Serial No. KN-44-45

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NEWARK PLANT

PIGMENT COLOR RESEARCH REPORT

Final Report

Title: Zinc Yellow/"IMPEDEX" Primer: Formulation of Navy Spec. 52-P-68

Period Covered: April to June 1944.

SUBMITTED BY: G. Grimm DATE SUBMITTED: 6/30/44

APPROVED BY : F. E. Bolton DATE ISSUED: 7/13/44

INTRODUCTION:

The Specification 52-P-68 comprises a zinc tetroxychromate/ "IMPEDEX"/Asbestine primer using an oxidizing alkyd vehicle (Spec. 52-S-8) of the aircraft primer type; zinc yellow may be substituted for the Z.T.O.C., the zinc yellow modification being pigmented at 35% pigment volume, the Z.T.O.C. primer at 40% P.V.

Grinding difficulty encountered in the manufacture of the primer led to W/R G-39 requesting a formulating study. The principle complaint was concerned with extreme bodying, which led to livering in the mill, of the Z.T.O.C. modification. "IMPEDEX" being a radical innovation in pigment material was suspected by some as the cause. The purpose of the present study was to establish the relative reactivities (bodying effect) of Z.T.O.C., zinc yellow and "IMPEDEX", and to recommend the most satisfactory grinding conditions. A survey of the products of three manufacturers of suitable alkyd vehicle was made.

CONCLUSION:

Relative Reactivities of the Prime Pigments. The primary purpose of this work was to develop data relative to the respective reactivities of Z.T.O.C., zinc yellow and "IMPEDEX" in the 52-P-68 formulation. The data demonstrated the order of reactivity (bodying): Z.T.O.C., "IMPEDEX", Y-539-D. Z.T.O.C. having been considerably more reactive than zinc yellow, and "IMPEDEX" approximately equal to Y-539-D but very slightly on the low side. Therefore it would seem that Z.T.O.C. were the offender rather than "IMPEDEX" in the cases reported to have livered in the mill; no case of livering has been reported for the zinc yellow modification.

It has been shown that extreme bodying may occur either in the mill or on storage in the case of single pigment or composite grinds of the Z.T.O.C. modification; however, by grinding the combination ZTOC/"IMPEDEX", the bodying tendency of Z.T.O.C. is not evident. Although properly formulated, bodying may occur in the Z.T.O.C. primer which in extreme cases may result in livering in the mill or in the can. In the case of the zinc yellow primer such reactivity is not evident; if properly formulated it should yield satisfactory primers.

Grinding Procedure. The phase of this study most important to the practical paint man concerns the grinding formula, i.e., single pigment mill bases vs. composite grind. It would appear from the data presented in Table IV and V that for maximum production in a given mill, the zinc yellow should be ground separately and later combined with a preground "IMPEDEX"/Asbestine mill base, with both bases at a pigment volume of 50%. This feature has been outlined in the formula suggestion P-190-G (see copy at end of report). A 16 to 20 hour grind in a plant sized ball mill for the zinc yellow and a 50 to 60 hour grind for the "IMPEDEX"/Asbestine would probably be sufficient, or a 50 to 60 hour composite grind should meet the

specification fineness rating. If for a given mill efficiency, the production rate were 14 gallons per hour for the composite grind, the production rate for the three stage P-190-G grind would be 20 gallons per hour: if auxiliary mixing equipment were available to process the bases, the production could be stepped up to 34 gallons per hour. This is a considerable advantage in favor of the P-190-G type of grind.

Comparison of Suitable Vehicles. Of the three vehicles tested, Am. Cyan, Rezyl 728-5, and Gen.Elect. ZV-3504 produced satisfactory primers. Strook-Wittenberg's Areplas, S-338 proved undesirable due to excessive bodying in the mill and on storage.

SUMMARY:

The bodying tendency of the three pigments was compared by formulating the primer in three ways: single pigment mill bases, composite mill bases, (chrome pigment/"IMPEDEX") and composite primer grinds (chrome pigment/"IMPEDEX"/Asbestine). The data are presented in tables I to VI.

Single Pigment Mill Bases (Table I).
As the thinner content was not held constant when the pigment volume was altered, comparisons of consistencies of any one pigment at different pigment volumes cannot be made. However, a comparison of pigments at constant pigment volume is valid. Thus Z.T.O.C. shows definitely greater bodying tendency in the mill than zinc yellow or "IMPEDEX"; whereas, zinc yellow shows slightly greater bodying than "IMPEDEX".

Two Pigment Composite Mill Bases (Table II).
The bodying tendency of Z.T.O.C. demonstrated in the single pigment mill base is leveled out in the two pigment bases so that bodying in the mill or in the can is close to the level of zinc yellow but still is on the high side.

Three Pigment Composite Mill Bases (Table III).
The bodying effect of Z.T.O.C. is demonstrated in the composite grind. Bodying may occur in the mill or in the can.

Rate of Texture Development (Table IV).
A series of mill bases of the zinc yellow modification were ground at 35% and 50% pigment volume, comprising zinc yellow, zinc yellow/"IMPEDEX", zinc yellow/"IMPEDEX"/Asbestine, and Asbestine. The rate of texture development during the course of the grind was followed by means of the Sherwin Williams fineness gauge. It was found that zinc yellow was much more easily dispersed than either "IMPEDEX" or Asbestine. "IMPEDEX" was as difficult to disperse to the specified fineness rating as was Asbestine.

Primers Finished From Mill Bases (Table V).

As indicated in the conclusion, the most suitable grinding formula both on the basis of highest production and the development of low consistency, is one which involves grinding the zinc yellow as one mill base and the A-1-D/Asbestine as another both at 50% P.V.

Comparison of Acceptable Vehicles (Table V).

Zinc yellow primers were prepared from American Cyanamide Rezyl 728-5, General Electric ZV-3504, and Strook-Wittenberg Aroplaz S-338; all three conformed to the specification 52-S-8. As may be seen from the tabulation Rezyl 728-5 and ZV-3504 produced primers having satisfactory properties. S-338 showed excessive bodying after about 72 hours grinding; the oven aged material livered. It would be anticipated that its high reactivity would create grinding difficulties and storage problems.

EXPERIMENTAL DETAILS

Refer to Notebook - 1037. Expts. 35-39, 56

TABLE I

Consistency of Single Pigment Mill Bases

Pigmentation	29% P.V.*		36% P.V.*		
	KU Fresh	KU after 4 days @ 120°F.	KU Fresh	KU after 4 days @ 120°F.	KU
Zinc Tetroxychromate (ZTOC)	153	155	138	157	1
Zinc Yellow (Y-539-D)	140	154	95	95	
"IMPEDEX" (A -1-D)	108	132	70	71	
Asbestine	—	—	108	114	

TABLE II

Consistency of Two Pigment Mill Bases

ZTOC/A-1-D (75/25)	108	142	93	112	
Y-539-D/A-1-D (73/27)	106	131	78	95	
Asbestine/A-1-D (61/39)	--	--	--	--	1

*At each P.V. the total vehicle (alkyd & xylol) was held constant.

NOTE: Data in Tables I & II are not strictly comparable since bases were ground
Also comparisons of same pigmentation at different pigment volumes cannot be made
content varied. Comparisons are only valid for pigmentations in any one P.V. gro

TABLE III

Consistency of Three Pigment Grinds

M.B.	Pigmentation	P.V. of Mill Base	KU Fresh (finished primer)	KU after 4 days @ 120°F. (finished primer)
1037-35	ZTOC/A-1-D/Asb.,55/16/27*	45%	72	126
36	" / " / " , "	"	109	101
35	Y-539-D/A-1-D/Asb.,51/19/30*	"	61	78
36	" / " / " , "	"	70	95

*Spec. ratio by weight

TABLE IV

RATE OF TEXTURE DEVELOPMENT

500cc Mill base in 1/3 gal jars with 3000 gm steel balls	Fineness Rating* after grinding for: 20 hrs.	28 hrs.	48 hrs.	72 hrs.	KU fresh	KU after 4 days at 120°F.
35% PV Mill Bases						
1. Y-539-D	5	5+	7		78	124
2. Y-539-D/A-1-D	3	4	5	6	91	132
3. Y-539-D/A-1-D/Asbestine	3+	4	4	5	106	140
4. A-1-D/Asbestine	3	3	4	5	118	>140
5. Asbestine	2	3	2	4	>140	>140
50% PV Mill Bases						
6. Y-539-D	5	6	7		56	59
7. Y-539-D/A-1-D	2	4	4	5	59	72
8. Y-539-D/A-1-D/Asbestine	2	3	5	5	70	91
9. A-1-D/Asbestine	2+	3	4	5	>140	>140
10. Asbestine	1	2	4	5	>140	>140

TABLE V

Primers finished from above mill bases	Fineness Rating*	Consistency (Spec. Limits : 64-70KU) fresh	3 days	4 days @ 120°F.
Mix 1 & 4	5+	75 KU	76 KU	59 KU
Mix 2 & 5	6	61 "	102 "	90 "
Composite grind (3)	5+	63 "	100 "	100 "
Mix 6 & 9	5+	61 KU	69 KU	64 KU
Mix 7 & 10	6	61 "	78 "	82 "
Composite grind (8)	6	61 "	91 "	100 "

* Sherwin-Williams fineness gauge : 1 very poor, 8 perfect, 6 or better specified in 52-P-68