

Gross Reference:

Industrial White Enamels
 700 Line Finishes
 Refrigerator Finishes
 Castor Oil Alkyds
 W-28
 W-43

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Marshall Laboratory
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MEMORANDUM REPORT NO. M-324

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"Z" PIGMENT IN HIGH BAKE WHITE ENAMELSIntroduction:

The initial evaluation of "Z" type pigment against W-28 (TiPure R-110) in high bake white enamels has disclosed certain peculiarities which may limit its use (see Memorandum Report No. M-305). In particular, two castor oil enamels were found to have much poorer storage stability when pigmented with "Z" than with W-28, and Florida exposures of the first samples in 704-6731 Castor Oil Enamel had an abnormal microscopic checking in 18 months.

The extension of the evaluation work to include more types of enamels and check previous results in laboratory and plant batches is the subject of the present report.

Summary and Conclusions:

Although some variation was observed between batches of "Z" pigment, it differs in general from TiPure R-110 in the following respects, confirming the previous work:

1. Dilutant Mill Bases and Premixes (generally worse in bases for two castor oil enamels which give stability troubles).
2. Fair to poor can stability (with the two above castor oil formulas).
3. Micro-checking in 12 months Florida exposure (in one of the above castor oil formulas), but less chalking than W-28.

"Z" and W-28 in 700 Line enamels appear to be about the same in appearance, gloss, hardness, initial color, overbake discoloration, flexibility, adhesion, grease, moisture and stain resistance.

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The risk involved in using "Z" in high bake whites depends upon the particular formulation and batch of "Z" pigment, but may seriously limit the durability and stability of such enamels unless reformulations are made which prove themselves immune to these weaknesses. It is probable, however, that blends of up to 25/75 "Z"/W-28 could be safely used and constitute a good business risk under the present emergency conditions.

Patent Situation:

No patent problems are expected to arise as a result of this study.

Action Taken or Proposed:

Release Letter No. 1293 is being prepared which proposes the replacement of 25% of W-28 with "Z", in 700 Line enamels.

Further investigation is recommended to reformulate certain 700 Line enamels so that 100% "Z" could be safely used in them without risk of incurring unsatisfactory stability or durability characteristics.

Experimental:

The following batches of "Z" type pigments have been evaluated against TiPure R-100 in Industrial High Bake White Enamels to date:

<u>DS No.</u>	<u>Designation</u>	<u>Date Received</u>	<u>Exposed in ES #</u>
—	"Z" pigment #637 (Lab. Batch)	May 1948	9703
—	PS-74-MZ (Finished in Lab.)	June 1949	10793
DS #20614	Old "Z" (Initial Plant Production) (C-3142)	February 1950	11340 & 11359
DS #20715	Ten Percent New "Z" (9831)	March 1950	"
DS #20717	New "Z" (ZL-597, C-3203)	March 1950	"
DS #20796	New "Z" (ZL-597B, C-3203)	June 1950	11435
DS #21030	New "Z" (ZL-597C, C-3203)	June 1950	"

Preparation of Enamels:

Mill bases were ground by the methods called for in the formulas, i.e., in pebble mills or by "47 Process". Again the pre-mixes containing "Z" were much heavier in viscosity than the W-28 controls, and some of the gallon pebble mill base formulas required 2 to 4% additional solvent for the mills to grind properly. The extra dilatancy of "Z" is most pronounced in the presence of castor oil alkyds and varies with the batch of "Z" and the particular formula, but does not interfere with regular plant production.

The finished mill bases roughly parallel viscosity of the pre-mixes, and give an idea of what maybe expected in enamel stability. The viscosity of the fresh "Z" enamels were approximately equal to the W-28 analogues.

The enamels covered are listed in Tables I and II. Apparently the tendency for "Z" enamels to seed (which was encountered before) has apparently disappeared with the use of the newer batches of "Z" pigment, and no unusual spraying difficulties were encountered.

Stability:

Since previous experience indicated that "Z" causes serious stability problems in certain types of enamels, a survey of various types of enamel was made to discover which could be made safely with "Z". Samples of enamels were kept at 120°F and at room temperature in order to follow their viscosities in accelerated storage conditions. As before, two of the castor oil enamels, 704-6731 and 707-24396, increased in viscosity much faster than the W-28 controls. There is a possibility that the 704-6731 made with a pebble mill base using RL-295 + "Z" is more resistant to bodying than the current "47 Process" formula base using RL-484 + "Z". Under normal storage conditions, however, 704-6731 made with "Z" pigment should not cause serious complaints.

The mill bases containing "Z" are often much higher in viscosity than W-28 analogues. The basic cause of the greater instability of castor oil enamels containing "Z" may hypothetically lie in the more hydrophilic character of "Z", so that the castor oil hydroxyls may be preferentially absorbed on the pigment.

Film Properties:

Based on the different types studied, the initial film properties of enamels containing "Z" do not differ significantly from the W-28 analogues. Appearance, gloss, hardness, initial color, flexibility, adhesion, overbaking characteristics, grease, moisture, and stain resistance of the "Z" enamels are quite similar to the W-28 controls.

Durability:

Micro-checkings occurs in 12 months Florida exposure, however, in the 704-6731 formula containing "Z", but its chalking is intermediate between W-28 and W-43. The batch of "Z" (PS-74-MZ) in this series (ES #10793) was partially manufactured in the plant and finished in the laboratory of the Pigments Department, and duplicates in this respect with the previous old laboratory sample (Z #637). Since checking has been observed in 8 years in a short oil DCO enamel (704-6735), which shows no Florida checking in 2 to 5 years ordinarily, there is a definite hazard of pyramiding the two so that checking may occur in dangerously short period of time in the field if "Z" pigment is used.

References:

Notebook #5159, pages 181 to 203, #5211 page 1 to 23.

Exposure Series #9703, 10793, 11340, 11359, 11435.

Memorandum Report #M-305.

Letter, R. B. Davis to J. B. Bullitt, 10/6/50.

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TABLE I

"Z" PIGMENT VS. W-28 IN INDUSTRIAL WHITE ENAMELS

Code	Pigment	Lot #	Batch	AV. 22° Gloss	AV. Hard- ness	1 Mo. 120°F. Av. Visc. Increase	3 Mos. Av. Temp. Visc. Increase	Mill Base Viscosity (Centipoises)	1 Month Moisture Resistance
704-6731*	W-28	9608	Lab.	47	F	50% (6% 2 wks.)	40%	350	7+
	Z	DS20717	"	47	H-	9 5%	-	6,680	7
	Z	DS20614	"	44	F	69%	-	9,900	7+
	Z	DS20796	"	43	F	165%	80%	20,000	7-1/2
	Z	DS21030	"	56	F	152%	100%	20,000	7-1/2
	Z	ZL-597	Toledo	52	F	37% (2 wks.)	-	9,000	-
704-6735	W-28	9608	Lab.	44 to 48	2H-	53%	90%	11,830	7
	Z	DS20717	"	40	2H	50%	-	13,900	-
	Z	DS20614	"	44	2H	53%	-	19,700	-
	Z	DS20796	"	49	2H	151%	80%	-	7
	Z	DS21020	"	49	2H	56%	55%	-	7+
	Z	ZL-597	Toledo	43	2H	0% (2 wks.)	-	7,400	-
707-6741 (One coat White)	-28	9608	Lab.	57	F	42%	29%	11,840	9+
	Z	DS20717	"	61	H-	65%	-	13,900	9
	Z	DS20614	"	55	F	57%	-	19,700	9-1/2
	Z	DS20796	"	60	F	69%	28%	-	8-1/2
	Z	DS21030	"	59	F	61%	45%	-	8-1/2
	Z	ZL-597	Toledo	56	F	28% (2wks.)	-	14,000	-
707-24396* (Grosley White)	W-28	9608	Lab.	74	F	65%	96%	500	9+
	Z	DS20717	"	76	F	100%	-	-	8+
	Z	DS20614	"	76	F	Gel	-	-	9
	Z	DS20796	"	65	F	281%	100%	40,000	9
	Z	DS21030	"	75	F	123%	104%	22,000	9-
707-24239 (Mullins White)	W-28	9608	Lab.	64	H	4% (5 wks.)	4% (5 wks.)	5,000	9
	Z	DS20796	"	52	H	0%	3%	22,200	6
	Z	DS21030	"	60	H	81%	3%	11,000	8-1/2

*Manufactured by "47 Process" - All others by pebble mill

TABLE II

"Z" PIGMENT VS. W-28 IN MISCELLANEOUS INDUSTRIAL WHITE ENAMELS

Enamel Type	Pigment	Lot #	Batch	Av. 22° Gloss	Av. Hard- ness	5 Wks. 120° Viscosity Increase	5 Wks. Rm. Temp. Visc. Increase	Mill Base Visc. (Centipoises)	1 Month Moist Resist.
704-24494 (CO-6735 analog)	W-28 Z Z	9608 DS20796 DS21031	Lab. " "	56 42 45	H H H	60% 56% 51%	4% 3% 3%	540 2700 2800	7 7 7
704-23105* (SB0 White)	W-28 Z Z	9608 DS20796 DS21031	Lab. " "	50 42 52	F F F	44% 32% 40%	5% 9% 7%	700 5300 4200	7-1/2 7 7+
722-24185 (Melamine ChO Bendix)	W-28 Z Z	9608 DS20796 DS21031	Lab. " "	56 57 58	H H H	14% 22% 36%	0% 0% 12%	4600 50000 14000	9+ 9 9-
724-23492 (CO Panelyte)	W-28 Z Z	9608 DS20796 DS21031	Lab. " "	53 47 44	H H H	53% 4% 17%	10% 0% 22%	120 220 180	7-1/2 6-1/2 6-1/2
752-23312 (Wall Tile En. RC-723)	W-28 Z Z	9608 DS20796 DS21031	Lab. " "	77 81 79	F F F	39% 32% 43%	7% 0% 14%	260 17000 8000	- - -

*Manufactured by "A7 Process" - All others by pebble mill