samples of Snow White Filler were submitted by the Auxiliaries Research Laboratory for testing in Flat-Tone. They were: (1) Snow White Filler AURL 816, (2) Snow White Filler AURL 816 wet milled, and (3) Snow White Filler, Raymond mill grind. They were introduced for the calcium sulfate content of 2132 dry (rutile titanium calcium) and the TiO_2 replaced by 2269 dry - Titanox RA-10 MO. The paints were all considerably lower in sheen than the regular made with 2132 dry. The flat made with Sample (1) was rather scratchy under the brush. In other respects the Snow White Fillers were quite satisfactory for brushing, flow, drying and uniformity of tint. The mechanical mixtures of TiO_2 and extenders gave paints with somewhat lower hiding than the regular made with an equivalent poundage of 2132 dry.

Further work is being done on a calcicoater type flat, using a pigmentation similar to that in Flat-Tone White and a vehicle based on RB 8497, limed Calsom oil.

Enamels

Work was started on the formulation of a painter enamel. Resin Research prepared the following varnishes for this evaluation:

(Cont.)

#162 - Cont. (Enamels)

	Body	Acid Value	Color	Resin	Oil	N. V.
RB 8562	Z	8.1	8-9	2172 Pentalyn G	(2325)	70%
RB 8563	Z	8.0	8-9	2280 Pentalyn A	"	70%
RB 9098	Z_1	12.4	9-10	Petrex Alkyd		70%
RB 9099	Y	8.7	12	Inter ester	1/2 (1273) 1/2 (3017)	70%
RB 9103	Z	15	-	Petrex Alkyd	1/2 (1273) 1/2 (3017)	70%
RB 9271	Z	6.7	-	" "	(1273)	70%
RB 9105	Y +	6.9	7-8	Soy-Styrene Alkyd		70%

Kem Snow White was selected as a starting point for evaluating the varnishes. As indicated by the data below, all of the varnishes were found to be reactive with zinc oxide. An effort is being made to lower the acid value and improve the color of RB 9103. Work will be continued.

Batch	Varnish Being Tested	Viscosity #5 Orifice	Set-to-Touch	Over Nite Dry	Brushing	Flow	Color	Gloss
989 L Reg.	(3109)	25"	2 hrs. 37 min.	Good	OK	OK	Char-acteristic	Good
990 L. M-S	MV 1299 Painter En. Rex 2640	48"	3 hrs. 40 min.	Very good	OK	Sl. short	Sl. yel.	Good
991 L	RB 8562	2' 10"	16 min.	Very good	Too heavy to brush.			Good
992 L	RB 8563	2' 23"	17 min.	Very good	Too heavy to brush.			Good
994 L	RB 9103	1' 35"	20 min.	Very good	Too heavy to brush.			Good
995 L	RB 9099 with 1415	44"	57 min.	Soft	Very sticky	High	Poor	Sl. low.
996 L	RB 9271	47"	4 hrs. 13 min.	Very good	Sticky	OK	Sl. yel.	Sl. low
1000 L	RB 9098	1' 21"	1 hr. 46 min.	Very good	Sticky	OK	V. sl. yellow	Good
1 M	RB 9105	14.8"	39 min.	V.V. good	Good	High	OK	Good
2 M	RB 9099 without 1415	29"	6 hr. 42 min.	Very good	OK	High	Yellow; poor.	Good

#162 - Cont.

Enamels - Cont.

In work on the discoloration of alkyd enamels it was found in comparing alkyd varnish (3109) with Resinous Products D 65 a, that in the absence of lead and manganese driers, (3109) requires 5 - 6 hours to dry to touch, whereas D 65 a dries in 1 - 1-1/2 hours. Pure TiO_2 alkyd enamels are less susceptible to discoloration by sulfides after five days' drying than they were after one day. When equally dry (3109) was equivalent to D 65 a in these tests, and in light stability tests the inclusion of 35 pounds 1415 dry Kadox Zinc Oxide improves the yellowing resistance.

Drier Absorption

The drying rates of Rex 729 Enameloid Black samples carrying the regular blend of driers compared to one prepared according to the Ferro Chemical Company technique were studied after the enamels had aged in the package for a period of six weeks. The drying rates at the dry-to-touch stage were equal at 80 minutes. They both dried to touch in 90 minutes when freshly made. Both samples showed substantial losses of drying potential for the dry-to-handle stage after the six week ageing period, but the Ferro Chemical Company blend of driers held its original advantage over standard Rex 729 as can be seen from the test data below:

	Drying Time			
	Dry to Touch		Dry to Handle	
Sample	Fresh	6 Weeks	Fresh	6 Weeks
Rex 729 - Enameloid Black Regular	90 min.	80 min.	4 hrs.	6 hrs.
Ferro Chemical Co. Blend	90 min.	80 min.	3.33 hrs.	5 hrs.

The loss of drier in the respective samples amounted to 50% in each case. Drier loss is calculated from the gain in time required for drying-to-handle and the rate established by respective samples when freshly made.

#86 - Leaded Zinc Pigments

At the request of the P. C. and C. Department we prepared an itinerary and conducted a tour of our exposure farm for representatives of Montgomery Ward and Company. This was the third annual visit by this group. Considerable care was exercised to limit the panels inspected to exposures of conventional formulations.

Mr. H. F. Saunders and Mr. C. H. Adams, of the Auxiliaries Research Department, reviewed current exposures on basic silicate white lead. To date no failures have occurred which would advise against its use. From a paint application and appearance standpoint, basic silicate white lead seems to cause a puffy type consistency which leads to definite brush-marking.

#187 - Physical Properties of Pigments

A method has been developed to determine the relative degree of dispersion or agglomeration of pigments in paint systems by means of the microscope. It is a very simple and effective technique for obtaining flat fields of well separated particles or agglomerates on a microscope slide and seems to have the quality of not destroying agglomerates as they exist in the original dispersion.

The method consists of diluting about 0.1 cc of the paint to be examined with about 100 cc of a non-polar compatible solvent, dispersing the paint well by stirring or shaking, and spraying a very thin layer of this dilute suspension on a microscope slide by means of a small atomizer. Permanent mounts, or those with which oil immersion objectives can be used, are prepared by cementing a microscope cover glass over the slide by means of a suitable resin such as Clarite.

Good microphotographs have been obtained for a number of suspensions of the same pigments in vehicles having various dispersive effects. A very good coordination between the degree of dispersion or agglomeration as determined by such means as the relative CPVC and the microphotographs was observed. The technique should prove very usable in studies of pigment/binder relationships, as well as in any work involving microscopic studies of pigments.

Electrokinetic Theory of Pigment Dispersion

A study is being made of the applications of the electrokinetic theory as applied to pigment/binder systems. This seems to provide answers to many of the questions which arise in the consideration of the physical relationships which are encountered in paints. It is planned later to prepare a more complete analysis of the factors involved and to present the data on which the conclusions are based. In the meantime, the following theoretical discussion will give the background for the work.

If a paint with a well dispersed pigment system is placed between the poles of a strong electrical field, the particles will move toward one of the poles. This phenomenon substantiates the theory that pigment particles of a highly dispersed paint system carry an electrical charge, which may originate as the result of the following phenomena:

1. The charge may be inherent with the internal phase as a result of the tendency of that phase to be transformed from the molecular to the ionic state; or, what is more probable in paint systems -

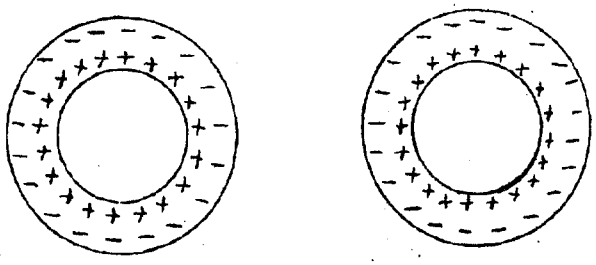
2. The charge may result as a consequence of the capacity of the particles to preferentially adsorb certain polar constituents of the vehicle.

#187 - Cont.

The nature and magnitude of the charge is determined by the unbound charges of the dipoles constituting the first adsorbed layer. Those exert an electrical force in an outward direction which very closely resembles the effect of electrical induction. The forces of mutual repulsion established in this way can be considered responsible for the dispersive capacity of a pigment/binder system. Since orientation depends on the nature of both the solid and liquid phases, a change in the nature of the vehicle will alter the charge on the particle.

Where the electrical charge on the particles is low, as will be the case where pigments are suspended in media containing low concentrations of dipolar-molecules or where these are entirely absent, agglomeration of the particles will result.

The mechanism of dispersion may be represented in the following manner: Assume two isolated pigment particles in a highly dispersed paint system, for instance, zinc oxide, which generally displays a positive charge. These can be pictured in the following manner:



The negative charges in this case, where the particles are charged positively, constitute the so-called contra-ions or contra-charges of the system whose concentration is only slightly greater around the particle itself than in the body of the vehicle. The two relatively distinct layers surrounding the particles resemble a concentric condenser and this phenomenon is termed the electrical double layer. The distinction between the double layer and the concentric condenser, which must be kept in mind is, that in the case of the former, the contra-ionic charges are not fixed, but are relatively free to move. The existence of the electrical double layer clearly explains why, despite the fact that the individual particles carry a charge, the over-all system is neutral and no charge can be detected on the body of the dispersion by means of an electroscope.

#187 - Cont.

Around each particle as pictured above with an adsorbed (+) charge and a (-) contra-charge, the sum of which is zero, a surface can be drawn enclosing both layers of charges. As the charges exactly neutralize each other, the solid thus enclosed will be electrically neutral, and any two particles separated by a distance greater than the diameter of this surface will have no mutual electrical effect upon each other. If now, two particles approach each other so closely that their electrical fields begin to intersect, they will repel each other because of their mutual charges. Unless the kinetic energy of approach is greater than this force of repulsion, they will not agglomerate.

Reverting to the analogy between the electrical double layer and concentric condenser, the formula showing the relationship between the physical behavior of particles and the forces involved can be derived to be:

$$F = \left(\frac{D\,\zeta}{d}\right)^2 \frac{(r_1^2 \cdot r_2^2)}{\Delta^2}$$

Where: F = force acting between the two particles; D = dielectric constant of the double layer; ζ = potential difference across the layer, commonly referred to as the electrokinetic, or ζ - potential; d = thickness of the double layer; r_1 and r_2 the radii of the two particles respectively; and Δ = the distance of separation between them.

This formula, although requiring some corrective factor due to the inherent difference between electrokinetic double layer and concentric condenser, undoubtedly closely represents the conditions existing in paint systems. It may also give an indication of why small particles agglomerate more readily than larger ones under similar external conditions.

Agglomeration of pigment particles can be considered the result of either or both of the factors:

1. Partial or complete removal of the electrical charges on the surfaces of the particles.

2. Removal of the protective shell responsible for the inability of the particles to adhere to each other after collision.

#187 - Cont.

The first probably assumes the greater prominence in paint systems. Investigations carried out on pigment/binder systems clearly show a direct relationship between dispersion and ζ-potential. From an analogy to lyophobic colloidal systems it must be assumed that the greatest stability in the paint exists above or below a certain "critical" potential. Agglomeration begins within this critical range rather than at the iso-electric point or zero ζ-potential. This critical ζ-potential is typical for each combination of pigments and vehicles, and is strongly influenced by the conditions existent in the paint.

It can be assumed that agglomeration involves two rather distinct types of phenomena. The first is the result of complete or nearly complete absence or removal of the electrical charge on the particle surface. The second is the result of a small charge or only partial neutralization. The essential difference between the two is that the first is rapid and the second, because of the residual forces of repulsion, is slow. Rapid agglomeration occurs in the neighborhood of zero ζ-potential, while slow agglomeration occurs within the zones of the critical potential.

As the adsorption phenomena of some of the constituents of paint systems take place over a considerable period of time, the over-all condition due to a change in charge may cause a substantial change in the degree of dispersion with time. Under some conditions the ζ-potential may even completely reverse in sign due to these phenomena, causing a shift to a higher or lower level of dispersion or even a shift back and forth.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paint

Considerable time was devoted to the preparation of panels and exhibits for the meeting on flat wall paints that was held in Chicago on June 17 and 18. The same exhibits were also shown to the Sales Department at Cleveland on June 28 and 29. The various exhibits included the institutional flats and a number of competitive materials that are being sold in various sections of the country. The flats were all checked for brushing, flow, drying, uniformity of tint and sheen, and washability over glue size.

In general the institutional flats compared quite favorably on all tests with competition. As indicated by the data in the following chart, Flat-Tone and Paintercraft One Coat Flat #10 were found to be better in general than outside competition.

Comparison of Properties of Flat Wall Paints

Sample	Wt./Gal.	Viscosity #5 S-W Orifice	Grind	Drying		Brushing	Flow
				Set-to-touch	O'Nite		
Sherwin-Williams Flat-Tone White Rex 810 - OJ 955 L	11.76	8.4"	3 H	14 min.	Very good	Good	Good
Sherwin-Williams Paintercraft #10 White, red. 12-1/2%	12.67	19.6"	3-1/2 H	17 min.	Very good	Good	Good
Dutch Boy Wonsover White - 410	11.87	15.0"	2-1/2 H	18 min.	Fair	Good	Short
Dutch Boy One Coat White - Interior From Chicago	12.70	18.0"	3-1/2 H	25 min.	Brittle	Good	Good-
Dutch Boy One Coat White - Interior From Newark	12.39	23.2"	2 H	22 min.	Very good	Sl. sticky	Short
du Pont Flat Interior From Chicago	14.00	13.2"	3 H	12 min.	Poor to fair	Sl. sticky	Sl. short
du Pont Flat Interior From Newark	13.65	20.2"	2-1/2 H	14 min.	Good	Sl. sticky	Sl. short
Acme Decorators Color Mix White - 2 F 10	11.77	10.6"	3 H	11 min.	Good	Good	Good

#162 - Cont.

Comparison of Properties of Flat Wall Paints
(Cont.)

Sample	Wt./Gal.	Viscosity #5 S-W Orifice	Grind	Drying: Set-to-touch	Drying: O'Nite	Brushing	Flow
Kyanize - Cling-Cote Flat White	12.08	9.2"	2-1/2 H	6 min.	Good	Hard to handle; very loose.	Short
Pratt and Lambert Lyt-All Flowing Flat White	11.78	29.8"	4 H	19 min.	V.V. good	Sticky	Good
Lowe Brothers Mellotone White 622	12.39	25.6"	2-1/2 H	5 min.	Fair	Good	Sl. short
BPS Flatlux White - 2977	12.57	20.0"	2-1/2 H	5 min.	Poor to fair	Sl. too free	Washy
Martin-Senour Neutone Rex 675 - White	12.62	32" + 1/8 cup	2 H	12 min.	Very good	Good	Good
Martin-Senour Painters White Rex 2652	13.09	Too hvy to register.	3 H	29 min.	Very hard	Good	Good
Pittsburgh Wallhide Flat - White	12.30	38" + 3/8 cup	1 H	42 min.	Very good	Good	Sl. short
Merkin's Mercotone Flat White	15.81	Too hvy to register.	0	13 min.	Good	Sticky	Short
Benjamin Moore Sani-Flat White	13.22	8.0"	2-1/2 H	30 min.	Very good	Good	Good
Keystona Flat Finish White	16.39	15.5"	2 H	13 min.	Fair +	Sticky	Short
Gypsy Flat Finish White	13.05	64"	3 H	30 min.	Soft	Sl. sticky	Good
Paintercraft Maintenance #3 - OJ 21 M White - Rex 27877 reduced 12-1/2%	12.45	11.6"	2-1/2 H	17 min.	Very good	Good	Good
Paintercraft Metropolitan Flat #73 Rex 619 - OJ 22 M reduced 12-1/2%	13.30	7.8"	2-1/2 H	10 min.	Very good	Good	Good

#162 - Cont.

Comparison of Properties of Flat Wall Paints
(Cont.)

Sample	Wash-ability	Color as Compared With S-W Flat-Tone	Uniformity of Tint* at 20° Angle	Uniformity of Sheen* at 20° Angle	Degree of Sheen at 20° Angle	Remarks
Sherwin-Williams Flat-Tone White Rex 810 - OJ 955 L	Over 200 turns	Good	5 - Good 9 - Fair 13 - "	5 - Fair 9 - " 13 - "	Medium	
Sherwin-Williams Paintercraft #10 White, red. 12-1/2%	Over 200 turns	Slightly yellow	5 - Good 9 - Fair 13 - "	5 - Good 9 - " 13 - "	High	
Dutch Boy Wonsover White - 410	50 turns	Slightly yellow	5 - Good 9 - Fair 13 - "	5 - Poor 9 - " 13 - "	Medium	
Dutch Boy One Coat White - Interior From Chicago	35 turns	Very slightly yellow	5 - Good 9 - Fair 13 - "	5 - Fair- 9 - " 13 - "	Medium low	
Dutch Boy One Coat White - Interior From Newark	Over 200 turns	Good; same as Flat-Tone.	5 - Good 9 - Fair 13 - "	5 - Poor 9 - " 13 - "	Medium low	
du Pont Flat Interior From Chicago	Over 200 rubs	Slightly blue	5 - Good 9 - Fair- 13 - Fair-	5 - Poor 9 - " 13 - "	Medium	Strong odor
du Pont Flat Interior From Newark	Over 200 rubs	Slightly yellow	5 - Good 9 - " 13 - Fair	5 - Poor 9 - " 13 - "	Low	
Acme Decorators Color Mix White - 2 F 10	180 turns	Slightly yellow	5 - Good 9 - Fair 13 - "	5 - Good 9 - " 13 - "	High	
Kyanize - Cling-Cote Flat White	40 turns	Very slightly yellow	5 - Good 9 - Poor 13 - "	5 - Good- 9 - " 13 - "	High	
Pratt and Lambert Lyt-All Flowing Flat White	195 turns	Good; same as Flat-Tone	5 - Good 9 - Fair 13 - "	5 - Good 9 - " 13 - "	Medium high	
Lowe Brothers Mellotone White 622	175 turns	Slightly blue	5 - Fair 9 - Fair- 13 - Poor	5 - Fair 9 - " 13 - "	Medium	
BPS Flatlux White - 2977 (Package condition poor)	70 turns	Slightly yellow	5 - Poor 9 - "	5 - Poor 9 - "	Medium high	Short on 5 min. wet edge.

#162 - Cont.

Comparison of Properties of Flat Wall Paints
(Cont.)

Sample	Wash-ability	Color as Compared With S-W Flat-Tone	Uniformity of Tint* at 20° Angle	Uniformity of Sheen* at 20° Angle	Degree of Sheen at 20° Angle	Remarks
Martin-Senour Neutone Rex 675 - White	110 turns	Very slightly dirty	5 - Good- 9 - Fair 13 - Fair-	5 - Poor 9 - " 13 - "	Medium low	
Martin-Senour Painters White Rex 2652	Over 200 turns	Very slightly dirty	5 - Good- 9 - Fair 13 - Fair-	5 - Fair- 9 - " 13 - "	Medium	
Pittsburgh Wallhide Flat - White	40 turns	Slightly yellow	5 - Poor 9 - " 13 - "	5 - Good 9 - " 13 - "	High	Very strong odor
Merkin's Mercotone Flat White	75 turns	Slightly yellow	5 - Poor 9 - " 13 - "	5 - Fair- 9 - " 13 - "	Medium	
Benjamin Moore Sani-Flat White	Over 200 turns	Slightly yellow	5 - Fair 9 - to 13 - Good	5 - Poor 9 - " 13 - "	Medium	Very poor package condition
Keystona Flat Finish White	Over 200 turns	Good	5 - Fair 9 - " 13 - "	5 - Poor 9 - " 13 - "	Medium	
Gypsy Flat Finish White	90 turns	Good	5 - Good- 9 - " 13 - "	5 - Fair 9 - " 13 - "	Medium	
Paintercraft Maintenance #3 - OJ 21 M White - Rex 27877 reduced 12-1/2%	Over 200 turns	Good				
Paintercraft Metropolitan Flat #73 Rex 619 - OJ 22 M reduced 12-1/2%		Good				

*Lap tests - strips at 5, 9, 13 minutes.

#162 - Cont.

Work has been under way to increase the wet edge on Flat-Tone by the introduction of various amounts of (141) and/or Cosene (Commerce Petroleum Company). Martin-Senour prefers Cosene to (141) in their flat wall paints, since they believe it is somewhat better than (141) for increasing wet edge time. However, our tests do not indicate that Cosene is any better in this respect.

Experimental batches of Flat-Tone were made based on a kerosene content of 14-1/2, 22 and 29 gallons of (141) and/or Cosene per 100 gallons. The paints were checked for double coating on 5, 9 and 13 minute laps, as well as for drying over night. These tests indicate that 16 to 18 gallons of kerosene introduced as (141) or Cosene is the optimum amount required for wet edge, still permitting satisfactory drying under adverse drying conditions.

In the May report reference was made to the evaluation of CTV 5055, a limed linseed-chinawood oil and CTV 5056,limed linseed. These liquids were compared with (2287), a limed linseed-soya-chinawood oil based on Lowe Brothers' LV-3600, in the Flat-Tone White formulation.

As previously reported, flat wall paints made with CTV 5055 and CTV 5056 were similar to (2287) in brushing, flow, drying, etc. After 22 days of storage the flat made with CTV 5055 had approximately the same viscosity as the regular, whereas CTV 5056 produced a slightly higher consistency. Because a slightly higher initial viscosity would be preferred in Flat-Tone, CTV 5056 would be more desirable from a body standpoint than CTV 5055. However, the Varnish Laboratory has reported that the cooking time on CTV 5056 is 3 to 4 hours longer than on CTV 5055.

Flat-Tone White Batches

		Viscosities at 75° F. - #5 Cup					
		Fresh	1 Day	12 Days	15 Days	18 Days	22 Days
OJ 6 M	Using (2287)	7"	9.6"	14.8"	12.6"	16.4"	13.2"
OJ 7 M	Using CTV 5055	6.2"	8"	12"	9.6"	12"	12.2"
OJ 8 M	Using CTV 5056	9"	11.6"	20.5"	15"	21"	16.8"

#162 - Cont.

Bulk Painter Market Survey

A survey was made on June 3 and 4 by Mr. Fred Statton and Mr. O. R. Jagd of the bulk painter market in Chicago to determine what products and working characteristics, prices, etc. are desired in painter products for local sales. Five large concerns were contacted:

1. Plamondon Decorating Company
2. Dobbe Decorating Company
3. Richard H. West Company
4. Associated Decorators, Inc.
5. Cassity-Richards, Inc.

In general the various contractors desired consistently uniform quality in the materials they use. Wall primers and sealers should have good build and sealing properties and dry to recoat over night. They should also dry glossy. In a painter flat they demand high opacity, easy brushing, medium high angular sheen and good washability. The flat must not show any flashers or color floating when shaded. In no case were they interested in a calcicoater flat. The most popular type of flats used by the various concerns contacted were Pratt and Lambert's Flowing Flat, Pittsburgh's, Detroit Graphite, Carbitcoat One Coat Flat.

On enamels the requirements appear to be easy brushing, good opacity and build, with fair leveling qualities. The enamel should dry to touch in about one to two hours. Popular materials in this line are Barreled Sunlight, Plam Enamel (Great Lakes) and du Pont's Dulux.

A number of the decorating concerns referred to the fact that a large amount of their work was covered by specifications where the architect stipulates which paint manufacturer's materials are to be used. It appears that Pratt and Lambert are doing a good job of contacting the various architects as their materials are specified in many cases and the contractor has no alternative but to use them.

Semi-Lustre

A series of pigmentations were prepared to compare pure TiO_2 and Titanox RC HT 2132 dry to increase the opacity of Semi-Lustre White - Rex 210 while holding the raw material cost per gallon within 10¢ of the current formulation. 2132 dry affords the most opacity per dollar because the extender portion is priced in at about 1¢ per pound. Pure TiO_2 raises the tinctorial strength more rapidly as opacity increases than does 2132 dry. Titanox RC HT is therefore preferred because of (1) higher opacity per dollar, (2) lower tinting strength, requiring less shading color.

#162 - Cont.

Enamels

The Resin Research Department submitted three additional non-phthalic varnishes for evaluation as enamel liquids. The high acid value and body of the vehicles submitted last month produced considerable reactivity with zinc oxide. Therefore, an effort was made to reduce the acid value and body so that a percentage of zinc oxide could be used in the enamel pigmentation to maintain color stability. The liquids were:

	Body	Acid Value	Color	Resin	Oil	N.V.
RB 9127	U	8.5	11	Petrex-Alkyd	(1273) (3017)	70%
RB 9297	S	7.2	7	" "	(1273) (3019)	70%
RB 9298	N	5.9	7	" "	(1273) (3107)	70%

Three enamels were made based on the pigmentation used in Kem Snow White (300 pounds 2030 T, 34 pounds 1415 dry). The enamels were too thin in body for proper application characteristics. However, the varnishes appear to be less reactive than the samples tested last month and an effort will be made to increase the body of the enamels by a revision in pigmentation.

Panels 12744-7 C and F were prepared for exposure 45° south at Chicago and Miami. These are 8" x 24" white pine panels having a coat of Flat Rite Undercoater, a split coat, and a top coat of enamel. The enamels include regular Enameloid Whites based on (2848)E and the (4100)-(3109) combination, and on two special vehicles carrying a combination of RC 3372 (45% styrene - 55% castor) and RC 3473N6 (also 45% styrene - 55% castor) and a combination of RC 3473N6 and B3424N6 (50% styrene - 10% tung - 40% soya).

#162 - Cont.

Wall Primer and Sealer

The Resin Research Department submitted a linseed-styrene vehicle RB 9676 for evaluation in a wall primer and sealer. It has a body of F, acid value 4.1, NVM 50%. Wall Primer and Sealer made with RB 9676 did not seal or hold out as well over porous surfaces as the regular Rex 25 made with (2848)E.

An effort was also made to formulate a sealer from (4950)G and (3880)E but this vehicle combination was not as good as the current formulation.

Miscellaneous

During the month W. K. Asbeck and R. R. Bruhn attended the symposium on Light and Electron Microscopy, organized by the Illinois Institute of Technology. Many interesting and instructive lectures were presented. Among the most informative techniques discussed were the shadow casting and replica systems first developed for electron microscopy and now being used for light microscopy.

Crystal formation from molten silica was demonstrated with motion picture photo-micrographs. Once again the value of motion pictures was demonstrated over and above slide presentations.

Light and Electron Microscopy are no longer separate fields and one must be considered an extension of the other. Plans are under way to make this symposium a regular event since those present felt it to be a worth while effort.

#177 - Pigment Studies

A final report was prepared on panels 4479-82 C after 6 years' exposure at Chicago vertical south. The tests were comparisons of special lots of basic carbonate white lead of varying CO_2 contents in Rex 462 SWP Cream of 1940, which carries about 8% lead carbonate. The special lots were as follows:

Lot No.	Type	CO_2 Value	Tinting Strength	Particle Size
982	Quick Process	11.7	100	Medium
960	" "	11.6	110	"
1020	HTS	11.0	129	Finer

The tests were two coats self-primed on cedar. After 3 years in Florida the panels showed no differences except some indications of an inferior trend in #960. After 6 years' exposure in Chicago the tests show little difference in fading or dirt collection. Although failure is quite advanced there is little choice between panels. #982 has a slight edge in durability but this probably is not significant since there is only a single test.

#187 - Physical Properties of Pigments

Sufficient data have been accumulated on the relationship between particle size and CPVC so that we are able to make a number of general observations. The determinations were made by grinding series of pigments of the same kind and of increasing average particle sizes in three distinctly different liquids. The liquids used were: (3109), which has a rather high dispersive action, (2) raw linseed with 2% water added on the basis of pigment volume, and an S.A.E. #20 motor oil. The latter two liquids have high agglomerating tendencies.

The pigments investigated to date consist of the following groups:

Pigment	Approximate Particle Diameters in μ				
Carbon Black	0.027	0.036	0.08	0.18	0.37
Zinc Oxide	0.2	0.7	0.9	1.5	
Silicon Dioxide	0.02	0.02	2.0		
Celite Diatomaceous Silica	3.0	5.0	9.0	15.0	30

The first two silicon dioxide pigments were 1948 dry - Santocel C and an aerosol produced by the Linde Air Corporation. As no direct data on the particle sizes of the silicon dioxide pigments were available, the sizes are estimations. The average particle sizes of the remaining pigments are rather accurate figures supplied by the respective manufacturers. The entire range thus represents a particle diameter range of more than 1000:1 between the largest and smallest particles.

It was originally anticipated that the various pigments dispersed in the alkyd resin (3109$ would show the highest CPVC in each case, with the dispersions in (2) and water and in motor oil showing the lower values. This is by no means true consistently as is shown in the following tabulation of the data obtained to date. Data for the degree of deviation from Newtonian rheological behavior for each of the dispersions is also shown under the heading "State." The numbers indicate the relative degree of deviation as visually observed and must be considered with some degree of reserve as no actual measurements of yield value or thixotropy were made. 4 indicates a very high degree of deviation, 3 - medium, 2 - slight, 1 - very slight, if any, and 0 - none.

#187 - Cont.

Pigment	Diameter in μ	(3109) CPVC (%)	State	(2) + Water CPVC (%)	State	S.A.E. #20 CPVC (%)	State
Carbon Black	.027	Data not complete	Data not complete	18	4	22	4
	.036			25	3	32	3
	.08			30	2	34	2
	.18			40	1	46	2
	.37			53	0	58	0
Zinc Oxide	.2	37	0	23	3	12.5	4
	.7	32	0	28	1	26	3
	.9	32	0	29	0	26	3
	1.5	39	0	50	0	32	0
Silicon Dioxide	.02	18	4	8	4	11	4
	.02	11	4	10	4	9	4
	2.0	36	0	46	0	46	0
Celite	3	27	0	32	0	29	0
	5	30	0	29	0	27	0
	9	36	0	38	0	32	0
	15	36	0	35	0	38	0
	30	50	0	40	0	50	0

If a plot of the logarithm of the particles size against CPVC is made from the above data, it will be found that a definite trend exists for each type of pigment to have higher CPVC for increasing particle size. This is true independently of the various dispersive capacities of the vehicles employed for the dispersion. An almost linear relationship exists for log D of the particle size vs. CPVC, for the carbon black investigated, while the other pigments show more or less deviation from a straight line function, although this is approached in almost all cases.

If, furthermore, the rheological behavior of the various dispersions is taken into account, it will be found that a straight line approximately perpendicular to the slope of the pigment lines can be drawn on the graph as described above, dividing it into two zones, one in which no or practically no anomalous viscosity is found, and the other, where deviation from Newtonian behavior increases with increasing particle size.

It is interesting to note that these observations fit in well with what might be the predicted behavior of pigments with decreasing particle size made on the basis of the electrostatic theory of dispersion as outlined in the June report.

#187 - Cont.

The formula for the force of repulsion F, between two particles with radii r_1 and r_2; distance of separation Δ; carrying an electro kinetic potential ζ; dielectric constant of double layer D; and thickness of this layer d, was shown to be very nearly:

$$F = \left(\frac{\zeta D}{d}\right)^2 \left(\frac{r_1^2 \cdot r_2^2}{\Delta^2}\right)$$

If $r_1 = r_2$, the force of repulsion becomes a function of the fourth power of the particle radii. Therefore, despite the fact that the values of the electrical characteristics within the first parenthesis of the equation might be comparatively large, the values for F become extremely small with the small radii of the particles encountered in some of the carbon blacks, silicas and zinc oxides.

Work on the adsorption of "active" and "passive" constituents of vehicles on pigment particles was continued and it is hoped that sufficient data will have been accumulated to give a comprehensive report on this subject next month.

A number of CPVC determinations were made on pigments subjected to hot resin treatment.

The study of pigment behavior by means of the microscope has been continued and a number of photomicrographs made.

#182 - A Study of Improved Mixing and Grinding Practices

A special sample of Lanodine #1 supplied by the American Chemical Paint Company was tested as a grind rate accelerator in a titanium dioxide 2147 dry - (3109) Enameloid roller mill paste. Lanodine #1 contains the calcium soaps of lanolin fatty acids. It is a dry granular solid that is insoluble in (348) and settles readily after being dispersed by stirring in this solvent.

The consistency change resulting from the addition of 1% of the agent, based on pigment content, to a high consistency roller mill paste, was negligible. This material would be ineffective as a roller mill grind rate accelerator.

#162 - Studies in Flat Wall Paint Formulation

Work has been under way to replace (2396) Linogel with (2287) Lowe Brothers LV-3600 in Paintercraft One Coat Flat No. 10. Experimental batches of Rex 630 made with (2287) were high in initial body but were quite standard in viscosity after standing over night. The (2396) was replaced with (2287) at equal solids.

The experimental flat made with (2287) was checked for general performance, such as brushing, flow, washability, etc. and appears to be similar to the regular in all respects.

		Viscosities - #5 Orifice		
		Fresh	Over Night	7 Days
Batch	Vehicle	No reduction	Reduced 12-1/2%	Reduced 12-1/2%
OJ 928 L	(3880)E (2396) (140)	15.2"	7"	10"
Repeat OJ 928 L	"	8"	5"	-
OJ 929 L	(3880)E (2287) (140)	46"	7.4"	11.4"
Repeat OJ 929 L	"	39"	12.6"	-

Our work to date would indicate that (2287) is somewhat slower in wetting than (2396), but in other respects it is quite satisfactory. Arrangements will be made with the factory to make an experimental batch of Rex 630 based on (2287), (3880)E and (140). The plant batch will be checked for general performance and reported on at some later date.

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Laboratory batches of Flat-Tone White were made by introducing the vehicle solids as (1752), and the paint was compared with the present formulation for brushing, flow, body etc. The blown oil produced a very thin bodied flat that was less uniform in tint and sheen and somewhat lower in washability.

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#162 - Cont.

Sherwin-Williams Company of Canada submitted two quart samples of Rex 810 based on Card No. 5 - Alternate A for our inspection. We noted somewhat more flashing and ghosting on their production, due primarily to the short wet edge time. Their formulation has a tendency to lap somewhat faster than our present Flat-Tone, which is formulated with (3880)E and (2287), whereas Card No. 5 - Alternate A uses all (3880)E. We have found that a TiO_2-titanium calcium pigmentation is somewhat better in uniformity of tint than a lithopone-titanium calcium pigmentation. A report of our findings was sent to Montreal.

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In connection with the formulation and development of a flat wall paint for the Bulk Painter Market, the Chicago Technical Service Department proposed a variation of Paintercraft One Coat Flat #10, based on the use of a tall oil varnish (6107). An examination of this material indicated that this type of formulation has a tendency to thin out on storage. It also appears less uniform in tint than regular Rex 630.

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A sample of Solvasol #35 deodorized mineral spirits was received from the Socony Vacuum Oil Company for evaluation in Flat-Tone White. Solvasol #35 was compared for odor with Shell's deodorized mineral spirits #8296 and stock (348) when introduced for the total thinner content of the formula. The results of our tests indicated that Shell's deodorized mineral spirits #8296 was much superior to Solvasol #35 or (348). A report was sent to Cleveland with a suggestion that they conduct room tests to show the Sales Department the improvement that can be made by the use of Shell's deodorized mineral spirits #8296 in Flat-Tone White. The introduction of deodorized solvents would increase the cost about five to six cents a gallon.

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Enamels

The Rosin Research Department submitted three non-phthalic varnishes for evaluation as enamel liquids.

	Resin	Oil	N. V.	Body	Acid Value	Color
RB 9305	Alkyd	(1273) + (3019)	70%	Z_2-Z_3	8.1	-
RB 9143	"	(1273)-Isolene	"	X	7.2	7-8
RB 9297	"	(1273) - (3019)	"	S	7.2	7

#162 - Cont.

Enamels were made from the three varnishes using the Kem Snow White pigmentation (300 pounds 2030 T, 54 pounds 1415 dry). RB 9305 was too high in body and too reactive with zinc oxide for this usage. RB 9297 was checked for drying characteristics using various percentages of lead, cobalt and calcium octoate as driers. As indicated below, RB 9297 requires considerably more drier than (3109) to produce the same initial drying. However, after 24 hours the film is very hard and tough. Draw-downs on glass will be checked for elasticity upon aging.

Enamel Drying Tests Using RB 9297

	% Metal as Octoate Driers				Drying	
	Pb	Mn	Ca	Co	Set-to-touch	Over night
Reg. Kem Snow White (Batch OJ 37 M)	0.15	0.005	-	0.038	4 hr. 5 min.	Hard and tough
Test No. 1-RB 9297	0.80	0.004	0.40	0.16	3 " 40 "	V. hard and tough
Test No. 2 "	0.67	0.0033	0.33	0.13	3 " 50 "	" " " "
Test No. 3 "	0.57	0.0029	0.28	0.11	4 " 5 "	" " " "
Test No. 4 "	0.50	0.0025	0.25	0.10	4 " 35 "	Hard and tough

Based on the drying properties of RB 9297, it was decided that the following drier combination should be used with RB 9143: 0.67% lead, 0.33% calcium, 0.13% cobalt and 0.005% manganese, all introduced as naphthenates. Enamels made with this drier combination and with only one-half the amount of cobalt compared as follows with Enameloid and Kem Snow White for drying of 0.003 inch draw-downs on glass:

Formula	Material	% Metal as Naphthenate Driers				Drying Set-to-touch	O'Nite
		Pb	Mn	Co	Ca		
OJ 37 M	Reg. Kem Snow White	0.15	0.005	0.038	-	2 hr. 55 min.	Good
Rex 710, C 1218 A	Enameloid White	0.60	0.005	0.05	-	2 hr. 45 min.	Good
OJ 82 M	Painter Enamel	0.61	0.005	0.13	0.32	3 hr. 30 min.	V. hard
OJ 82 M-A	" "	0.61	0.005	0.06	0.32	4 hr. 25 min.	" "

The enamels made with RB 9297 and RB 9143 produce very hard films in 24 hours and become quite brittle after only three or four days' aging. Our tests indicate that slightly faster initial set-to-touch time is required, combined with somewhat more elasticity upon aging.

#187 - Physical Properties of Pigments

The work on the first stage of the adsorption of the "active" and "passive" constituents of vehicles on various pigments has been substantially completed. The method used consists of exposing various pigments to a number of vehicles varying in concentrations from 2.5% to 20%, dissolved in a non-polar solvent. The quantity of material adsorbed and the change in the acid number of the supernatant exposed liquid is determined and compared with the unexposed vehicle. As anticipated, it could be proven that certain constituents of vehicles usually present only in small quantities are preferentially adsorbed to form the bound portion of the vehicle solids.

When these materials are present in insufficient quantity to satisfy the surface requirements of the pigments, other, less active portions are adsorbed. These molecules, however, are replaced by the more active ones when more of the latter are present. This is clearly demonstrated by the typical data listed below for 1403 dry TiO_2 on which the constituents of the vehicles consisting of 2.5%, 5%, 10% and 20% of (2) raw linseed oil and (48) bodied linseed respectively in (63) naphtha, and 4%, 8%, 16% and 20% of (3109) alkyd in (63) have been adsorbed on the pigment.

% Vehicle in Thinner (63)	Mg. Vehicle Adsorbed Per 100 cc Vehicle	Mg. Acid Constituents Adsorbed per 100 cc Vehicle
2.5% (2) in (63)	202	25
5.0% (2) in (63)	132	43
10 % (2) in (63)	141	61
20 % (2) in (63)	192	37
2.5% (48) in (63)	323	57
5.0% (48) in (63)	328	75
10 % (48) in (63)	360	81
20 % (48) in (63)	228	95
4 % (3109) in (63)	548	37
8 % (3109) in (63)	690	54
16 % (3109) in (63)	484	85
20 % (3109) in (63)	279	83

#187 - Cont.

As more acidic constituents are available, the less polar, higher molecular weight materials are replaced by the more polar acids of lower molecular weight. A definite equilibrium seems to exist at the surfaces of pigments between the "active" and "passive" constituents of vehicles at any given proportions of concentrations.

A research bulletin will be issued on this work in the near future describing the results and procedure more completely.

The CPVC of a number of hot milled Ken-Tint dry bases have been determined. A different technique for coating the pigment particles with resin was tried. This consists of adsorbing the resin to the pigment surfaces from solution in a non-polar solvent and removing the interstitial solution by subsequent filtration and washing. A friable, easily pulverized material results, which is now being evaluated against the standard hot milled product.

Preliminary runs have been made to determine the average agglomerate size by a permeability method involving the CPVC cell. The method is very simple and the average agglomerate sizes of the paint dispersions can be run simultaneously with the determination of the CPVC with only slight changes in technique. The method is based on the same principle as that for determining particle sizes of powders but has been varied to make possible the determination of the sizes of agglomerated pigments by determining the CPVC simultaneously. A more detailed description of the method and technique will be given when more data have been accumulated.

#177 - Pigment Studies

Lufax 77 A

Several months ago the Rohm and Hass Company announced a new product "Lufax 77 A" "Opacified Zirconium Oxide." This has been examined for pigment properties and found to be of no value. Texture is poor, opacity is low, and the oil absorption is high.

Ti-Cal R 25, R 25 Special, R 27

Comparing these rutile calcium extended titanium pigments with Titanox RC HT and RC HT-X in Rex 210 Semi-Lustre White certain differences were shown as against many similar characteristics.

Opacity, tinting strength, color and brightness were similar. Gloss characteristics were different Titanox RC HT-X developed the highest gloss with Titanox RC HT and Ti-Cal R 27 slightly lower and Ti-Cal R 25 and "R 25 Special" still lower. All of the above paints were in the high range for gloss so these reported differences are only comparative and should not be construed to indicate that difficulty in obtaining gloss should be associated with the Ti-Cal pigments. (See also under Project 162.)

#162 - Studies in Flat Wall Paint Formulation

Reports were received from the Chicago Paint Test Laboratory that various production batches of Flat-Tone have been found slow in drying after several weeks' storage. Because of this report we examined some of the first production made on the present formula as well as some of the more recent production. It appears that some batches have decreased in drying, while others are satisfactory.

We have found that the drying was quite satisfactory on 0.003" films dried in the laboratory at a temperature of 85 to 90° but drawdowns placed in the constant temperature and humidity room at 75° F. and 45% R.H. were rather poor in drying. A suggestion has been made to Cleveland that two additional gallons of (4230) be used in Flat-Tone White and 5 pounds of 1128 dry per 100 gallons in the tints, where brightness is not a factor, to insure better drying under adverse weather conditions.

Work is under way to determine the effect of drying time on the washability of flat wall paints. A number of tests were conducted by hand scrubbing and with the machine used for checking the washability of Kem-Tone.

The results of the tests indicated a progressive drop in washability over a period of two weeks' drying. From then on the washability appears to be quite constant. We have found that it requires considerably more scrubbing with the machine as compared with hand scrubbing when the panels are fresh. However, after a period of one week the scrubbing time or rubs required to remove the film are greatly reduced with the machine and approach hand scrubbing. After the panels have aged for two weeks, the number of rubs required with the machine (with or without added weight) and by hand are very close.

Washability of Flat-Tone Made With
Three Production Batches of (3880)E

	OJ 986 L Newark* (3880)E	OJ 9 M Cleveland (3880)E	OJ 11 M Chicago (3880)E
Drying time of film:			
24 hours			
Machine			
4# Weight	350 rubs	500 rubs	400 rubs
7# Weight	425 rubs	550 rubs	450 rubs
Hand	50 rubs	200 rubs	110 rubs

(Cont.)

#162 - Cont.

	OJ 986 L Newark* (3880)E	OJ 9 M Cleveland (3880)E	OJ 11 M Chicago (3880)E
Drying time of film:			
1 week			
Machine			
4# Weight	65 rubs	300 rubs	65 rubs
7# Weight	30 rubs	100 rubs	50 rubs
Hand	25 rubs	85 rubs	60 rubs
2 weeks			
Machine			
4# Weight	40 rubs	100 rubs	45 rubs
7# Weight	20 rubs	50 rubs	40 rubs
Hand	20 rubs	35 rubs	35 rubs
4 weeks			
Machine			
4# Weight	30 rubs	35 rubs	40 rubs
7# Weight	20 rubs	35 rubs	40 rubs
Hand	20 rubs	35 rubs	35 rubs

*The sample of Newark (3880)E tested above was made without a CO_2 blow. Their new production made by the standard cooking procedure is now under test.

Laboratory batches of Rex 630 Paintercraft Flat No. 10 were made with rutile titanium oxides 2173 dry and 2273 dry to check the performance of these pigments. A comparison was also made between aluminum stearate 547 dry and calcium stearate 1826 dry. It appears that 2273 dry or 1826 dry can be used in this flat without imparing the performance in any way.

#162 - Cont.

As mentioned under Project 177, a sample of Ti-Cal R 25 Special was submitted by the du Pont Pigment Division as a match for Titanox RC HT-X. Batches of Flat-Tone White were prepared using the following titanium calcium pigments: Ti-Cal R 25, R 25 Special, R 27, Titanox RC HT and RC HT-X.

The flats were compared for brushing, flow, washability, uniformity of tint, sheen, etc. As indicated by the following data, the R 25 Special was lower in sheen and weaker in tinting strength than RC HT-X or 2132 dry. The washability reported is much lower than usually obtained on tests of this type. These tests indicate that the Ti-Cal R 25 Special is somewhat inferior to the other pigments tested, as far as use in flats is concerned.

Properties of Flat Wall Paints

Flat-Tone Batch No.	OJ 83 M Regular Formula Using 2132 Dry	OJ 84 M Using R-25 Special	OJ 95 M Using R-27	OJ 94 M Using R-25	OJ 112 M Using RC HT-X
Viscosity at 75° F. #5 S-W	10.4"	9.0"	8.8"	7.0"	7.3"
Weight per Gallon	11.80#	11.80#	11.81#	11.79#	11.78#
Brushing	Good	Good	Good	Good	Good
Flow	Good	Good	Good	Good	Good
Washability at 9 days	20 rubs	12 rubs	25 rubs	25 rubs	25 rubs
Grind	2-1/2 H	2-1/2 H	3 H	3 H	3 H
Uniformity of Laps					
5 minutes	Good	Fair	Fair	Fair	Good
9 "	Good	Fair	Fair	Fair	Good
13 "	Good	Fair	Fair	Fair	Good
Sheen	Std.	Lower than 2132	Equal to 2132	Equal to 2132	Sl. higher than 2132
Tinting Strength	Std.	Sl. weaker than 2132	Sl. weaker than 2132	Sl. weaker than 2132	Equal to 2132

#162 - Cont.

The same evaluation will be made in a Semi-Lustre formulation.

Enamels

The Resin Research Department submitted the following varnishes for evaluation in enamel formulations.

RC No.	Resin	Oil	Solids	Color	Body	A. V.
0154	Pentalyn G	(2325)	70%	9	U	9.8
0155	Pentalyn G	"	"	9	W -	10.6
0157	Pentalyn A	"	"	9	S-T	13
0159	Pentalyn A	"	"	9	W +	14
RB No.						
*8626	Pentalyn G	(2325)	70%	11	S	5.48
**8625	Pentalyn G	"	"	11	T	8.50
RC 0037	Rosin Styrene	"	"	9	U	2.30
RB 9148	Petrex and Piccolyte S-125	(1273) (3019)	"	8 -	W	5.7

Varnishes RC 015, 0155, 0157 and 0159 were found to be too reactive with zinc oxide for our usage. RB 8625 and RB 8626 are 50 and 80 gallon varnishes submitted for intermixes with RB 9148 to produce more elastic films. However, after only one week all intermixes became very brittle. RB 8625 and RB 8626 were intermixed with RB 9148 to the extent of equal parts by volume but the films were still too brittle after only seven days.

The sample of RC 0037 (Rosin Styrene) was compared with (3109) and RC 3372 and RC 3473N6 (Styrene Castor Varnishes from Cook Paint and Varnish Company) using the Kem-Namel Snow White Gloss pigmentation. The RC 0037 varnish was slow in drying, poor in color and too low in body for this usage.

		Viscosity #3		Drying Time		Brush-		
OJ No.	Varnish	Fresh	O'Nite	Set-to-touch	O'Nite	ing	Flow	Color
158 M	(3109)	18.8"*	26"	4 hr. 55 min.	Good	Good	Good	Good
159 M	RC 0037	14.2"	20"	6 " 15 "	V.poor	OK	Sl.high	Poor
664 L	(RC 3372 (RC 3473N6	26.8"	31.6"	1 " 35 "	Good	V.good	Good	Good

*Viscosity below standard

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#187 - Physical Properties of Pigments

A new cell for the continuation of the study of the electrokinetic behavior of pigment particles was constructed. This apparatus provides a potential of 6000 volts D.C. at the electrodes, which are stainless steel. Preliminary runs indicate that the migration velocities of particles will be measurable by this means. A more complete report will be submitted when more data have been accumulated.

Moisture permeabilities were run on a number of commercial paints in order to ascertain the degree of permeation of water vapor through a paint barrier. The permeabilities were determined for the combinations as indicated on the following table. The samples were prepared by making .003" draw-downs on permeability paper and applying the subsequent coatings in the same way after drying of the previous film.

Paints	Permeability in g./16 hrs.
1. Rex 25 - Wall Primer and Sealer Rex 810 - Flat-Tone	0.0888
2. Rex 50 - Flat-Rite Undercoater reduced with (2), 4:1 Rex 50 + Rex 710 - Enameloid 1:1 Rex 710	0.0663
3. Rex 50 Rex 50 + Rex 710, 1:1 Rex 710	0.0451
4. Rex 25 Rex 210	0.1120
5. Rex 29 - Aluminum Paint Rex 25 Rex 810	0.0408
6. Rex 29 Rex 25 Rex 210 - Semi-Lustre	0.0482
7. Rex 50 + (13), 8:1 Rex 50 + Rex 710, 1:1 Rex 710	0.0495

#187 - Cont.

These are the averages of three runs at 105° F. and 100% R.H. and the weight of water vapor transmitted is reduced to 16 hours of exposure (over night). No correction for thickness of the two or three coat systems has been made. A re-run of the above systems is contemplated, employing rubber gaskets in the cells instead of the paper ones employed. This might account for some of the slight apparent discrepancies. An electrographic print of the various films is contemplated to test for possible pin holes.

A display for the Trail Blazer Exhibition at the National Chemical Exposition in Chicago, October 12 - 16 was prepared. This describes the principles involved in the CPVC cell.

#177 - Pigment Studies

The work on the evaluation of International Talc 3 X has been reported completely by Mr. Sahli, of the Cleveland Technical Service Department in his letter-bulletin dated September 21, 1948. Samples referred to are available in this laboratory should anyone care to see the effect of magnesium silicate texture on paint properties of SWP.

Ti Cal R 25, R 25 Special, R 27

In working with the Rex 210 - Semi-Lustre White formula it was found that the binder requirements of du Pont's titanium calcium materials are greater than of Titanium Pigment Company's RC HT and RC HT-X, so that consistency is excessively high and the gloss is lost almost completely. This would explain the low gloss reported in August.

TiO_2 Chalking Rate Test

Using the Damar - Weather-Ometer system of measuring the chalking rates of various TiO_2 pigments the following results have been obtained:

	TiO_2	Hours To Trace	Hours to Slight	Hours to Considerable	Hours to Bad
1403	Titanox A	90	120	180	250
2030 T	Titanox AA	140	160	250	275
2269	Titanox RA-10 MO	160	270	300	420
2228	Ti-Pure R 510	125	250	290	420
2174	Ti-Pure R 610	100	345	445	550
1004	Titanox RA NC	250	400	470	650

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paints

T. F. Washburn Company's #3401 Vehicle has been evaluated for general performance as a flat wall paint vehicle, using their suggested 1-X white calcicoater formula. This flat carries 480 pounds of Ti-Cal R 25 and 260 pounds of Surfex. The brushing, flow, wet edge and washability were similar to Flat-Tone based on (3880)E and (2287). The Washburn flat could be improved from the standpoint of uniformity of sheen but it shows promise as to uniformity of tint on lap marks.

An investigation has been under way to determine the reactivity characteristics of representative bodying agents that are being offered for sale. The products selected were as follows:

OKO - M - 25	Archer-Daniels-Midland
25 M - Oil	Brown Oil and Chemical Co.
Alinco M-25	Archer-Daniels-Midland
No. 3359 Trick Bodying Liquid	T. F. Washburn Co.
Puf-It	U. S. Vehicle and Chemical Co.
Falkovar VR 10	Falk and Co.
(324)	Heat Bodied Linseed Oil

The bodying agents were used in three different types of paints - One Coat House Paint White - CH 4697, Flat-Tone White - Rex 810, and Kemclad Enamel White - F70 W 2. No. 3359 Trick Bodying Liquid, Puf-It and (324) were found to be the most reactive agents when added to the One Coat House Paint. However, when the various agents were added to Flat-Tone White or the Kemclad Enamel White there were only minor differences in the degree of reactivity. Viscosity readings were taken at once, after over night storage, 3 days, 1 week, a half month, and a month's storage where the tests have reached that point. (324) appears to be equivalent to Puf-It or 3359 Bodying Liquid and more reactive than the others. Portions of the data follow.

#162 - Cont.

Bodying Agent Tests (Viscosity)
Viscosities at 75° F. - #5 Cup

Rex 810 - Flat-Tone White

Agent	Time In Days	None	1/8 Oz./Pt.	1/4 Oz./Pt.	3/8 Oz./Pt.	1/2 Oz./Pt.
Puf-It	At once	9	9.2	9.4	10	-
U. S. Vehicle	1 day	11	11.2	12.8	13.4	-
and Chem. Co.	15 "	9.4	10.2	11.4	12.4	-
25 M - Oil	At once	9	9.4	10.4	11.2	12.4
Brown Oil	1 day	11	12.4	14.2	15	16
and Chem. Co.	15 "	9.4	11.4	13	14	15.4
3359 Trick	At once	9	9.2	9.6	10.2	11
Bodying Liquid	1 day	11	12	12.8	13.4	14
T. F. Washburn	15 "	9.4	11.2	11.2	12.6	13.2
Linco M-25	At once	9	10	11	11.6	13
Archer-Daniels-	1 day	11	12.2	13.6	14.4	16.2
Midland Co.	15 "	9.4	11.8	12.8	13.8	16.4
10 M-25	At once	9	10	10.4	12	13
Archer-Daniels-	1 day	11	12.2	13.4	14.2	16.4
Midland Co.	15 "	9.4	12	13	14.2	15.2
Alkovar VR 10	At once	9	9	9.4	9.4	9.4
Polk and Co.	1 day	11	11.6	11.8	10.4	11
	15 "	9.4	10.6	10	10.2	10.4
(324)	At once	9	9	9.2	9.4	9.6
	1 day	11	11	11.6	11.6	12.4
	15 "	9.4	10.4	11.2	12.2	13.4

#162 - Cont.

Bodying Agent Tests (Viscosity)
Viscosities at 75° F. - #3 Cup

Kemclad Enamel White - Rex F70 W 2

Agent	Time In Days	None	1/8 Oz./Pt.	1/4 Oz./Pt.	3/8 Oz./Pt.	1/2 Oz./Pt.
Duf-It	At once	17.2	19.2	20	21.4	-
V. S. Vehicle	1 day	22.6	24	26	28	-
and Chem. Co.	15 "	26	27.6	29	33	-
25 M - Oil	At once	17.2	20.4	22.8	25.4	27
Brown Oil	1 day	22.6	23.4	27	29.4	31.4
and Chem. Co.	15 "	26	31.8	32	36.6	38.2
559 Trick	At once	17.2	19.6	21	22.4	23.4
Bodying Liquid	1 day	22.6	23	25	26.4	28
C. F. Washburn	15 "	26	28	28.2	28.4	32
Clinco M-25	At once	17.2	19.8	20.6	23.4	26
Archer-Daniels-	1 day	22.6	25.4	27	28.6	33
Midland Co.	15 "	26	34	34.4	34	39
210 M-25	At once	17.2	20.6	22.2	23.6	26.4
Archer-Daniels-	1 day	22.6	25	27.6	29	32
Midland Co.	15 "	26	29.4	31	33	37.8
Alkovar VR 10	At once	17.2	19	21	21.6	25.4
Alk and Co.	1 day	22.6	23.4	25.4	27	28.8
	15 "	26	27	27.8	29	32.2
(324)	At once	17.2	19.8	21.8	22.8	23.6
	1 day	22.6	24	25.6	28.2	30
	15 "	26	29	30.4	31.4	35

#162 - Cont.

Bodying Agent Tests (Viscosity)
Viscosities at 75° F. - #3 Cup

One Coat House Paint White

gent	Time In Days	None	1/8 Oz./Pt.	1/4 Oz./Pt.	3/8 Oz./Pt.	1/2 Oz./Pt.
f-It**	At once	19.4	21.6	30.8	36 +	36 + 1/16 cup
S. Vehicle	1 day	21	21	26.2	30	31.6
Chem. Co.	15 "	21.6	22.4	29.8	33.4	30
	31 "	21.8	23	28.8	33.2	31
M - Oil	At once	19.4	25.4	33	40.6	45 +
on Oil	1 day	21	27	35	40.8	44 + 1/16 cup
Chem. Co.	15 "	21.6	29	39	44	55
	31 "	21.8	29.2	38.8	45	56.2
9 Trick	At once	19.4	25	32	36 +	37 + 1/8 cup
ying	1 day	21	22.2	30.2	38.2	35.4
uid**	15 "	21.6	24.6	31	35	37.2
. Washburn	31 "	21.8	24.8	32	33.2	32.8
nco M-25*	At once	19.4	23	27.2	30	31.2
er-Daniels-	1 day	21	23.8	27.4	30.4	31.6
land Co.	15 "	21.6	25	25.8	27.8	27
	31 "	21.8	23.8	25	26.6	26.2
M-25	At once	19.4	20.8	23.4	25	28.4
er-Daniels-	1 day	21.	23.8	24	25	29.6
land Co.	15 "	21.6	25	28.2	28.4	30.8
	31 "	21.8	25.2	28	28.4	31.2
lyvar VR 10	At once	19.4	19.4	20	20	20.4
and Co.	1 day	19.6	19.6	20.2	20.6	22
	15 "	19	19	20.2	20.2	21
	31 "	-	-	-	-	-
)**	At once	19.4	26	32	35 +	31 + 1/4 cup
	1 day	21	25	28.6	31	34
	15 "	21.6	26.4	32	35	37.4
	31	21.8	25.8	30.8	35.2	46.8

*Reduced 400% (348)

**Reduced 1600% (348) or 5.90% solids

#162 - Cont.

Semi-Lustre

A study is being made of the settling characteristics of Rex 210 Semi-Lustre. Test paints have been prepared on the formulas of Cards #4 and #5 and have been set aside to age. Variations include additions of wetting and flocculating agents.

Enamels

In U. S. Patent 2,448,505 claims are made for improvements in performance characteristics of synthetic and semi-synthetic paints by adding small percentages of halogenated amines. It is stated that working qualities are improved, the life of the film lengthened, hiding power increased and the smoothness and texture of the surface enhanced. To check such claims, 1% of para-chloroaniline was added to two enamel formulas. As indicated by the following data we could not substantiate the claims of the patent. The addition detracted from the drying and affected the color and brightness, and no improvements were observed in brushing qualities or control of flow. It may be that such agents would be effective with specific types of vehicles.

Properties of Painter Enamels
Made With and Without 1% Para-Chloroaniline

	Viscosity - #3						
Batch No.	Initial	After Add'n	48 Hr. After Add'n	Set-to-Touch	Over Night Dry	Brushing	Flow	Color
OJ 71 M	2' 27"	-	-	4 hr. 45 min.	Good	Very sticky	OK	Very good
OJ 71 M + 1% Para-chloro-aniline	-	1' 50"	2' 20"	5 hr. 45 min.	Good	Very sticky	OK	Very pink
OJ 2 M	35"	-	-	Wet at 8 hr.	Good; sl. tack	Slightly sticky	High	Poor (Yellow)
OJ 2 M + 1% Para-chloro-aniline	-	31.2"	48"	Wet at 8 hr.	Soft	Slightly sticky	High	Poor (Sl. pink)

#162 - Cont.

Enamels - Cont.

The Resin Research Department submitted a number of varnishes for consideration as enamel vehicles. They were checked for performance in Kem Namel Snow White Gloss. Their characteristics and experimental data follow:

Enamel Vehicle Tests
Kem Namel Snow White Gloss Pigmentation

Batch No.	Varnish	Resin	Varnish Characteristics Oil	N. V.	Color	Body	A. V.
155 M	RC 0037	Rosin Styrene	Dehydrol	70%	9	U	2.3
159 M	RC 0037	Rosin Styrene	Dehydrol	70%	9	U	2.3
169 M	RB 9148	Piccolyte	(1273) (3019)	70%	8	W	5.7
	RB 8625	Pentalyn G	(2325)	70%	11	S	8.5
170 M	RB 9148	Piccolyte S 125	(1273) (3019)	70%	8	W	5.7
	RB 8626	Pentalyn G	(2325)	70%	11	S	5.48
177 M	(3109)	Glyceryl Alkyd	(1273)	70%	6-8	Y-Z_1	3.5
178 M	RB 9007	Ether Resin	Linseed F. A.	70%	15	$>Z_6$	7.4
179 M	RC 0579	Ether Resin	Soya F. A.	70%	12	X	3.0
180 M	RB 9334*	Petrex Alkyd	(1273) (3019)	70%	7	X	6.1
181 M	RB 9355**	Petrex Alkyd	(1273) (3019)	70%	8	Y +	7.2
187 M	RB 9338	Petrex Alkyd	(1273) (3019)	70%	7-8	W-X	4.8
192 M	RB 9344	Alkyd	RC 0071 Soya Styrene	70%	5	U	4.5

20% Petrex as phthalic anhydride (Piccolyte-modified)

20% Petrex as phthalic anhydride

Cont.

162 - Cont.

Enamels - Cont.

Enamel Vehicle Tests
Ken Namel Snow White Gloss Pigmentation

Batch No.	Viscosities #3 Orifice Initial	O'Nite	Brushing	Flow	Color	Gloss	Drying Set-to-touch	O'Nite
J 155 M	14.0"	15.8"	OK	Sl. high	Poor	OK	Very poor	Very poor
J 159 M	14.2"	(3 days) 20.0"	OK	Sl. high	Poor	OK	6 hr. 15 min.	" "
J 169 M	24.0"	63.0"	-	-	-	-	4 hr.	Good
J 170 M	25.2"	62.0"	-	-	-	-	3 hr. 50 min.	Good
J 177 M	20.2"	27"	Good	Good	Good	Good	3 hr. 15 min.	Good
J 178 M	Too heavy	Too heavy	-	-	Poor	-	- 35 min.	Good
J 179 M	63" + 1/2 cup	Too heavy	-	-	Poor	-	- 40 min.	Good
J 180 M	27"	40"	Good	Good	Good +	Good	4 hr. 8 min.	Good
J 181 M	25.2"	38.2"	Good	Good	Good +	Good	- 42 min.	Good
J 187 M	34.8"	63"	-	-	-	-	2 hr. 3 min.	Good
J 192 M	12.8"	15"				Good	1 hr. 20 min.	Poor

Cont.

752 - Cont.

Enamels - Cont.

Enamel Vehicle Tests
Kem Namel Snow White Gloss Pigmentation

Batch No.	Embrittlement 3 Days	1 Week	2 Weeks	1 Month	Remarks
155 M	-	-	Sl. short	Sl. short	Driers as Kem Namel Snow White Gloss - Rex 100
159 M	-	-	Short	Short	Same as 155 M but drier as Enameloid.
169 M	-	-	Very brittle		80% RB 9148 20% RB 8625 (50 gal.)
170 M	-	-	Very brittle		80% RB 9148 20% RB 8626 (80 gal.)
177 M	O.K.*	O.K.	-	O.K.	Regular Kem Snow White
178 M	O.K.	O.K.	-	Sl. short	
179 M	O.K.	Sl. short	-	Short	
180 M	Sl. short*	Sl. short	-	Very brittle	(20% P. A. modified)
181 M	Short	Brittle	-	Very brittle	(Piccolyte Modified) (20% P. A. Modified)
187 M	Brittle	Very brittle			Repeat of RB 9148 See chart of intermixes

* lacks toughness

#162 - Cont.

Enamels - Cont.

The two Petrex alkyds (modified with 20% phthalic anhydride) became very brittle in 30 days, whereas (3109) remained elastic. The two ether resin varnishes were too high in body for practical use. Due to the high body it was impossible to check the brushing or flow. 0.003" draw-downs were made on glass to check embrittlement, - after 30 days the films were quite hard. The rosin-styrene-Dehydrol varnish RC 0037 was found to be poor in color and drying properties.

The two Pentalyn G - (2325) varnishes RB 8625, 50 gallon length and RB 8626, 80 gallon length were used in various proportions to increase the elasticity of RB 9148. Equal parts of RB 9148 and RB 8625 or 8626 became brittle in one week. Other tests were made to improve elasticity using intermixes of RB 9338 with (2325) and/or (310). It was necessary to use equal parts of RB 9338 with the two oil blends to maintain elasticity after 30 days. These mixtures retained considerable tack after over night drying. With smaller amounts of oil the films become too brittle.

Intermixes of Enamel OJ 187 M
(Based on RB 9338) With (2325) and (310)

Test No.	Batch No. OJ 187 M	Blend of 70% (2325) 30% (348)	Blend of 70% (310) 30% (348)	Viscosity Fresh	Viscosity O'Nite
1	4 oz.	4 oz.	-	27"	29"
2	4 oz.	3 oz.	-	31"	37"
3	4 oz.	2 oz.	-	42"	51.8"
4	4 oz.	1 oz.	-	54"	58"
5	4 oz.	-	4 oz.	27.4"	30"
6	4 oz.	-	3 oz.	30"	36"
7	4 oz.	-	2 oz.	41.8"	51"
8	4 oz.	-	1 oz.	52.2"	62"

Cont.

#162 - Cont.

Enamels - Cont.

Intermixes of Enamel OJ 187 M
(Based on RB 9338) With (2325) and (310)

Test No.	New	Embrittlement 1 Week	1 Month	Set-to-touch	Over Night Dry
1	OK	OK	OK	5 hr. 30 min.	Cons. tack
2	OK	OK	Short	5 hr. 25 min.	Cons. tack
3	OK	Sl. short	Brittle	5 hr. 25 min.	Def. tack
4	OK	Short	Brittle	5 hr. 10 min.	Sl. tack
5	OK	OK	OK	5 hr. 30 min.	Cons. tack
6	OK	Sl. short	Short	3 hr. 25 min.	Cons. tack
7	OK	Sl. short	Short	3 hr. 30 min.	Sl. tack
8	OK	Short	Brittle	3 hr. 35 min.	Sl. tack

Porch and Floor Enamels

Panels 12009-17 C, F were examined after 9 months' exposure, 45° south, at Chicago and 8 months in Florida. The series consists of Porch and Floor Enamels, based on the formula of Rex 69 of 7-2-47, using (6173) and (2841)G, which is on the control panel. Special interest was centered on a batch using RB-7019, an ether resin from Resin Research. The outstanding scrub resistance of this enamel was reported in October, 1947 under Project 162, pages 25 and 26. At this point of exposure, the enamel looked very good in all respects, cleaner and less faded than the regular, with essentially no failure as against serious checking and cracking for the regular in Florida. An alkyd (4100-(4103) formula in the series was also very good in all-around performance, but this type has been criticized on occasions for slipperiness when wet. Several formulas using Standard Oil's "A" resin with linseed and castor were also in the series, and all were rated as little, if any, better than the regular in either durability or appearance.

#187 - Physical Properties of Pigments

In conjunction with the studies of the packing behavior of various extender pigments reported several months ago, the CPVC's of various hiding pigments have been determined. The pigments were dispersed in a fairly highly dispersing vehicle, 60% of (2) plus 40% of (48), (63) being used as the thinner. Vehicle substitutions were first carried out to facilitate the determination. The results obtained are tabulated below:

Pigment		CPVC
18	Basic Carbonate White Lead	59%
412	Leaded Zinc 35/65	54
414	Leaded Zinc 12/88	54
1403	Titanium Oxide, Anatase	41
1707	Zinc Oxide XX-50, Med. P. S.	39
2059	Zinc Oxide XX-503, Large P. S.	53
2132	Titanium Calcium, Titanox RC HT	54
2140	Titanium Calcium, Titanox RC	57
2174	Titanium Oxide Ti-Pure R-610	50
2295	Zinc Oxide, ZZZ-33, Acicular	39

From the data, the fact again becomes evident that the chemical composition is immaterial to the packing behavior of the pigments and that it is the particle size distribution and shape which plays the major role.

The work on the electrokinetic behavior of dispersed pigment particles was continued. Data on the behavior of mixed systems was obtained and an adaptation of the CPVC cell carried out with which it is hoped the ζ-potential can be measured directly.

Electrokinetic determinations on flooding pigments show promise of giving information for some of the reasons for these phenomena. A more comprehensive report on this subject will be submitted when more data have been obtained.

A report on the electrokinetic theory and the experimental progress made in this direction was given at the Research Meeting in Chicago on October 26.

#86 - Leaded Zinc Pigments

Panels 11611-28 F, C were examined after 12 months' exposure at Florida and 17 months at Chicago, vertical south, cedar beveled siding. The purpose is to test the results obtained by using mechanical mixtures of lead and zinc pigments at three zinc oxide levels, the lower ones having been suggested as possibly more suitable in the case of finer particle size zinc oxides than the usual level of about 32%. All panels are primed with Rex 450 Undercoater. In the top coats, the following zinc oxides, and also 412 dry leaded zinc, are used at (a) 32% zinc oxide content, (b) 21% and (c) 10% using 108 dry, XX 592; 1707 dry, XX-50; 2059 dry, XX-503; 2295 dry, Azo ZZZ-33.

On the basis of orthodox estimates of the PbO, $Pb(OH)_2$ or "active" constituent" contents, the mechanical mixtures should be higher in total reactivity than the corresponding co-fumed formulations. It would probably be considered normally that lead-free zinc oxides would be more reactive than the zinc oxide in co-fumed leaded zinc. B.C.W.L. "reactivity" may be expressed roughly as 35% $Pb(OH)_2$ or 30% PbO as against about 15 to 20% for the lead portion of lead sulfate, plus about 5% zinc oxide. 412 leaded zinc runs from 4 to 6% PbO. It was rather surprising, therefore, to find that in every part of the above test 412 samples were cleaner and better than the corresponding mechanical mixes, especially in the Florida series, which was most important because of mildew growth. There was an increase in mildew due to decreasing zinc oxide, as expected.

Though perhaps too early to be significant, there were signs of failure on the ZZZ-33 samples and in the 10% zinc oxide group. Mr. C. H. Adams has expressed great interest in these results, and plans to run actual reactivity tests by the fatty acid method on these various pigments. We should be able to report at some future time as to whether his results tend to uphold the orthodox conceptions or the data of these exposures, which certainly do not agree.

Two added zinc oxides, St. Joseph's #46 and #17, used at the 30% level only, showed up no better than the poorest of those listed above.

#177 - Pigment Studies

Mr. Bruhn is preparing a report of his trip east during which he inspected the Hunter Color Difference Meter, the Pittsburgh Plate Glass-IDL Color Eye, and the Razek-Mulder Spectrophotometer. He also reviewed the New Jersey Zinc Company's house paint exposures and discussed some problems on the application of films of uniform thickness and hiding power determinations with their laboratory.

#162 - Studies in Flat Wall Paint Formulation

Flat Wall Paint

Samples of Cleveland and Chicago Flat-Tone production were compared for drying characteristics in the constant temperature room (75° F. - 45% R.H.). Cleveland's production was found to be superior in drying to the Chicago production made without litharge, but production containing litharge at 3 pounds per hundred gallons was equivalent in drying to Cleveland stock. It was thought that the slower drying may be due to the (3880)E. However, identical batches of Flat-Tone made with Chicago, Newark, Acme, Cleveland and a standard laboratory batch of (3880) were all rated fair in drying. This would indicate that the (3880)E varnishes produced at the various plants are similar in drying, and that the slower drying properties may be due to the driers or type of mill used. These points are to be checked.

Until we can determine the cause of the slower drying, we will continue to add 3 pounds of litharge 1128 dry per 100 gallons in all Flat-Tone colors. In the Flat-Tone White formula, we are adding two extra gallons of (4230).

Work has been under way to determine the reason for the lower washability experienced with (3880)E made during recent months. In connection with this problem, it was thought that the oil may be over-limed, resulting in a calcicoater type of liquid. However, from an analysis of the calcium contents we can see no connection with washability. It appears that the washability figures below are directly proportional to the viscosity of the flat. The film thickness is probably greater in the case of better washability.

Chart follows.

#162 - Cont.

Flat-Tone Vehicle Tests

Batch	Formulation	Viscosity #5 Orifice Fresh	Viscosity #5 Orifice O'Nite	Wt./Gal.	Brushing	Flow	Drying Set-to-Touch	Drying O'Nite	Uniformity of Tint	Uniformity of Sheen	Washability Rubs to Failure 1 Weeks	Washability Rubs to Failure 3 Weeks	% Ca as CaO*
OJ 229 M	RB 9638 Lab. Std. (3880)E	23"	23.2"	11.81	Sl. sticky	Good	24 min.	Fair	Good	Good	200	90	0.22%
OJ 320 M	Chicago Body I (3880)E	9.8"	11.8"	11.96	O.K.	Good	22 "	"	"	"	89	55	0.25%
OJ 321 M	Newark (3880)E	7.2"	10.8"	11.94	Good	Good	32 "	"	"	"	35	33	0.43%
OJ 322 M	Acme (3880)E	10.0"	13.0"	11.93	Good	Good	27 "	"	"	"	62	55	0.12%
OJ 323 M	Cleveland V 11161 (3880)E	15.0"	17.6"	11.96	Sl. sticky	Good	23 "	"	"	"	100	80	0.10%

*Theoretical lime content 0.21%

#162 - Cont.

Work also has been in progress to check the permeability of four flats, based on (3880)E, (2287) and combinations of both liquids to determine if there is any relationship with the decrease in washability which occurs over a four week period. As indicated by the data, about the same degree of moisture transmission is obtained, regardless of the type of varnish or the V/P ratio. This suggests that there are other factors which control the degree of washability of flat wall paints. Work will be continued.

	Flat-Tone OJ 115 M Reg. Form. 4-27-48	Special Flat-Tone OJ 116 M	Special Flat-Tone OJ 117 M	Flat-Tone OJ 118 M Reg. Form. 2-28-44
Pigmentation				
2203 dry	134 pounds	134 pounds	134 pounds	-
20 L	-	-	-	72 pounds
2188	-	-	-	72
2132	500	500	500	495
2228	25	25	25	-
Vehicle				
(3880)E	36 gals.	48-1/2 gals.	-	53 gals.
(2287)	17	-	66-1/2 gals.	-
V/P Ratio	.70	.70	.70	.79
Washability				
24 hour dry				
Washed by machine				
4# weight	425 rubs	375 rubs	170 rubs	600 rubs
7# "	325	200	65	480
Washed by hand	70	70	65	180
7 days				
Washed by machine				
4# weight	75	70	50	155
7# "	20	35	30	110
Washed by hand	25	40	25	50
2 weeks				
Washed by machine				
4# weight	50	55	35	140
7# "	35	25	30	100
Washed by hand	25	35	25	50
4 weeks				
Washed by machine				
4# weight	15	35	45	30
7# "	30	10	30	40
Washed by hand	20	20	15	30

(Cont.)

#162 - Cont.

	Flat-Tone OJ 115 M Reg. Form. 4-27-48	Special Flat-Tone OJ 116 M	Special Flat-Tone OJ 117 M	Flat-Tone OJ 118 M Reg. Form. 2-28-44
Permeability				
Water transmitted through film				
Age of film (days)				
1 day	0.239 g.	0.258 g.	0.246 g.	0.208 g.
6 "	0.275 "	0.261 "	0.280 "	0.240 "
14 "	0.277 "	0.264 "	0.238 "	0.204 "
28 "	0.275 "	0.275 "	0.263 "	0.246 "

Semi-Lustre

Settling characteristics of Semi-Lustre - Rex 210 are being studied through test series based on formula cards No. 4 and 5. In these, the suspension effects of Acto 450, CW (2343); Lecithin, 2270 dry; and increased calcium stearate, 1826 dry, are being observed. (310) was used where formulas called for (48).

Both formulas produced high viscosity paints. All the lithopone Ti-Cal formulations of Card #4 and one item in the TiO_2 formulations of Card #5 were reduced to standard viscosities by additions of from 7 to 9% (348) before being set aside to age. The additives and increased stearate caused marked increases in initial viscosities. In spite of this, they show no tendency to decrease the stability of the packaged goods. The extent of settling is so slight in all cases that conclusions as to effects of agents cannot be drawn at this inspection. The lithopone Ti-Cal formulation, Card No.4 appears to have better package stability than the TiO_2 formulation at this time.

Chart follows.

#162 - Cont.

Rex 210 Semi-Lustre
Stability and Settling

Formula Card	Agent	Viscosity Fresh batch Full body	Viscosity Fresh batch Reduced	30 days	Settling
#5	None	37.5"	-	55"	Very soft bead, puffy.
5	CW (2343)	69	-	70	No settling, very smooth.
5	2270 dry	51	-	62	" " "
5	3# 1826 dry	56	30"	40	Very soft bead, puffy.
5	4# 1826 dry	46	-	63	No settling, smooth, puffy.
4	None	40	22	22	Small soft bead.
4	CW (2343)	72	26	24	Soft bead.
4	2270 dry	57	27	25	Very small, very soft bead.
4	3# 1826 dry	51	29	30	Very soft bead.
4	4# 1826 dry	72	31	27	Small, very soft bead.

Enamels

Archer-Daniels-Midland's V 70 and Var Z_3 were made up into enamels and compared with Kem Namel Snow White Gloss for general performance. Var 70 is similar to (3109) in resistance to whitening in the water or soap tests, but the Var 70 enamels were quite yellow and appeared somewhat reactive in the presence of zinc oxide. The Var Z_3 enamel was very thin in body and poor in water and soap resistance. Var Z_3 is recommended as a blending liquid.

Chart follows.

#162 - Cont.

Tests on Painter Enamel Vehicles

Batch No.	Formulation	Viscosity Fresh	Viscosity O'Nite	Wt./Gal.	Drying Set-to-touch	Drying O'Nite	Brushing	Flow	Color	Gloss
OJ 37 M	Regular Kem Snow White	24.6"	37"	10.04	5 hr. 15 min.	Good	Good	Good	Good	Good
OJ 212 M	Using Var 70	25"	52"	9.80	2 " 5 "	Good	Good	High	Poor, yellow.	Good
OJ 213 M	Using Var-Z_3	7"	8"	9.82	4 " 55 "	Good	Too hasy	Very high	Fair	Good

Spot Tests

	H_2O	1% Soap
OJ 37 M	Whitening - trace.	Definite whitening; recovery in 2 hours, none.
OJ 212 M	Whitening - slight.	Definite whitening; recovery in 2 hours, none.
OJ 213 M	Whitening - bad.	Bad whitening; recovery in 2 hours, none.

#162 - Cont.

During the month the Resin Research Department submitted a considerable number of organic driers for test in SWP, Enameloid and Kem Namel Snow White. In most cases the organic driers caused bad staining and odor in all formulations. However, the last set (RC 1020 - 1028) were considerably improved in these characteristics.

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#187 - Physical Properties of Pigments

From time to time the CPVC's of single pigment paint systems ground in a mixture of 40% (48) bodied linseed + 60% (2) raw linseed oils have been reported. Both extender pigments as well as hiding pigments were investigated. Below is a comprehensive list tabulated according to dry numbers of the CPVC of the pigment systems so far determined. A conversion of the CPVC values to equivalent units of oil absorption in grams of oil per 100 grams of pigment is also included as well as a comparison of some of the standard oil absorption values.

			Oil Absorption		
Dry No.	Pigment	CPVC	Calc. from CPVC	Specification for Pigments	Method
3	Silica, Amorphous	59	25	23 - 27	419.1
18	Basic Carbonate White Lead	59	10	10 - 11	
20 F	Magnesium Silicate, Fibrous, 3 X	47	37	32	419.3
20 MSK	Magnesium Silicate, Loomis	40	50		
108 N	Zinc Oxide, Blend American and French Process - N. J. Z. XX-592	34	33		419.2
306	Barytes, Natural Barium Sulphate	59	15	8	
412	Leaded Zinc 35/65	54	14	15	419.2
414	Leaded Zinc 12/88	54	14	15 - 19	419.2
461 L	Lithopone, Low Consistency	59	15		
511	Leaded Zinc, 50/50	50	16	14	419.1
566	Calcium Carbonate, Natural Water	63	20	16 - 24	419.3
1194	Calcium Carbonate, Natural Chalk	60	24	15 - 19	419.3
1246	Soap Stone	42	46	26	419.3
1271	Titanium Calcium, Anatase Low Oil	54	26	23	419.2

(Cont.)

#187 - Cont.

Dry No.	Pigment	CPVC	Oil Absorption: Calc. from CPVC	Oil Absorption: Specification for Pigments	Oil Absorption: Method
1403 K	Titanium Dioxide, Anatase	41	35	24 - 25	419.2
1552	Diatomaceous Silica, Flux	36	75	100	419.3
1707	Zinc Oxide XX-50 Med. P.S.	39	27	14 - 17	419.1
1817	Calcium Carbonate (Surfex)	67	18	20	419.3
1897	Titanium Barium, 30% TiO_2	55	19	14 - 16	419.2
1901 T	Titanium, Anatase Low Oil	36	42	20 - 22	419.2
1989	Microne Talc	32	74	58 - 64	419.3
2030 T	Titanium Dioxide, Anatase Semi-chalk resistant	42	34	21 - 23	419.2
2031 T	Titanium Dioxide, Rutile Non-chalking	49	23	18	419.2
2059	Zinc Oxide XX-503, Large P. S.	59	15		
2077	Diatomaceous Silica, Fine Flux Calcined	38	67	90	419.1
2132	Titanium Calcium, Titanox RC HT	54	25	23	419.2
2140	Titanium Calcium, Titanox RC	57	22	21 - 22	419.2
2174	Titanium Oxide, Ti-Pure R-610	50	22		
2188	Micro Velva "A"	57	28	39 - 43	419.3
2201	Metronite B-XXXX	58	24	16	419.3
2203	Carbola Talc	45	45	30 - 36	419.3

(Cont.)

#187 - Cont.

Dry No.	Pigment	CPVC	Oil Absorption: Calc. from CPVC	Oil Absorption: Specification for Pigments	Method
2228	Titanium Dioxide, Rutile (R-110)	50	23		
2229	Titanium Dioxide, Rutile (R-510)	48	24		
2247	Calcium Carbonate (Atomite)	55	28	20 - 24	
2269	Titanium Dioxide, Rutile (RA-10 MO)	38	37		
2295	Zinc Oxide, ZZZ-33, Acicular	39	26	15	419.2
2307	Mica, AA	45	23	43 - 53	419.3

The numbers under "Method" refer to the specifications for obtaining oil absorption values in the S-W Testing Methods Handbook. 419.1 is the spatula method; 419.2 is a modified Gardner-Coleman method for hiding pigments; 419.3 is a rapid method for inert pigments.

Some of the above converted values from CPVC to "oil absorption" agree closely with those obtained by the spatula method, using (2) as the oil for the oil absorption liquid. Others diverge considerably. The CPVC in any event is the better measure of the packing behavior of pigments as it represents the actual packing of the pigments in relation to the vehicle employed for the dispersion, while the oil absorption method uses only linseed oil.

A determination was made of the amount of (4230) lead - (4231) magnesium - (4232) cobalt-naphthenate driers adsorbed on 20 dry magnesium silicate, 1403 dry titanium dioxide and 1707 dry zinc oxide pigments, respectively. The method consists of the procedure previously outlined: 5% solutions of the material to be preferentially adsorbed are made up in a suitable non-polar solvent such as (348) mineral spirits. A certain volume of this solution is then ground with a known weight of the pigment. After centrifuging the pigment out, the residue after evaporation of a known volume of the supernatant liquid is compared to the residue from an equal volume of the original solution. The difference in weight is the amount of drier adsorbed on the pigment, the quantity being calculable to convenient units of pigment weight or volume.

#187 - Cont.

Because of the apparent presence of free acids in the driers, erratic results were obtained, particularly for the zinc oxide pigment. By determining the acid numbers of the driers the amount of the soluble reaction product, zinc naphthenate can be determined and appropriate corrections made. The amounts of drier adsorbed on the 20, 1403 and 1707 pigments will be reported as soon as these correction terms have been obtained.

Considerable progress has been made in the determination of the physical action and causes of flooding and floating. Work is continuing on this project and a comprehensive report will be submitted when some of the remaining questions have been answered.

#177 - Pigment Studies

Opacity Study

The New Jersey Zinc Company has recently published its routine method for the evaluation of pigment opacity. The method which they have described embodies several features which are of interest to this laboratory.

Following the New Jersey Zinc procedure, paints are made on the Hoover muller using "Lucite" spatulas and a "Lucite" retaining ring on the muller to avoid metal contamination and discoloration. These paints are transferred directly from the muller to the draw-down surface which is a cellulose acetate sheet held in place on a vacuum bed plate. The draw-down is made and placed in a low temperature oven to accelerate the drying. After the drying cycle a 2-1/4" circle is cut from the draw-down using a sharp die. A corresponding blank is cut from the acetate sheet and the spreading rate is determined for the draw-down by weight difference.

These acetate supported paint films are then measured for reflectance over black and white backgrounds. Dibutyl phthalate is used between the background and the acetate sheeting to eliminate the air interface in much the manner that an oil immersion lens is used on a microscope.

The New Jersey method then sets up typical contrast ratio versus spreading rate curves for paints of various brightnesses, so that reflectance readings on any one draw-down may be extrapolated to give data for spreading rate at a 95% contrast ratio (this is the comparison point between pigments or paints).

The above procedure differs from that used in this laboratory by its use of acetate sheeting over a single set of backgrounds and by its mode of determining contrast ratio. We have used Morest charts and multiple draw-downs of various thicknesses to plot contrast ratio against spreading rate and read spreading rate at 95% C. R. from this curve.

It is interesting to note that duplicate values are obtained using Morest charts or the acetate sheet system of measuring contrast ratio. The use of acetate sheet offers an advantage in the weighing operation for the determination of spreading rates. It also affords an advantage for constancy or uniformity of the test backgrounds.

With a wide variety of paint types we are inclined to use the acetate sheet support in our normal method of testing. Further detail is available if there are those who are interested.

#86 - Leaded Zinc Pigments

Exposures 11319-47 F, C were examined after 18 months at Florida, vertical south, and Chicago north and south, regular cedar siding. The purpose was to test what was considered in early 1946 to be the formulations most likely to be used by National Lead in their forthcoming ready-mixed outside white. The basic assumption was that it would be 20% each of ZnO, BSWL, BCWL, anatase (for the white) titanium and extenders, the lead and zinc being a mechanical mixture. On this basis several lead-zinc conbinations were tested as follows, using (317) "Z" bodied linseed and formulating at both 30.4% and 34% p.v.c.:

XX-503 ZnO, National HTS BCWL and National Acicular BSWL.

ZZZ-33 ZnO, National HTS BCWL and National Acicular BSWL.

ZZZ-33 ZnO, National #111 BCWL and National Acicular BSWL.

ZZZ-33 ZnO, National HTS BCWL and 9 dry Sublimed BSWL.

412 dry (co-fumed), with National HTS BCWL.

The Florida tests are two coats self-primed only, but the Chicago tests included self-priming, and the use of Rex 450 and Titanium Pigment's MW-401 (zincless) as priners.

Differences at present are slight, but the following tentative inferences are possible:

1. Co-fumed formulas have at least a slight margin in durability.
2. No particular choice as to p.v.c. level.
3. Slightly greater failure using National HTS-acicular BSWL with XX-503 and ZZZ-33 than when using #111 or 9 dry.
4. ZZZ-33 with #111 possibly poorest of all. (Chicago results contradict this, showing ZZZ-33 with National HTS poorest.)
5. Practically all special tests show more mildew and dirt than co-fumed regulars.

Exposures 11611-28 F, C were examined after 12 months at Florida, vertical south, and 17 months at Chicago. The purpose is to determine whether certain zinc oxides of varying particle sizes could be used more successfully in Rex 471 SWP Gloss White by reducing the amounts used. Regular Rex 471, bodied oil type, all anatase TiO_2 is the basic formula and guide. Mechanical mix formulas at 32%, 21% and 10% zinc oxide make

#86 - Cont.

up the main tests, using at each level the following zinc oxides: 108 dry (XX-592), 1707 (XX-50), 2059 (XX-503), 2295 (Azo ZZZ-33), also 412 (Ozlo 35/65). A second portion of the test covers #46 and #17 zinc oxides from St. Joseph Lead Company at the 32% level only.

Very sharp differences in mildew (Florida) and dirt (Chicago) showed up, due to both the type and quantity of pigment. Greater mildew on the lower ZnO samples is obvious. 412 is much cleaner than the mechanical mixes at each ZnO level. There is no serious failure, but the two lower-ZnO groups show signs of early erosion, with ZZZ-33 tending to check slightly on Florida exposure. The two St. Joseph samples seem even more dirty than the other zinc oxides, and are the only ones to show really significant checking and cracking.

#162 - Studies in Flat Wall Paint Formulation

RCI Drying Recorder

The Reichhold Drying Recorder has been received and is being put through a series of tests to determine whether it is suitable for rather general use throughout the institution. After preliminary inspection and testing there is a definite possibility that several major changes will be required to develop maximum usefulness and versatility. It is suggested that other institutional laboratories might do well to delay ordering Drying Recorders until this department has had an opportunity to do further work.

The following variables are under consideration at this time:

1. Pin design to give a more positive endpoint.

2. Size of top plate to accommodate standard draw-downs on glass plates.

3. Effects of light and ventilation on drying of films.

Some interesting results have been obtained on the effect of light on drying. Comparing one sample of Rex 710 Enamaloid White under constant temperature and humidity conditions but varying the light conditions from darkness through radiation with diffuse daylight and diffuse fluorescent light the following comparable points were read with the RCI recorder (actually the point where the standard pin lifts from the glass - somewhat later than the conventional "set-to-touch time"):

Type of Illumination	Foot-Candles	Dry Point
Darkness	-	215 minutes
Diffuse daylight	Approximately 10 - 15	190 "
Diffuse fluorescent	Approximately 40 - 50	205 "

These figures are the averages of three runs under the specified conditions.

Flat Wall Paints

A recheck of Flat-Tone made at Chicago during recent months shows viscosities between 8 and 10 seconds on the #5 orifice when (3880)E of standard body is used. Pebble mill batches appear to have slightly lower viscosity than those made on roller mills. After we receive Cleveland's report on the viscosities of Flat-Tone made at Cleveland, Newark and Detroit, we may find it necessary to set up an alternate formula for pebble mill production to increase the initial body slightly.

#162 - Cont.

Flat Wall Paints - Cont.

Samples of Flat-Tone White made with Shell's 8296 Mineral Spirits and deodorized kerosene, Regular Base #1 which were sent to Cleveland for test were reported to be much superior in odor to regular Flat-Tone. Shell has reported that the special 8296 Mineral Spirits and regular mineral spirits are the same in cost but their deodorized kerosene is approximately 3-3/4¢ higher than (141). The increase in cost would therefore amount to less than one cent per gallon. Cleveland is to check with the sales department to see if they are interested.

A sample of Dianol Paint Insecticide, manufactured by Intercontinental Enterprises, Inc. was tested as an insect repellent in flat wall paint. According to their directions, one pound of Dianol was added to a gallon of flat wall paint. Paints made with and without Dianol were brushed on Upson board panels and allowed to dry for 72 hours. Tests were run using flies obtained from Sinclair Refining Company. Dianol did not seem to repel the flies or to have any effective killing power when used to the extent of one pound per gallon of paint.

Porch and Floor Enamels

The Resin Research Department submitted two ether resin varnishes, RC 0620 and RC 0621, as liquids for use in Porch and Floor Enamels:

	Resin	Oil	Body	A. V.	Color	Solids
RC 0620	*	Linseed	Z_5	5.1	11	70%
RC 0621	*	Soya	$Z - Z_1$	1.2	7	70%

*Butyl phenol formaldehyde modified bisphenol epichlorohydrin resin.

The two varnishes were compared with an earlier ether resin varnish, RC 0579, which is also based on soya and regular floor enamel made from (6173) and (4950)G. RC 0620 was too high in body to be suitable for Porch and Floor. However, enamels made with RC 0621 and RC 0579 were only slightly high for body. From the standpoint of gloss RC 0621 was quite good, whereas RC 0579 was rather low compared with standard Porch and Floor Enamel. The enamels will be exposed at 45° south in Chicago and Florida. They will also be checked for washability and package condition.

#162 - Cont.

Porch and Floor Enamels

Batch	Vehicle	Viscosity #3 Fresh	Viscosity #3 3 Days	Brushing	Flow	Drying Set-to-touch	Drying O'Nite	Gloss
358 M	(6173) (4950)G	20"	27"	Good	Too high	1 hr. 50 min.	Good	V. good
357 M	RC 0621	39"	49"	Sticky	Good	1 " 20 "	V. good	V. good
356 M	RC 0620	2' 1"	2' 5" 7 days	Too high in body - no tests.				
205 M	RC 0579	33.4"	38.6"	Sticky	Sl. short	2 hr. 20 min.	Good	Low

Water and Soap Resistance

Batch	Vehicle	16 Hour Water Test	3 Hours - 1% Soap
358 M	(6173) (4950)G	No whitening	Slight + whitening
357 M	RC 0621	" "	Trace whitening
205 M	RC 0579	" "	Definite whitening

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#187 - Physical Properties of Pigments

The September Report of Investigations gave data on the moisture permeability of a number of conventional interior wall paint systems. Because of certain anomalies the run was repeated but with no greater success.

The systems under test were as follows:

First Coat	Second Coat	Third Coat
Rex 25 Wall Primer and Sealer	Rex 810 Flat-Tone White	-
Rex 29 Aluminum Paint	Rex 25	Rex 810
Rex 25	Rex 210 Semi-Lustre White	-
Rex 29 Aluminum Paint	Rex 25	Rex 210
Rex 50 Flat-Rite Undercoater	50/50 Flat-Rite/Rex 710	Rex 710 Enameloid White
Rex 50 Reduced 8/1 with boiled oil	"	"

Because of the relatively low degree of permeability, these determinations are comparatively difficult to carry out. The results obtained on the second series do not agree too well with those of the first, although the order of magnitude is within reasonable limits. Reruns on individual samples of films check rather closely, but as soon as a new sample of drawdowns is prepared the checks between different samples of the same materials becomes rather poor. A more refined technique than that employed up to now has been worked out and it is hoped that the major sources of error will be eliminated.

The work on flooding, floating and silking has progressed very satisfactorily. The major sources of these phenomena have been isolated and a number of photomicrographs illustrating the various phases have been prepared.

It was determined that flooding, floating and silking as well as orange peel are the result of the formation of eddy currents in the applied films while drying, the float and silk being brought about directly through vortex action. A portion of the pigmentation of the wet paint film is floated away from its original position and deposited at different positions of the film in higher concentrations.

If the shade or hue of this pigment varies from that of the main portion of the film, a color differing from that of the original mixture will result which is manifested in the appearance of flooding, floating or silking. The various conditions under which these states can be induced or repressed have been studied and a comprehensive report covering these phenomena is being prepared and will be ready for distribution at an early date.

#162 - Studies in Flat Wall Paint Formulation

RCI Drying Recorder

There was some discussion in the November report of the work in progress with the Reichhold Drying Recorder. During the past month several decisions have been made and action is being taken to modify the recorder for increased utility. It is suggested once more that other institutional laboratories delay ordering Drying Recorders pending completion of the study which we have under way.

During the past month the instrument has been in almost 24-hour operation testing house paints at night and enamel types during the daytime hours. The pin or stylus design has been standardized as a square end flat "hoe" 1/4" wide x 1/32" thick. These have been adjusted to a bearing weight of 4.03 grams on the paint film.

The operation has been standardized so that under normal conditions two endpoints are observed:

(1) The "tear point" is that point at which the first visible characteristics of a hardened top film become evident. This is a measure of surface dry and corresponds quite closely to "set-to-touch" time. On the time-drying track it is the point at which the paint starts to ripple and tear along the edges.

(2) The "break point" is the point at which the stylus raises from the substrate to ride on the surface of the film. This point gives some measure of through dry.

Using the stylus and the interpretation described above, these comparative measurements have been made with the recorder:

Product	Tear Point (Minutes)	Break Point (Minutes)
Rex 100 - Kem-Namel	-	355
Rex 210 - Semi-Lustre	-	185
Rex 710 - Enameloid (oleoresinous)	120	154
Rex 810 - Flat-Tone	-	75
Rex 471 - Pre-war	535	830
Rex 471 - Post-war (linseed)	500	620
Rex 16174 - Kromik	-	170
Rex 51400 - Kem-Glo	- None	-

#162 - Cont.

RCI Drying Recorder - Cont.

A study of these tests reveals two interesting and separate phenomena. It was found that paints formulated at or near the CPVC do not exhibit surface drying as distinguished from through drying. There is no evidence of a top film formation with these paints. Only the break point is noted without the typical tear point as evidenced with such materials as Enameloid or SWP. The second unusual performance was that of Kem-Glo enamel. This material was found to dry from the bottom up as evidenced by the fact that the stylus lifts very gradually from the bottom, leaving a wedge shape depression in the paint film much like the slot of the Hegman grind gauge. Work is under way to determine the cause of this performance.

The recorder is being modified to test 12 samples simultaneously. Details of this modification will be reported as soon as they have been worked out completely.

Flat Wall Paints

Work continues to improve the washability of Flat-Tone. In connection with this problem, we have investigated a product called Vistac #1 made by Advance Solvents and Chemical Corporation, also an alkyd called Syntex 131 from Jones-Dabney Company.

Vistac #1 was introduced for the solids of (2287) which amounted to 4-1/2 gallons per 100 gallons paint or approximately 25% of the vehicle solids. A second test was also made using 3 gallons per 100. It produced an improvement in washability but was poor in uniformity of tint and sheen. The flats containing Vistac were rather poor in drying over night.

Properties of Flat Wall Paints

Batch	Viscosity #5 Fresh	Viscosity #5 O'Nite	Brushing	Flow	Drying	Washability No. Rubs 1 Week	Washability No. Rubs 2 Weeks	Uniformity Tint	Uniformity Sheen
425 M Reg. formula	14.6"	16"	Good	Good	Good	100	75	Good	Good
427 M 4-1/2 gals. Vistac	17"	18.8"	Good	Short	Soft	200	75	Fair	Fair-
498 M 3 gals. Vistac	13"	14.6"	Good	Sl. short	Sl. soft	200	175	Good	Fair-

#162 - Cont.

Flat Wall Paints - Cont.

Laboratory batches of Flat-Tone made with (3880)E and Syntex 131 were good in washability, flow, drying, etc. but additional work will be required to improve the uniformity of sheen and to increase the initial viscosity.

Wall Primer and Sealer

The new formula for Rex 25 (card #4) was compared with the previous formulas dated 3-11-48 and Alternate A dated 4-13-48. The new formula was better in drying but not equivalent in sealing to the formula dated 3-11-48. The latest revision is based on the same pigmentation as the alternate formula dated 4-13-48. The sealing properties of these two formulas are not equivalent to that of card #3.

Properties of Wall Primer Formulations

Batch	Characteristics	Viscosity Fresh	Viscosity O'Nite	Brushing	Flow	Gloss (On Upson Board)	Gloss of Recoat (Semi-Lustre on Upson Board)
OJ 487 M	Card #3 With 110# 1403	25"	27"	OK	OK	Very low sheen	Good
OJ 488 M	Card #3 Alt. A With 90# 2173 and 3 gal. (4230)	22"	24.6"	OK	OK	Very low sheen	Good
OJ 489 M	Card #4 As card 3-A but 8 gal. (4230)	25"	26.8"	OK	OK	Very low sheen	Good

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Batch	Drying Set-to-touch	Sealing O'Nite	Sealing (On Transite Board)	Sealing (On Upson Board)	Drying (On Steel)
OJ 487 M	50 minutes	Good	Good	Good	Good
OJ 488 M	1 hour	Good	Sl. spotty	Good	Good
OJ 489 M	50 minutes	Good	Sl. spotty	Good	Good +

#162 - Cont.

Semi-Lustre

In a study of settling in Semi-Lustre - Rex 210, a series of enamels was prepared on Formula Cards #4 and #5, with variations to show the effects of wetting agents Acto 450 CW (2343) and lecithin 2270 dry. The settled state of these materials was observed after three months in the package.

There was no objectionable settling in any case, and samples containing wetting agents showed slightly softer and less thixotropic settled pigment cakes than did the reference materials with no additives. Lecithin fortified batches hold a very slight advantage over those containing Acto 450 CW (2343) at this point in the test.

Enameloid

The Resin Research Department submitted a 25 gallon Dehydrol-Krumbhaar Resin K-454 varnish coded RC 1338 to be compared with (2848)E in Enameloid White. The Krumbhaar 454 resin is a rosin maleic acid type resin designed for pale varnishes.

The enamel made with RC 1338 was similar to Enameloid White made from (2848)E. However, RC 1338 is about 11¢ a gallon higher in cost than (2848)E. The two enamels will be checked for clasticity and after-yellowing.

Batch	Varnish Tested	Drying Properties		Viscosity	
		Set-to-touch	O'Nite	Fresh	3 Days
OJ 500 M	(2848)	2 hr. 15 min.	Good	41.2"	44"
OJ 501 M	RC 1338	2 hr. 30 min.	Good	29.8"	32"

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Batch	Brushing	Flow	Color	Gloss	Spot Test	
					1% Soap	Water
OJ 500 M	Sl. sticky	Good	Good	Good	Definite whitening	Very slight whitening
OJ 501 M	Good	Very good	Good	Good	"	"

#162 - Cont.

Bodying Agents

In addition to the bodying agents referred to in the September report, we have also investigated the two agents listed below in One Coat House Paint - CH 4697, Flat-Tone Dawn Blue - Rex 808, C 3158, and Kemclad Enamel White - F70 W 2. The Kemclad Enamel was not checked for viscosity at the 31 day period due to the fact that both bodying agents separated from the Kemclad vehicle.

Bodying Agent Tests (Viscosity)
Viscosities at 75° F.

Agent	Time in Days	Amount of Agent Added per Pint: None	1/8 Oz.	1/4 Oz.	3/8 Oz.	1/2 Oz.
One Coat House Paint - 411 M						
Enamel Thickner X-151 F. S. Lewis and Co.	At once	19.4"	22"	25.6"	28.2"	32.8"
	1	20.4	23.4	26.6	29.8	33
	3	20.0	22.8	25.6	29.8	31.6
Note:	7	20	22.8	24.6	27	30.4
Agent reduced 1600% with (348).	15	20.2	22.6	24.2	25	29.4
	31	21.8	22.6	24.2	25.4	27.2
Kemclad Enamel - Rex F70 W 2						
Agent was not reduced.	At once	14.4"	14.8"	15.4"	16.2"	17"
	1	14.8	15.6	15.8	17.2	17.4
	3	15.6	16.8	17.6	18.4	19.2
	7	16.6	17.2	18.2	19	20.2
	15	17	18	19.4	19	21
	31	Agent separated from Kemclad.				
Flat-Tone Dawn Blue - Rex 808						
Agent was not reduced.	At once	15.4"	15.8"	16.6"	17.4"	17.8"
	1	15.2	16.4	17.8	18.8	19.4
	3	16	17.2	18.6	20.4	21.2
	7	16	17.4	19	20.2	20.6
	15	16	18	19.2	20	20.8
	31	18.2	18.4	20.4	21	21

#162 - Cont.

Bodying Agents - Cont.

Bodying Agent Tests (Viscosity)
Viscosities at 75° F.

Agent	Time in Days	Amount of Agent Added per Pint: None	1/8 Oz.	1/4 Oz.	3/8 Oz.	1/2 Oz.
		One Coat House Paint				
V-510 Vehicle Carlson Industrial Finishes. Note: Agent reduced 1600% with (348).	At once	19.4"	20.6"	26.4"	32"	36"
	1	20.4	21	25	31	35
	3	20	20.6	25	30.2	35
	7	20	20.6	24.8	30	32
	15	20.2	21	23	28	31
	31	21.8	20.6	24	27.4	28
		Kemclad Enamel - Rex F70 W 2				
Agent was not reduced.	At once	14.4"	15.4"	16.2"	17"	19.8"
	1	14.8	15.6	16.8	18	19
	3	15.6	16.8	18.4	19.4	21
	7	16.6	17.6	19	20.4	21.4
	15	17	17	19.2	21	22.2
	31	Agent separated from Kemclad.				
		Flat-Tone Dawn Blue - Rex 808				
Agent was not reduced.	At once	15.4"	16.4"	17.4"	18.6"	19.6"
	1	15.2	17.2	18.8	20.4	21
	3	16	18.8	20.2	22	23.4
	7	16	18	20	22	23.4
	15	16	18	20.2	22	25
	31	18.2	18.4	20.4	22.6	24.4