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File: 1810

Marshall Laboratory
August 16, 1955

MEMORANDUM REPORT NO. M-746, SUPPLEMENT A

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UNIVERSAL TINTING BASES

OBJECTIVE:

To develop a line of tinting colors which will be compatible with oil based as well as with emulsion paints. The system should contain the same pigments and the bases should have the same strength as the present Custom Color bases.

SUMMARY:

The Universal Tinting System that has been under development has reached a point where many evident advantages to the present Custom Color System can be established:

1. The new Universal bases are compatible with alkyds, regular "Flow Kote" quality and PVAc-Sealer Coater.

2. Universal bases provide improved color development in deep tone "Flow Kote".

3. From standpoint of consistency and general storage stability the Universal bases are ahead of the Custom Color colorants.

Uncompleted work:

1. Improving dry of alkyd products tinted with Universal bases to deep tone tints. At present, the universal system represents some sacrifice in the dry of tinted alkyd products.

2. Effect of aging on compatibility. Information on this question at this point is variable, but inconclusive. The aging study will be completed within 3 Mos.

3. No information of exposure series yet available.

4. Improving of color development of some pigments in alkyd tinting whites is desirable.

INTRODUCTION:

The search for a vehicle for Universal bases started in April, 1954. The first phase of the accomplishments was reported in Memorandum Report No. M-746 prepared by C. W. Secker and H. R. Heikel. At that time dehydrated castor oil H-156 (DCO) had been found to be most suitable vehicle when used together with a wetting agent. The most promising wetting agent was Triton X-100 (H-609) an alkyl-aryl ether of polyoxyethylene glycol

This report will cover the following subjects:

1. Eliminating thinner from Universal bases.
2. Establishing the optimum level of wetting agent.
3. Establishing best grinding procedure.
4. Extending of Universal bases for light tone tints.
5. Intermixes of Universal bases.
6. Improving color development of some universal bases in alkyds.
7. Exposures.
8. Storage stability.
9. Dry of tinted material.

Above questions will be handled each separately.

1. ELIMINATING THINNER FROM UNIVERSAL BASES.

The odorless thinner H-632 seems to impair somewhat the compatibility of the Universal bases with the emulsions. With the exception of W-679-base the Universal bases, because of the low viscosity and good wetting properties of the Universal vehicle (DCO + wetting agent) have a creamy consistency even without thinner. From standpoint of consistency the thinnerless Universal bases are superior to the Custom Color bases. In order to obtain the maximum color development by minimum stirring of emulsion paints the consistency of tinting base plays an important roll.

2. OPTIMUM LEVEL OF WETTING AGENT.

In initial work the level of wetting agent was arbitrarily set at 5% by weight of the tinting base. For the inorganic pigments this amount seemed in most cases to be adequate but the organic bases required up to 10% wetting agent to become compatible in emulsions. Because the inorganic bases are approximately twice as heavy as the organic bases they naturally require only half as much wetting agent an the organics to make

amount of wetting agent equal by volume of colorant. The Triton X-100 has been the most promising wetting agent. However, it was not able to provide sufficient compatibility for W-622 base (Molybdate orange) not even at 10% level. W-630 base (ferrite yellow) required Triton up to 10% for getting best results. For W-622 base another wetting agent suited better. This was Tween 81 (polyoxyethylene sorbitan mono-oleate) that earlier had been considered as a Universal vehicle. Tween 81 seemed to suit also other inorganic bases as well as Triton X-100, however, Tween 81 could not replace Triton X-100 in organic bases.

The best results were obtained by following amounts of wetting agent:

W-679	5% Triton X-100 or 5% Tween 81
W-895	" "
W-303	" "
W-630	10% Triton X-100 or 10% Tween 81
W-622	10% Tween 81
W-300	12% Triton X-100
W-527	10% Triton X-100
W-785	"
W-205	"

In addition to wetting agent a small amount of Soya Lecithin is needed for the inorganics to assure compatibility with emulsions.

When Universal bases were subjected to oven aging some of them lost their compatibility which might be caused by too low wetting agent content. More details about these facts and proposed corrections are given under the heading 7, Storage Stability.

3. GRINDING PROCEDURE

All inorganic bases were suitable for 5 Roll mill and a good fineness was obtained by grinding two passes. Of the organics only the W-205 base (Lamp black) had heavy enough consistency for 5 Roll mill. The other organics were ground both on ball mill and "47 Process". These bases have a tendency to become thixotropic by grinding. Better fineness was obtained by "47 Process" and therefore also better color development in alkyds. The fineness of tinting base does not seem to have much influence on color development in the emulsions. The optimum fineness is 0.5-1.0 mil.

4. EXTENDING OF UNIVERSAL BASES FOR LIGHT TONE TINTS

The extender was prepared by grinding W-73 ($CaCO_3$) with DCO + 5% Triton X-100. The concentrated Universal bases were blended with this extended base at the ratio giving equal pigment volume to the corresponding Custom Color colorants. The color development of the extended bases was excellent in both alkyds and emulsions.

5. INTERMIXES OF UNIVERSAL BASES

The present Custom Color system includes 70 color families of which most represent intermixes between two tinting bases. To compare the Universal bases to Custom Color system, these 70 color families were prepared using both the new and old tinting systems. The colors were made at 28/1 tinting level in the light tone range and at 28/4 level in the deep tone.

a) Light tones

Custom Color light tone gloss 639-775 and Custom Color light tone "Flow Kote" 389-006 were tinted side by side with the extended Custom Color bases and the extender Universal bases in that way all 70 colors were obtained in both systems. The tints were brushed out and the color match between alkyd and "Flow Kote" was evaluated. After close comparison it could be concluded that Universal system was superior to Custom Color system as far as color match between alkyd and "Flow Kote" is concerned except in those cases where the monastral pigments (W-527 and W-785) were involved. It should be pointed out that 53% of the 70 colors include W-527 and 18% W-785. The poor color match of the monastrals resulted from excess color development in "Flow Kote" and low color development in alkyds. Efforts to correct this disadvantage are described under heading No. 6.

The "Flow Kote" used in making the mentioned tints contains wetting agent that makes it suitable for Custom Color tinting. The Universal bases already include wetting agent and are therefore compatible in regular 391-Line "Flow Kote". The same tints using Universal colorants were made in 391-012 "Flow Kote" by calculating the amounts of needed tinting base according to the TiO_2 content of the white base. Tinting 391-Line "Flow Kote" led to further improvement in favor of Universal bases; however, W-527 was still unsatisfactory in many cases. All 70 colors were also tested in PVAc-Sealer Coater with favorable results.

b) Deep tones

A deep tone "Flow Kote" of 391-012 quality which is adjusted to the same TiO_2 content as Custom Color deep tone in "Flow Kote" has been prepared for testing Universal colorants in deep tone range.

The concentrated colorants of Custom Color and Universal systems were letdown in deep tone gloss and respective "Flow Kotes". In this case the over-all picture in respect of color match between alkyd and "Flow Kote" fell in favor of Universal system. Once more it was noticed that W-527 did not develop sufficient color depth in alkyd.

c) Cross blends of Custom Color and Universal Colorants

A few intermixes of Custom Color bases and Universal bases were tested. When only inorganic pigments were involved the colors were excellent. Where organic pigments were used the color uniformity represented a compromise between that obtained in either system above. The Custom Color - Universal cross blends were surprisingly good in PVAc-Sealer Coater, showing only slight color variation at various film thickness.

6. IMPROVING W-527 COLOR DEVELOPMENT IN ALKYDS

It was noticed that cross blends of Custom Color bases with the Universals gave good compatibility in PVAc-Sealer Coater and slightly improved color development of the organic pigments in alkyds. This fact indicated that W-527 ground in a vehicle composed by blending DCO with RC-601 would probably not only improve color development in alkyd but would also retard the excess color development in "Flow Kote" and the color difference between alkyd and "Flow Kote" could in this way be minimized. On the basis of this theory, a number of grinds were made in order to determine the best RC-601/DCO ratio. The ratio 55/45 resulted in considerably improved color match between alkyd and "Flow Kote".

Using this new W-527 base containing RC-601 a few most troublesome intermixes with other pigments were made. In most cases an improved color match was obtained. In extended W-527 colorants the alkyd/DCO vehicle around the blue pigment particles was not able to provide better color development unless the extender base also was ground in the combined vehicle of alkyd and DCO.

The above described vehicle combination could probably also be successfully used in conjunction with other pigments whose color development in alkyds leaves room for improvement. Blending RC-601 in Universal bases would unfortunately increase the viscosity but would probably be slightly advantageous in respect of dry. Besides incorporation of RC-601 in Universal W-527 base, replacement of Triton X-100 with other less hydrophillic wetting agents was tried. However, this approach did not lead to any improvement.

7. EXPOSURES

To determine how the Universal bases will compare with Custom Color colorants when used for tinting exterior Trade Sales Products, an exposure series was prepared (No. 15095) by tinting 301-888 Two Purpose Outside White, 601-910 Cement and Stucco and 387-301 Vinyl Masonry Paint. These same exterior products were doped with plain Universal vehicle to determine whether it will adversely affect mildew resistance (No. 15094). The first exposure information available within end of September, 1955.

8. STORAGE STABILITY

The Universal colorants were subjected to oven aging for determination of their stability characteristics. After 3 Mos. oven aging at 120°F it could be established that the general condition of the bases was good, oil separation and settling being less prominent than in Custom Color System. The W-527 and W-300 bases have, however, a tendency to skin readily, but we are inclined to believe that skinning will not occur when the colorants are packaged in tubes. Further work to incorporate an effective anti-skinning agent is in progress, however. The picture of color development after aging was less encouraging. In this respect the organic pigments were satisfactory, however, the inorganic colorants had lost some of their ability to develop color in PVAc-Sealer Coater. One of the inorganic bases, the W-622 Molybdate Orange, ground with DCO + 10% Tween 81 (instead of 5% Triton X-100) was satisfactorily dispersible after aging even in Sealer Coater. This fact gives rise to the belief that higher level of wetting agent and the use of Tween 81 could provide better stability for all inorganics. In this aspect a new series of inorganic bases at 10% wetting agent level was prepared and repeated oven aging of these commenced.

Besides stability of oven aged colorants the stability of tinted material was checked. One month old room samples of all 70 color families were brushed out and panels were compared to the initial coatings. The most conspicuous color changes notices were those tints including W-300 BON-red. The pattern was uniform showing excessive color development of this pigment in "Flow Kote". The same condition although very slightly less prominent was observed in the present Custom Color System. Also W-527 in "Flow Kote" seemed to become darker on aging. The other color changes in "Flow Kote" were of minor significance. The tinted alkyd paint in light tones were stable, but the deep tones in many cases showed a perceptable inclination for getting lighter. This latter change is slight, however and is probably not commercially significant. The most attention with respect to color drift has to be paid to W-300. The speed of this darkening was tested and it could be stated that the first perceptable change took place six hours after the red tinting base had been dispersed into "Flow Kote". Within 24 hours the change had become objectionable and was getting worse from day to day. It was tried by lowering the amount of wetting agent to avoid the excessive emulsification of the BON-red but this approach failed. It might be worth mentioning that the color change of BON-red in PVAc-Sealer Coater is considerably slower and less prominent than in "Flow Kote". This might be caused by lower emulsifying ability of the Sealer Coater or also by less sensitivity of BON-red to acidic conditions in this product ("Flow Kote" pH-9, Sealer Coater pH - 5.) This color drift after tinting with W-300 in "Flow Kote" is considered sufficiently great to bar the use of these tints in the system.

9. DRY OF TINTED MATERIAL

When Custom Color deep tone gloss 639-776 was tinted with Universal colorants at 28/4 level (deepest step) a very detrimental effect on dry was noticed. In this respect the BON-red caused by far the slowest dry. This is also true in our present system. To determine which universal vehicle component is most responsible for retarding dry, the alkyd white was doped with DCO and wetting aging at levels corresponding to the deepest tint. This test indicated that the predominant retarding effect was contributed by the DCO.

Many ways for improving the dry have been considered and tested. The most natural approach was incorporation of a drier into the base. Spot tests fell in favor of lead naphthenate but because additional thinner was undesirable this drier as 100% solid had to be dissolved in the colorant. Dissolving well in DCO and improving the dry considerably, lead naphthenate seemed to be a suitable solution for the dry problem. However, incorporation of Pb-drier in the organic colorants resulted in interference of the compatibility with emulsions.

A number of other driers were tested with no success.

The incorporation of a small amount of Chinawood Oil (10% on the oil) is also being considered, and preliminary results are encouraging. To definitely establish the situation, Custom Color tints and Universal tints with and without lead drier were tested side by side by dry at varied tinting levels. Results are illustrated in the table below:

TACK FREE TIME IN HOURS

OF TINTED CUSTOM COLOR GLOSS

Pigment	DEEP TONES						LIGHT TONES		
	28/4				28/2		28/2		
Pigment:	ST	A	B	C	A	B	ST	A	B
Untinted	8						5		
W-679		16	20	8	9	12		8	8
W-895		16	20	8	9	12		8	7
W-303		16	20	7	10	11		8	16
W-630		7	20	7	8	13		8	8
W-622		7	16	8	8	13		6	8
W-300		20	22	-	9	13		5	5
W-785		7	20	-	7	11		6	8
W-527		16	16	-	8	8		7	8
W-205		8	20	-	10	12		16	16

ST = standard white
A = Custom Color
B = Universal
C = Universal + Pb-naphthena

Comments: In 28/4 deep tints both Custom Color and Universal tints are considerably slower in dry than the untinted white, the universals being much worse than the Custom Colors. The Pb-naphthenate addition to the Universal bases seemed to have remarkable effect on dry (amount of added Pb-naphthenate 1/3% by weight of tinted material).

In 28/2 deep tone the Custom Color is only slightly better than Universals.

In 28/2 Light tone the two tinting systems are about equal. Surprising is the fastest dry of W-300 tints. In deeper tints this pigment had an extremely retarding effect on dry. BON-red is a manganese salt, the structure resembling Mn-naphthenate. This pigment might in light tints act as a drier but when added in large amounts in deep tones it inhibits the dry.

It seems likely that a dry improvement for universal bases could be obtained by using less Pb-naphthenate than in the above tests. As mentioned previously the Pb-addition impairs the compatibility of the organic bases with the emulsions. In this respect the W-785 (monastral green) is worst. Tests were conducted to determine how much Pb-drier this base will tolerate without losing its compatibility. The answer was discouraging - even 1% Pb-naphthenate (on the colorant) caused noticeable incompatibility.

At this point it would appear that the dry problem might be most favorably solved by incorporation of additional driers to the airdrying tinting whites provided that this would not cause skinning in 7/8 filled cans. It has also to be taken into consideration that further drier addition in the present white bases could lead to serious film brittleness. On the other hand the small amount of non-drying wetting agent that will be incorporated in the white base in conjunction with the universal colorant might plasticize the film, preventing brittleness caused by excess drier.

The dry problem was discussed with Mr. L. Hubbuch who was inclined to believe that the favorable effect of Pb-naphthenate might be a result of "soaping" the film rather than a catalytic dry action. This thought is confirmed by the fact that the universal + Pb tints reached the "set-to-touch" stage faster than the Custom Color tints although the latter overtook the tack-free state in lesser time. Mr. Hubbuch suggested testing other soaps. Solid zinc naphthenate has been ordered from supplier and will be tried as soon as it is received.

NOTEBOOK: 5828, 5979, 5980

SALES DEVELOPMENT

H. R. Heikel

HRH:mtm
8/16