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PREPARED BY: W. F. SINGLETON

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COLOR VARIATION IN BRUSHED FILMS OF "FLOW KOTE"

INTRODUCTION:

During the past year, scattered complaints have been received concerning variation in color or depth of color in brushed films of "Flow Kote". The most specific observations have been made in Dallas, where it has been reported that Satin Luminall and possibly other competitive paints are superior to "Flow Kote" in this regard. The phenomenon has been variously reported as "streaking", "shadows" and other terms.

The trouble appears to be "floating" of the shading pigments in medium and deep tints. This process goes farther in thick films where there is relatively little working by the brush and where the film remains fluid longer. If the paint is not thoroughly brushed out on a wall, the areas at the end of brush strokes and the areas under light brush strokes will be thicker than most of the wall, and floating of the shading pigment will make them darker.

SUMMARY:

A simple and effective method to correct the color variation in most "Flow Kote" tints has been demonstrated in the laboratory. Potassium tripolyphosphate is used as a dispersing agent in the "48 Process" dispersion of titanium oxide and extender. The potassium tripolyphosphate must be added in the dispersion step; it is not effective when added later.

In addition, the shading base with monastral blue has been revised to improve the dispersion of the blue pigment in water.

Enough work has been done in the laboratory to show that the dispersion of carbon black requires drastic improvement. This problem remains for further investigation. The chief colors in which it is important are Driftwood Gray and Moss Green.

Other organic pigments, toluidine yellow and toluidine red, may require attention, but have not yet been investigated.

One thousand gallons each of Aspen Green and Bellflower Blue have been made in the plant on a potassium tripolyphosphate formula. Both are a definite improvement over current production. Neither is as good as laboratory material made on the same formula. An obvious further step is to increase the concentration of potassium tripolyphosphate for plant production, this remains to be tried.

#### ACTION:

The Research Laboratory has stopped work on this problem because it has been reclassified as C rather than A research. The leads that have been developed will be taken up by the Sales Development Laboratory.

#### DETAILS:

##### Color Variation in "Flow Kote" and Competitive Paints:

A simple test will demonstrate the degree of pigment "floating". The paint is brushed out on a panel in a uniform film. While the film is still wet, paint is flowed over half the panel. After the film dries, the color contrast between the flowed and brushed films is an exaggerated measure of color variation.

By this test, all the tints in the "Flow Kote" Line except the very lightest ones show a degree of color variation that requires correction. Satin Luminall has almost no color variation. Contrary to the situation in "Flow Kote", the white pigment tends to "float" in Satin Luminall rather than the shading pigments. Super Kemtone is better than "Flow Kote" overall, although some Super Kemtone colors show definite color variation.

##### Mechanism of Pigment "Floating":

Pigment "floating" is an abnormal result of the circulation of pigment that always occurs when a film dries by evaporation. Convection currents tend to carry the pigment to the surface and back through the depth of the film. The ease with which the pigment is carried along depends on the following:

Ultimate particle size  
Density  
Breakdown of agglomerates in primary dispersion  
Flocculation  
How well the liquid medium wets the dispersed pigment particle.

In the production of "Flow Kote", the blend of titanium dioxide pigment and clay extender is dispersed in casein solution. The degree of primary dispersion is satisfactory. Casein is a good wetting agent for titanium oxide; a slurry in casein solution will be quite fluid when stirred, while the same concentration of pigment in water alone is a heavy puffy paste. Upon standing, the slurry in casein sets to a reversible gel. The gelation is responsible for much of the color variation that occurs in "Flow Kote"; it prevents titanium oxide from being carried to the surface of the film, with the result that the shading pigments become more concentrated at the surface.

#### Potassium Tripolyphosphate to Deflocculate $TiO_2$ :

Potassium tripolyphosphate is an extremely effective dispersing agent for titanium oxide. The heavy puffy paste with water alone is changed to a thin water suspension by small concentrations of potassium tripolyphosphate, and the pigment settles rapidly from these suspensions. When potassium tripolyphosphate is added to a casein slurry, the slurry remains permanently fluid. Potassium tripolyphosphate corrects the color variation in "Flow Kote" by partially destroying the titanium oxide gel. An optimum concentration of potassium tripolyphosphate must be found; at low concentrations the shading pigment will still float in preference to titanium oxide, and at concentrations that are too high, the titanium oxide will float in preference to the shading pigment. The optimum concentration is not very critical, so that one concentration will probably be satisfactory for most colors.

Four representative shading pigments were added to "Flow Kote" containing three different concentrations of potassium tripolyphosphate. The color variation was determined in the fresh paint and also after the paint had been aged one week at 120°F. in order to accelerate any changes that might occur. The results are shown in Table I. For three pigments - red iron oxide, pigment green-B and monastral blue - the optimum concentration is about 0.2% potassium tripolyphosphate on the weight of the total paint. Little change occurs at this concentration when the paint is stored in the oven for one week.

#### Loss of Tinting Strength with Black Shading Pigment:

The black shading pigment now used in "Flow Kote", Aquablak-L, shows loss of tinting strength in the fresh paint with potassium tripolyphosphate. The brushed film is a normal

gray color, although it shows white streaks along the brush marks. The flowed film is almost white in color, forming an extreme contrast with the brushed film. A possible interpretation of this behavior is that the black pigment is much more readily wetted by organic materials than by water; it surrounds itself with particles of latex by a process of flocculation. When the paint is heated for one week, the pigment becomes much better wetted by the aqueous medium, and the tinting strength is restored. The problem with this shading pigment therefore is to find a surface active agent or a combination of agents that will disperse the carbon black rapidly to the degree that it becomes dispersed on aging in the oven.

#### Potassium Polyacrylate as Deflocculating Agent:

Potassium polyacrylate, VM-5470, can be used in place of potassium tripolyphosphate to regulate the degree of gelation of titanium oxide in the presence of casein. Paints were made in the laboratory in which color variation was corrected by dispersing the titanium oxide in a mixture of casein with a minor proportion of potassium polyacrylate.

However, potassium polyacrylate precipitates casein. After this discovery was made, the use of VM-5470 was dismissed from consideration. Previous work had shown that the viscosity stability of "Flow Kote" is poorer with a blend of casein and potassium polyacrylate than with either alone as thickener. It now appears advisable to eliminate potassium polyacrylate completely from "Flow Kote" in the expectation that the viscosity will be more stable.

#### Other Wetting Agents for Titanium Dioxide:

Tamol 731 is not effective in the presence of casein, although it is an effective wetting agent for titanium dioxide by itself. Lustrex 820 and Triton 770, agents used in Custom Color "Flow Kote", are fairly effective wetting agents for titanium dioxide, but their effect in the presence of casein has not been determined. Soya lecithin and potassium pentachlorophenate (Dowicide), surface agents normally present in "Flow Kote", have little wetting action for titanium dioxide and have no effect in the presence of casein.

#### Monastral Blue Shading Base:

Part of the color variation in Bellflower Blue is caused by the difficulty in wetting Monastral Blue. The latex dispersible pigment W-526 that is used in "Flow Kote" consists of Monastral Blue pigment with about 30% of Daxad KLS and Lustrex 820 to promote dispersion of the pigment in water. These agents alone are not sufficient. The current mill base, 547-5009 disperses the pigment in Latex, G-728, and soya lecithin. This mill base does not stir into water readily, and the pigment is apparently not well wetted. As an improvement, a new mill base,

P-547-U-79187 has been formulated in which W-526 is dispersed in glyceryl monoricinoleate, KH-5187. The formula is given in Table II. The Monastral Blue pigment is diluted with extender in order to improve the fluidity of the base and the ease of mixing it into water. There is an optimum concentration of glyceryl monoricinoleate; at higher concentrations, glyceryl monoricinoleate separates as an organic phase that contains most of the blue pigment. Soya lecithin and pine oil are wetting agents for W-526, but less effective than glyceryl monoricinoleate.

The hydrophilic agents that are effective with titanium dioxide are not effective with Monastral Blue. Monastral Blue requires an organophilic surface agent to wet the pigment in the first place, and a hydrophilic agent to disperse the wetted pigment in water. Besides Daxad KLS and Lustrex 820 that are present on W-526, Triton X-100 is effective as a hydrophilic agent.

#### Plant Trial:

1000 gallons each of Aspen Green, 391-023, and Bell flower Blue, 391-019, have been made in the plant on formulas containing potassium tripolyphosphate and the improved Monastral Blue mill base. The formulas are given as Tables III and IV.

Quantitative measurement of the color difference between brushed and flowed films is presented in Table V. The films were measured in the duPont differential colorimeter, and color difference was calculated in NBS units from the tables prepared by Brown and Troy. The minimum perceptible color difference is 0.3 NBS units.

The plant trial batches are better than laboratory or plant control batches. They are not quite as good as the laboratory batches on the same formula. Plant production may require more potassium tripolyphosphate because the conditions are different while titanium dioxide is being dispersed. Dissolving the potassium tripolyphosphate before it is added to the dispersion mixer might increase its effect as an alternative to raising the concentration.

The application properties and film properties of the trial batches are satisfactory, including scrub resistance and stain removal. Viscosity stability may be a problem. The viscosity drops faster than control batches in an accelerated test at 120°F. Elimination of potassium acrylate is one lead toward improving the viscosity stability.

REFERENCES:

Notebook 5771.

Notebook 5829, pages 2 through 9.

"Tables of Color Co-ordinates": Engineering Research  
Laboratory Report DED-X-52-22, by J. B. Brown  
and D. J. Troy.

*William F Singleton*  
WILLIAM F. SINGLETON

WFS:mlf  
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TABLE I

Color Variation in "Flow Kote" Tints with Potassium Tripolyphosphate  
Color of "Flowout versus Brushed Film.

| PIGMENT               | AGING         | POTASSIUM TRIPOLYPHOSPHATE<br>% OF TOTAL PAINT BY WEIGHT |             |             |
|-----------------------|---------------|----------------------------------------------------------|-------------|-------------|
|                       |               | 0.4%                                                     | 0.2%        | 0.05%       |
| W-723 Pigment Green-B | Initial       | Sl.light                                                 | No contrast | Dark        |
|                       | 120°F-1 Wk    | Sl.dark                                                  | Sl.gray     | Dark & Gray |
| W-303 Red Iron Oxide  | Initial       | Light                                                    | Light       | Dark        |
|                       | 120°F-1 Wk    | No contrast                                              | Sl.light    | Dark        |
| W-526 Monastral Blue  | Initial       | Light                                                    | No contrast | Sl.Dark     |
|                       | 120°F<br>1Wk. | No contrast                                              | No contrast | Dark        |
| W-231 Aquablak L      | Initial       | V.Light                                                  | V.Light     | V.Light     |
|                       | 120°F<br>1Wk. | Sl.dark                                                  | No contrast | Dark        |

TABLE II

Monastral Blue Tinting Base:

| CODE<br>STATUS |                          | <u>P-547-U-79187</u><br><u>Improved</u> | <u>547-5009</u><br><u>Current</u> |
|----------------|--------------------------|-----------------------------------------|-----------------------------------|
| H-506          | Water                    | 36.2                                    | -                                 |
| KH-5187        | Glyceryl Monoricinoleate | 10.5                                    | -                                 |
| G-728          | Dow Latex 762-W          | -                                       | 65                                |
| G-729          | W.D. soya lecithin       | -                                       | 2                                 |
| <hr/>          |                          |                                         |                                   |
| W-1002         | ASP-400 Clay             | 42.8                                    |                                   |
| W-526          | Monastral Blue, L.D.     | 10.5                                    | 15                                |
| <hr/>          |                          |                                         |                                   |
| H-506          |                          | -                                       | 18                                |
| <hr/>          |                          |                                         |                                   |
|                |                          | 100.0                                   | 100                               |
| Process        |                          | 3-roll*                                 | 3-roll**                          |

\* "48 Process" satisfactory in laboratory; not yet tried in plant.

\*\* "48 Process" not satisfactory in plant.

TABLE III

Aspen Green "Flow Kote":

| FINISHED PRODUCT CODE<br>STATUS |                                 | P-391-U-89982<br>Improved | 391-023<br>Current |
|---------------------------------|---------------------------------|---------------------------|--------------------|
| "48 Process" Base               |                                 | P-548-U-89981             | 547-999            |
| VM-5497                         | Casein-Dowicide Solution        | 96                        | 143                |
| H-506                           | Water                           | 68                        | -                  |
| KG-5243                         | Potassium tripolyphosphate      | 2                         | -                  |
| W-1002                          | ASF-400 Clay                    | 232                       | 249                |
| W-93                            | "Tl Pure" - Z                   | 162                       | 168                |
| W-723                           | Pigment Green-B                 | -                         | 4                  |
| H-506                           | Water                           | -                         | 76                 |
|                                 |                                 | 560                       | 640                |
| "48 Process" Base               |                                 | 560                       | 640                |
| G-733                           | Nopco 1407 antifoam             | 6                         | 6                  |
| G-729                           | W.D. soya lecithin              | 12                        | 11                 |
| H-506                           | Water                           | 97                        | 46                 |
| H-224                           | Butyl cellosolve                | 10                        | 10                 |
| G-728                           | Dow Latex 762-W                 | 357                       | 377                |
| 547-5012                        | Pigment Green-B base            | 44                        | 18                 |
| 547-5009                        | Monastral Blue base             | -                         | 4                  |
| P-547-U-79187                   | " " "                           | 5                         | -                  |
| W-231                           | Aquablak-L                      | 4                         | 1                  |
| VM-5470                         | Potassium polyacrylate solution | 16                        | 16                 |
| H-284                           | Ammonia                         | -                         | -                  |
|                                 |                                 | 1111                      | 1129               |
| Total - 100 Gallons             |                                 |                           |                    |
| Stormer - KU                    |                                 | 72+2                      | 72+2               |
| Pigment Volume - %              |                                 | 40                        | 40                 |
| Solids by volume - %            |                                 | 40                        | 42.9               |

TABLE IV

Bellflower Blue "Flow Kote":

| Finished Product Code<br>Status |                                 | P-391-U-89986<br>Improved | 391-019<br>Current |
|---------------------------------|---------------------------------|---------------------------|--------------------|
| "48 Process" base               |                                 | P-548-U-89985             | 548-829            |
| VM-5497                         | casein - Dowicide solution      | 96                        | 130                |
| H-506                           | Water                           | 64                        |                    |
| KG-5243                         | Potassium tripolyphosphate      | 3                         |                    |
| W-1002                          |                                 | 245                       | 258                |
| W-93                            |                                 | 122                       | 128                |
| H-506                           |                                 | 530                       | 69<br>585          |
| "48 Process" base               |                                 | 530                       | 585                |
| G-733                           | Nopco 1407 antifoam             | 6                         | 5                  |
| G-729                           | W.D. soya lecithin              | 12                        | 11                 |
| H-506                           | Water                           | 120                       | 73                 |
| H-224                           | Butyl cellosolve                | 10                        | 10                 |
| G-728                           | Dow latex 762-W                 | 359                       | 369                |
| 547-5005                        | Red iron oxide base             | 29                        | 32                 |
| 547-5009                        | Monastral blue base             | -                         | 21                 |
| P-547-U-79187                   | Improved Monastral blue base    | 28                        | -                  |
| VM-5470                         | Potassium polyacrylate solution | 16                        | 8                  |
| H-284                           |                                 | -                         | -                  |
| Total 100 gallons               |                                 | 1110                      | 1114               |
| Stormer KU                      |                                 | 72+2                      | 72+2               |
| Pigment volume %                |                                 | 40                        | 39                 |
| Solids by volume %              |                                 | 40.0                      | 41.7               |

TABLE V

Color Variation in Improved and Control Batches Measured on DuPont Differential Colorimeter:

| COLOR              | CODE                  | DESCRIPTION             | LIGHTNESS |       | COLOR DIF-      |
|--------------------|-----------------------|-------------------------|-----------|-------|-----------------|
|                    |                       |                         | Brush-    | Flow- | ERENCE          |
|                    |                       |                         | out       | out   | N.B.S.<br>units |
| Aspen Green        | P-391-U-89982         | Lab batch               | 58.5      | 58.0  | 0.7             |
|                    | " #986732             | Plant trial             | 60.4      | 59.3  | 1.2             |
|                    | P-391-U-89946         | Lab Control             | 58.9      | 56.5  | 2.4             |
|                    | 391-023 #33506        | Plant production        | 60.1      | 57.3  | 2.9             |
|                    | 391-023 #354315       | Atlanta complaint batch | 58.8      | 54.7  | 4.0             |
| Bellflower<br>Blue | P-391-U-89986         | Lab batch               | 53.4      | 52.9  | 0.3             |
|                    | P-391-U-89986 #986731 | Plant trial             | 53.8      | 52.7  | 0.5             |
|                    | P-391-U-89942         | Lab control             | 54.6      | 53.8  | 1.0             |
|                    | 391-019 #376502       | Plant control           | 53.2      | 52.1  | 1.3             |