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MEMORANDUM REPORT # M-551

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HIDING OF TITANIUM OXIDE AND CELITE EXTENDER IN "FLOW-KOTE"INTRODUCTION:

Super Kemtone Shasta White contains less titanium oxide than "Flow-Kote" White, but measurements made a year ago by the Pigments Department showed that it had at least as good hiding as "Flow-Kote" per gallon.

The comparison of hiding efficiency is complicated by the fact that "Flow-Kote" is whiter than Super Kemtone. Hiding varies inversely with whiteness. For a comparison of hiding efficiency, "Flow-Kote" must be tinted to match the color of Super Kemtone.

This memorandum reports new measurements to decide the question whether there is a real difference in the hiding efficiency of titanium oxide in the two paints.

CONCLUSION:

1. Super Kemtone has significantly better hiding than "Flow-Kote" per pound of titanium oxide; the difference is about 10%.

2. This does not agree with the conclusion reached from the older set of measurements, because the hiding efficiency of Super Kemtone has been increased during the year since the older measurements were made.

3. Diatomaceous earth (Celite) is responsible for the increase in hiding efficiency of Super Kemtone.

4. A modification of "Flow-Kote" with Celite at the present gloss level has better hiding than Super Kemtone per

pound of titanium oxide, presumably because the proportion of Celite to titanium oxide is higher.

5. The effect of Celite is peculiar to emulsion paint. It does not increase the hiding of a solvent-type paint like Superwhite.

ACTION:

The use of Celite to lower cost and improve hiding is being investigated under project P-10201.

DETAILS:

Comparison with Super Kemtone:

Two recent production batches of low gloss "Flow-Kote" White, P-391-U-46482 (391-012), have been compared with two recent samples of Super Kemtone Shasta White. "Flow-Kote" was tested both at its original whiteness and tinted to match Super Kemtone. Data are shown in Table I.

All Samples were analyzed chemically for titanium oxide. Super-Kemtone contains more titanium oxide than is shown on the label. The hiding efficiency has been calculated separately for the formula amount of titanium oxide and the amount found by analysis.

The amount of titanium oxide in "Flow-Kote" found by chemical analysis checks closely with the calculated amount.

Effect of Extender:

Diatomaceous fragments can be seen in Super Kemtone under the microscope. A "Flow-Kote" modification, P-391-U-53110, was prepared to contain the maximum amount of Celite #266 (W-165) at the gloss level specified for "Flow-Kote". The pigment volume was kept unchanged at 38% by adding China clay (W-1) as the remainder of the extender. The titanium oxide content was reduced to the nominal concentration in Super Kemtone. These changes reduce the raw material cost of "Flow-Kote" 13¢ per gallon.

The hiding of P-391-U-53110 is shown in the last two lines of Table I. The increase in efficiency of hiding is evident.

In addition to "Silica and Silicates", Super Kemtone probably contains Lorite extender. This material is described as 80% calcium carbonate and 20% diatomaceous silica. We have measured the hiding of paints in which it is the sole extender; in contrast to Celite, it contributes nothing to the hiding.

Comparison with Superwhite:

To determine whether Celite increases the hiding of solvent type paints, the hiding of Superwhite Gloss and Superwhite Flat was measured. Superwhite Flat contains Celite as extender. A

comparison with the hiding of "Flow-Kote" is shown in Table II. Since Superwhite has lower brightness than "Flow-Kote", the figures in the last column of Table II have been corrected to the brightness of Superwhite by means of the Kubelka-Munk relation⁽¹⁾.

Experimental Procedure:

The values in Table I were obtained on films brushed on black and white paper charts. For Table II, films were drawn down on glass. The reflectance of the film on glass was then read over a white backing and a black backing to determine the contrast ratio. The variability of this method is found to be higher than for the brushed films.

The figures for the hiding of "Flow-Kote" in Table I and Table II do not agree. There is a difference between the brushed films and drawdowns too large to be ascribed to experimental error. The reason for the difference has not been determined.

The spreading rate at 0.950 contrast ratio has been estimated from the observed values by means of the Kubelka-Munk chart ⁽¹⁾. The usual method is to make a graph of the experimental data and to interpolate at the selected contrast ratio. Some of the data in Table I have been handled both ways, and the agreement between the graphical method and the values estimated from the Kubelka-Munk chart is very close.

REFERENCES:

- Letter: W. F. Singleton to D. McBurney 10/10/52
 Letter: J. B. Bullitt to J. W. Illiff 10/14/52
 Notebook 5578, pp. 8-27.

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(1) D. B. Judd, et al: J. Research National Bureau of Standards 19, 287-317, (1939).

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TABLE I: HIDING OF BRUSHED FILMS OF "FLOW-KOTE" AND SUPER KEMTONE WHITE

PRODUCT	NO. OF DYER- MINA- TIONS	BRIGHT- NESS	LB. PIGMENT PER GALLON		SQ. FT. /GALLON	SQ. FT. /LB. TiO ₂
			TiO ₂	LITH- OPONE		
391-Q12 White "Flow-Kote"	6	89.3	2.68	----	449	168
White "Flow- Kote" tinted	4	78.1	2.63	----	599	224
Super Kemtone: Actual TiO ₂ content (a)	5	79.7	2.33	0.56	590	242 (c)
Nominal TiO ₂ content (b)			2.12	0.56	590	266 (c)
P-391-U-53110	2	88.3	2.10	----	520	248
P-391-U-53110 tinted	2	80.1	2.10	----	601	286
Standard Deviation of Single determination					±30	±13

(a) Amount of TiO₂ determined by chemical analysis.

(b) Amount of TiO₂ calculated from label analysis.

(c) Hiding of Lithopone deducted on the basis: one pound lithopone equals 0.18 pound TiO₂.

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TABLE II: EFFECT OF CELITE IN SOLVENT-TYPE AND LATEX FILMS

PRODUCT	BRIGHT- NESS	LB. PIGMENT PER GALLON			SPREADING RATE AT 0.950 CONTRAST	
		TiO ₂	CELITE	ZnO	RATIO SQ.FT./GALLON	RATIO SQ.FT./LB. TiO ₂ 84.0
391-012 "Flow-Kote" with Asbestine	88.8	2.68	----	----	404	150
P-391-U-53110 "Flow-Kote" with Celite	88.3	2.10	0.67	----	445	212
58-5223 Superwhite Gloss	83.7	3.19	----	0.36	572	177 (a)
69-142 Superwhite Flat	84.5	3.17	1.00	0.19	539	169 (a)
Significant difference at 95% probability					485	130

(a) Corrected for hiding of Zinc oxide on basis: one pound zinc oxide equals 0.14 pounds TiO₂.