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NEWARK PLANT
PIGMENT COLOR RESEARCH REPORT

Final Report

WEAK MOLYBDATE ORANGE

MATCH FOR IMPERIAL'S A-4409 and SHERWIN-WILLIAMS 12145

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NEWARK PLANT

PIGMENT COLOR RESEARCH REPORT

Final Report

WEAK MOLYBDATE ORANGE MATCH FOR IMPERIAL'S A-4409 and SHERWIN-WILLIAMS 12145

APRIL 1945 - OCTOBER 1948

SUBMITTED BY: Otis D. Purdie DATE SUBMITTED: 12/7/48

APPROVED BY: A. Siegel DATE ISSUED: 1/21/49

INTRODUCTION:

Molybdate Orange finds considerable use when blended with organic reds in inexpensive toy and industrial enamels. As early as 1944, Imperial promoted the weak Rex Orange A-4409 as a blending agent. It was claimed that enamels made with A-4409 and organic red showed a lower gallon cost than the high strength Molybdate Oranges (YE-421-D and A-4403). Sherwin-Williams marketed a weak Molybdate Orange, 12145, about the same time.

SUMMARY AND CONCLUSIONS:

Laboratory work was initiated in 1945 to develop an offering against Imperial's A-4409. K-8752, an earlier laboratory formula, gave products close to competition and work continued with investigation of this formula both in the laboratory and the semi-works. At the time this development was progressing there was considerable speculation as to whether a weak type Molybdate Orange was really cheaper than a strong type when used as a blending agent. It was therefore decided to halt further work until a thorough study could be made in the paint laboratory.

The results of the paint study may be found in KN-47-27 in which the following general conclusion is drawn:

> "Only when formulated on the basis of equal pigmentation does Imperial's low strength Molybdate Orange, A-4409, or DuPont's K-8752, or Sher-Williams' 12145, show any cost advantage over an orthodox high strength Molybdate Orange,such as YE-421-D, when blended with Lithol Red."

This work was completed in August 1946 and in June 1947 it was decided to proceed with semi-works development of a match for A-4409. A close match, K-2490, was obtained when Sales requested that the somewhat darker, weaker Sherwin-Williams product be matched instead. Considerable difficulty with the formula was experienced in the laboratory and semi-works in attempting to produce darker material. In view of this difficulty, plant trial of K-2490 was made in an attempt to match, again, the Imperial color. The process proved unstable and laboratory work resumed to effect an improvement.

A modified I.C.I. Scarlet Chrome M formula gave good duplicability in the laboratory and products very close to Sherwin-Williams. After checking the results on a semi-works scale, plant trial was made. Although the process seemed duplicable, the products showed poor lightfastness. This was corrected by subsequent laboratory study and the improvement carried through to plant manufacture. A mix of the improved lightfastness products was set up as standard for this color, YE-570-D. Color readings against competition and YE-421-D were as follows:

Lot 88267 vs Sherwin-Williams 12145 (C #48756)	s.dk., yel., int., vs.red and int.	str. (92 = 100)
Lot 88267 vs Imperial A-4409 (C #50747)	dk., s.red, int.,	wk. red (115 = 100)
Lot 88267 vs YE-421-D SD-48416	dk., red, int.,	wek. red. (175 = 100)

A blend of YE-570-D and RT-431-D (5:1) closely matches a similar blend made with Sherwin-Williams' YE-570-D counterpart.

DISCUSSION OF EXPERIMENTAL DETAILS:

During the investigation of the original YE-421-D formula in 1937, it was discovered that darker, weaker products resulted from decreasing the molybdate-chromate ratio and lowering the pH of the lead nitrate solution from 3.4-3.5 to 2.7. When the problem of matching Imperial's A-4409 became active in 1945, this earlier formula, K-8752, was tried and close matches were obtained. Slight modification resulted in the K-2490 formula shown in Table #1.

The semi-works and plant trials of K-2490 were marked with poor duplicability. Dull masstones resulted in many cases. It was believed for a time that impurities in the lead, possibly copper or iron, were responsible but investigation revealed nothing significant. Attempts to make a darker masstone product were also unsuccessful. The optimum chromate-molybdate ratio appeared to be that used in K-2490. The use of lower pH's lead to duller masstones. It was concluded that the stability of this process was marginal and that it became more sensitive as the batch size increased.

It therefore became apparent that an entirely different formula would have to be used to obtain the necessary depth of masstone and duplicability. I.C.I's Scarlet Chrome M process was found to give products of the dark, weak type, even darker than Sherwin-Williams' 12145. The obvious changes were to reduce the acid somewhat to equal the Sherwin-Williams depth and to replace the lead phthalate with alum for lightfastness. This formula proved duplicable but lacking in lightfastness. The following changes were made to effect an improvement.

1. Decrease the lead excess.
2. Increase the alum.
3. Use sodium silicate as in YE-421-D.
4. Add all soda ash before alum/silicate.

In testing the dark, weak molybdate oranges for lightfastness, differences were found between fadeometer, weatherometer, and outdoor exposure results. Reversals were actually obtained in some cases. Outdoor exposure results seemed to depend upon the prevailing weather conditions:

	5 days sun	5 days sun & 1 day rain
1500-15C vs Sherwin-Wms. 12145 (Lab. product) C #48756	vs worse	s.better

Table #3 gives the results of one of the components of the standard mix. On the basis of these data YE-570-D is considered substantially equal to Sherwin-Williams 12145 although somewhat inferior to the lighter Imperial product and YE-421-D.

In developing control variables for YE-570-D it was discovered that an increase in molybdate gives light, strong, yellow tint material as does a decrease in acid. However, an increase in acid results in light, weak, yellow tint material. Acid and molybdate both must be increased to increase the depth and redness of masstone and to give weak red tints.

Plant Variables

	v.light & str.	light - strong	O.K.	dark - weak	very dark & weak
(Caustic Soda)	35	35	35	16	0
(Bichrome)	325	325	325	325	317
(Molybdate)	55	50	50	55	65
(Sulfuric Acid)	12	12	12	14	18
(Muriatic Acid)	16	16	29	33	42
(Soda Ash)	205	205	235	265	315

Gloss in enamels of YE-570-D was found to vary with the manner in which it was ground in paint vehicles, small differences in paint formulation often resulting in large differences in initial gloss. Table #4 gives two grinding formulas, one of which gives good gloss, the other giving poor gloss. It was also found that grinding with porox balls in porcelain jars gives poor gloss whereas grinding with porox balls in glass jars gives good gloss. It should therefore be borne in mind when testing molybdate oranges that gloss is dependent upon the use of the proper paint formulation and grinding conditions.

REFERENCES:

N.B. 623
N.B. 1266
N.B. 1300
DSN 46-51
DSN 48-

TABLE #1

	YE-421-D	K-8752	K-2490
Lead Nitrate	165.5	165.5	165.5
Volume	6 liters	6 liters	5.5 liters
Temp.	50°F	60°F	60°F
pH	3.4-3.5	2.7	2.5
Strike in 30 minutes with			
Chrome	55.8	59.8	58.6
Molybdate	11.7	9.7	7.80
Sodium Sulfate	8.3	10.0	9.56
Sodium Chloride	-	10.0	9.56
Volume	1 liter	1 liter	0.94 liter
Add			
Sodium Chloride)	-	50	49
Muriatic Acid)	5.1	5.2	5.1
Stir 10 minutes. Add in turn			
Alum	21	21	21
Soda Ash to pH 5.8-6.0	-	-	21
Bicarbonate	73.5	34	-

TABLE #2

	I.C.I. Scarlet Chrome M	(C)YE-570-D	YE-570-D(D) (Improved L.F.
Lead Nitrate	165.5	165.5	165.5
Volume	10 liters	10 liters	10 liters
Temperature	65°F	65°F	65°F
Add			
Caustic Soda	4.2	6.0	6.5
Strike in 60 min. with			
Bichrome	57.9	56.0	61.0
Molybdate	12.05	8.6	9.4
Sulfuric Acid	4.65	2.0	2.2
Hydrochloric Acid	5.88	5.0	5.4
Sodium Chloride	-	5.0	5.4
Volume	2 liters	2 liters	2 liters
Temperature	65°F	65°F	65°F
Add in turn			
Soda Ash	-	20	44
Sodium Silicate	-	-	11
Alum	-	24	26
Soda Ash to pH 5.8-6.0	34	30	-
	Add separately prepared lead phthalate solution.		

TABLE #3

YE-570-D 60703 vs	Color	Old Fadeometer	New Fadeometer	Weatherometer	Outdoor Exposure
YE-421-D SD-48416	v.dark & red	worse		s.worse	worse
Imperial A-4409 C #50747	v.dark & red	worse		=	s.worse
Sherwin-Williams 12145 C #48756	dark, s.int.	worse	vs.worse	vs.better	vs.worse
Sherwin-Williams 12145 C #50793	dark, red	=	=	better	vs.worse

TABLE #4

	A	B
Pigment	45 g.	45 g.
GE-2527	45	61
Amsco B	15	-
Mineral Spirits	-	14

Porox Balls. Mill 24 hours.

Add

GE-2527	57	37
Amsco B	15	-
Mineral Spirits	-	10
KV-30	2 cc	3 cc

Strain into jars. Spray panels.

Gloss: A good
B poor

Color: B vs A trace red.