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KREBS PIGMENTS DEPARTMENT
256 VANDERPOOL STREET
NEWARK, NEW JERSEY

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NEWARK PLANT
PIGMENT COLOR RESEARCH REPORT

Progress Report

Coloring of Resin Emulsion Paints.

Period Covered: 12/30/42 - 1/24/44

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NEWARK PLANT

PIGMENT COLOR RESEARCH REPORT

Progress Report

Title: Coloring of Resin Emulsion Paints

Period Covered: 12/30/42 - 1/24/44

SUBMITTED BY: M. G. Taber M. G. Taber DATE SUBMITTED: 10/25/44

APPROVED BY: A. A. Brizzolara A. A. Brizzolara 11/6/44 DATE ISSUED: 11-21-44

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INTRODUCTION:

In accordance with specific requests from the Service Department (S/R 868, 869, 879), a study was made of the behavior of our line of water colors in resin emulsion paints.

Most of the difficulties encountered in the trade involved the use of Hansa Yellow. The difficulty consisted in the loss of strength of the yellow paint during processing or aging, a phenomenon commonly described as "migration" of the yellow pigment into the oil or inner phase of the emulsion. The major portion of the work on this problem, therefore, was concerned with the coloring of emulsion paint systems with Hansa Yellow lake YL-465-D. The Newport White Pigments E-4 and E-6 emulsion paint formulations were used as base formulas for this work.

This study involved emulsion paint systems of the oil in water type exclusively.

SUMMARY AND CONCLUSIONS:

1. Testing method

Before any experimental work could be done, a testing method had to be devised which would duplicate the "loss of strength" of tinted paints which the customers said took place either during mixing or aging of their paint. The "migration" can easily be seen by merely scraping the paint film with sandpaper or even with the fingernail.

The most satisfactory test developed has been one where the hand tinted paint is mechanically mixed for thirty minutes at 60 to 70°C. In detail the method is as follows: Pigment to be tested is first wetted with a minimum amount of water. Paint is then tinted by hand to the desired depth. A small sample of this paint is thinned with water (usually 4cc to 20g. of paint) and painted out onto wallpaper. 120g. of the paint are then placed in a small ink can (3" diam.) over a hot water bath and mechanically mixed, 2500 r.p.m., for 30 minutes. Water is added at definite intervals (usually 10cc. after 15 min. and 5cc after 29 min.) to compensate for water lost through evaporation. After mixing, a sample of paint is painted out and the two paint-outs compared.

The second test devised is merely oven aging. Some of the handmixed paint above is bottled and placed in an oven at 180°F. At definite intervals- 5, 10, 26 and 48 hrs. samples are removed from the oven and painted out. Results of the two tests are similar but not identical. Occasionally a paint has been found stable by one test but unstable by the other.

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II. Preliminary testing --results.
(in this report the word "stability" will in every case refer to the strength of the tinted paint unless the word is otherwise qualified where used.)

(1) Strong and pastel tints of all colors are stable when aged at room temperature for as long as four weeks.

(2) All inorganic yellows give stable paints.

(3) Pastel tints of all the line of casein paint colors are entirely satisfactory with the exception of the yellow. These colors include BP-192-D, BL-220-D, GP-511-D, GM-534-D and GE-578-D.

(4) Deep tints of C.P.C. colors as well as Hansa Yellow give unstable paints and in some cases, break the emulsion.

(5) All competitive Hansa yellows give as much trouble as YL-465-D. Those tested include Ansbacher Siegle's Yellow 72-B-04 (C#46951), Harmon's Fanchon Yellow (C#46972) Imperial's Yellow lake X-1717 (C#45803 and 46677) and Sherwin-Williams yellow pulp (C#47370).

(6) Hansa yellows are entirely satisfactory in some emulsion paints.

III. Study of the paint vehicle

Since the commercial paints varied both in composition and behavior of their tints it was felt desirable to do much of the experimental work using laboratory made paints. The two paints most used were based on the DuPont White Pigment paints formulae, E-4 and E-6, both identical in pigmentation. The E-4 is an ester gum-linseed-oil-casein emulsion; the E-6 is a trimol 80-casein emulsion. The E-4 type appears to be "fool-proof" with all colors under both tests of stability. The E-6 paint, on the other hand, behaves similarly to many commercial paints yielding unstable yellow tints.

A third paint, made by pigmenting Aquaplex S-6 emulsion as for E-4 and E-6, was used as an example of the "alkyd" type emulsion paint.

An effort was made to discover exactly what constituent in the emulsion was chiefly responsible for the behavior of Hansa Yellow. Accordingly, all the variables in the E-4 vehicle were studied to see if an unsatisfactory paint could be made from a satisfactory one. Ratio of water phase to oil phase, oil length, amount of alkali, type of alkali, amount of wetting agent, and amount of fatty acids, all were varied over a wide range without making the paint unstable. Substitution of other resins did result, in some cases, in unstable paints. Bakelite C-9 resin, Falcolac and Glyptal solution #1247 gave such paints. All the others tested--K Wood Rosin, Congo Gum, Zinc Resinate, and Amberol- gave stable paints.

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IV. White Pigmentation (prime whites and extenders)

Conclusions below were based on pigmentation studies on E-6 trimol and DuPont Speed-Easy paint bases.

(1) Straight prime whites with no extender gave very unstable paints.
(2) An all clay paint behaved very much like the regular E-6 paint.
(3) Straight aratone or talc gave paints stable to mechanical mixing, though not to oven aging.

V. Evaluation of colored pigments

A. Inorganic

Cadmium yellow is the only inorganic yellow pigment satisfactory for use in emulsion paints. All the inorganic yellows tested gave stable paints.

B. Miscellaneous organic yellows

Of those tested only one type appeared of much interest -- the pigments derived from PCOMA and AAoCLA. They were stable in both pastel and deep tints in E-6 paint by both tests.

C. Our regular line of Casein Paint colors

Pigment Green B was entirely satisfactory. The "Monastral" colors were, in some paints, unstable in the deep tints but quite satisfactory in the pastel shades. Hansa yellow was unsatisfactory in both pastel and strong tints.

DISCUSSION OF RESULTS:

Initial study of emulsion paints indicated that Hansa yellows were very organophilic so that under favorable conditions the yellow in a tinted paint would migrate from the water phase in which it was originally placed, to the oil phase. Observation led to the conclusion that Hansa Yellow gives trouble only in emulsions which are inherently unstable, themselves. Trimol emulsions are known to be of that type.

Broken emulsions or poorly emulsified paints are indicated by (1) appearance in a paint of colored oil droplets, visible under a hand lens, (2) difficulty of washing out paint-brush with soap and water, (3) colored oil film on the paddle during mechanical mixing and on the brush during painting, and (4) paint becoming quite thin or granular. Oven aging at 180°F for 48 hours will break or coarsen almost all the paints examined. It is felt that even a 24 hour test is rougher treatment than a paint would be subjected to under conditions of commercial manufacture, so that results of the 5 and 10 hour tests may be more significant than the longer tests.

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The mechanical test could be made more or less rigorous at will. For determining whether or not a paint was at all unstable, the tests were made most rigorous by extending the time, increasing temperature slightly, or mainly by adding less water during mixing. Where it was desired to compare a series of colors, optimum conditions were chosen to best show up any differences in stability.

I. Study of the Paint Vehicle Variable.

The laboratory paints E-4 and E-6 both painted out satisfactorily. The non-thinned paints were stiffer than the commercial paints but all thinned down to about the same consistency for painting out. Aquaplex paint without casein did not adhere to wall paper well and was extremely thixotropic, although pigmented in the proportions recommended by the manufacturer.

In an effort to learn a little more about some of the commercial paints the Liebermann-Storch test for rosin was made on Kem-Tone and Ultra Luminall and the E-4 and E-6 paints. Only the E-6 paint gave a negative test.

To check the F&F, (DuPont) claim that YL-465-D in their paint decreased its hiding power, and also in the hope of establishing another testing method of "stability" reflectance measurements were made on a number of paints--white, tinted, and tinted and mechanically mixed, but the results were inconclusive.

Varying the proportions of the various constituents of the ester gum (E-4) formula not only failed to make the paint unstable with Hansa Yellow, but, in general, the state of the emulsion, its resistance to washing, its brushing properties, consistence, etc. remained good. Evidentally a pH of 7 or above is necessary for good stability. Wetting agents in the pigments did noticeably decrease the washability of paints, and commercial paints varied in their resistance to washing. (For washing tests, an ordinary hand brush covered with a wet laboraroty towel was rubbed steadily over the painted surface. Tests were made with and without soap. They were not too satisfactory.)

II. Pigmentation (White)

Early in the work it was found that white bases pigmented in the laboratory did not always behave like the same emulsions already pigmented, which were furnished us by commercial companies. It was with the DuPont Speed-Easy emulsion that this difference was so apparent that it was felt desirable to make a detailed study of pigmentation in relation to tinted paint stability.

High percentages of prime whites definitely decreased stability to mechanical mixing."Ti Pures" were worse in this

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respect than Ponoliths.

Clays (Dawson #5, Dawson #34, China clay) and Asbestine had little, if any, effect on stability. (Trade bulletins warn that asbestine will destroy the paint emulsion).

Aratone, talc and "Celite" were the only extenders examined which increased paint stability to mechanical mixing. Celite would not be practical to use in high percentages because of its high water absorbency. High aratone content affects the texture of the paint, giving slight sheen and increasing thixotropy; moderate amounts were more satisfactory in texture and yet the paint was still more stable than E-6. Talc stabilized the paint as efficiently as aratone without disturbing the texture. Even by oven tests the talc-"Ti Pure" formula is apparently more stable than the regular E-6.

III. Color Evaluation

Inorganic colors, in pastel shades, were all stable. But of them, lead cyanamide both faded on aging and turned dark on exposure to air; yellow lithopone was too weak to be practicable. Chrome and zinc yellows were very poor in alkali fastness; so cadmium yellow should be Hansa Yellow's only important inorganic competitor when it becomes available again.

In deep shades, zinc yellow reacted badly with the paint and chrome yellow did to a lesser extent. Cadmium and yellow ochre tints were satisfactory.

Pastel tints of YL-465-D, YE-531-D, K-1327, K-1839, YT-413-D and RE-433-D were unstable. Benzidene yellow tints on the other hand become so much stronger on mechanical mixing that they were unsatisfactory. Reasonably satisfactory tints were obtained from YE-513-D, RE-469-D, YL-170-D and possibly YE-530-D. Deep shades of the PCONA-AAoC1A were also stable: The others were not tested.

See attached chart for evaluations of representatives of Hansa Yellow G, C.P.C.'s, and Pigment Green B in the laboratory paints and also the commercial paints.

EXPERIMENTAL DETAILS

Notebooks 1031, 1056

I. Emulsion

A. Experimental emulsions

1. Testing results- 1031-26,27,30,35,36,50
   1056-3,5,24,28,30,31,32,33
2. Variable studies- 1031-46,53,55,58
   1056-2,7,8,9.
3. Pigmentation studies- 1031-16,27,35,44,45
   1056-4,11,12,14,15,16,17

DUP050149719

Experimental Details (cont'd)

B. Evaluation of customers' paints
1031-4,7,9,13,21,35,45,49,57
1056-4,26,28,29,38,39,40.

C. Miscellaneous 1031-43
1056-2

II. Colors

A. Testing Method 1031-10,11,12,38,57
1056-12

B. Inorganic colors 1031-12,13,25,29,49
1056-37

C. Competitive Hansa Yellows 1031-1,2,4,5,7,14,39
1056-29,38

D. Standard and Experimental Newark Colors - 1031-3,20
1056-10,25,29,30,32,
33,34,39

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	HANSA YELLOW G				C. P. C. COLORS										PIGMENT GREEN B			
	YL-465-D				YT-70-F		BF-192-D				BL-220-D				GK-578-D		GK-68-D	
	Pastel		Deep		Deep		Pastel		Deep		Pastel		Deep		Pastel		Deep	
	Mech.	Oven	Mech.	Oven	Mech.	Oven	Mech.	Oven	Mech.	Oven	Mech.	Oven	Mech.	Oven	Mech.	Oven	Mech.	Oven
E-4 ESTER GUM	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-	-	OK	OK	OK	OK
E-6 TRIMOL	NG	NG	NG	NG	OK	NG	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
AQUAPLEX	OK	OK	NG	NG	NG	NG	OK	OK	NG	NG					OK	OK	OK	OK
CCROC (Cook P.A V.)	NG	NG			NG	NG	OK	OK	OK	OK								
KEM-TONE (Sh.-W) original	OK	OK			NG	NG	OK	OK	NG	OK								
KEM-TONE (Sh.-W) Recent	NG	NG	NG	NG	NG	NG	OK	?	NG	NG	OK	?	NG	NG	OK	OK	OK	OK
SPEED-EASY (DuP.) original	NG	NG			NG	NG	OK	OK	NG	?								
SPEED-EASY (DuP.) recent	NG	OK	NG	OK	NG	NG	OK	?	OK	?							OK	OK
SPEED-EASY (Wesco)	NG	OK			NG	OK	OK	OK	NG	OK								
TECHIDE (P.P.G.)	NG	NG			NG	NG	OK	OK	NG	NG								
ULTRA-LUMINALL (N.C.)	OK	OK			OK	OK	OK	OK	NG	OK								

Symbols

OK - satisfactory
? - possibly satisfactory
NG - unsatisfactory

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