265 Creosote Paint, Black S 395 - [illegible]
266
267
268
269
270
271
272 Copper Paint, Brown 35982 26/9/6
273 " Red 35606 "
274 " Green 35798. "
275 Roof & Iron Protective Paint, Lt. Red,
276 " Dk. "
277 " Brown
278 " Graphite. S489
279
280 Anti-Fouling Paint. Copper
281 " Red (X1004-C)
282 " Salmon
283 " Green
284 " Brown 14/8/6
285
286 Anti-Corrosive Paint, Red,
287 Anti-Corrosive Paint, Salmon
288 " Green.
289 " Brown (X1005-B)
290 Damp Resister, White
291 " Lt. Stone
292 " Dk. "
293 " Red,
294 " Black
295 " Transparent
296 " Green 31/10/6
297
298
299
300 Sheep Marking Oil, Blue
301 " Red,
302 " Black
303 " Yellow
304 " Green
305 Conservatory White (B.P. 100) S349
306 Men Ground, Lead, Rolls 23/2/6
307 Liquid Red Lead Extra S5479 31/10/6
308 Special - " Color CL 25526 "

0007-SWP-043277

970 Second Quality oil Colours. Chrome Yellow, No 3 Pale
971 . . Mid
972 . . . Dk
973 . . . Orange
974 . . No 2 Lemon or Pale 9/1/16
975 . . . Orange .
976 . . . Mid 30/8/16
977 . Stone .
978 . Drab
979 Slate
980 . Chocolate
981 . Teak
982 . . Chocolate OOO.
983 " Red or Oxide OO.
984 " Mast-Colour
985
986
987
988
989
990

991
992
993
994
995
996
997
998
999
1000 Third Quality oil Colours. O Black.
1001
1002
1003 . No 3 Blue.
1004
1005
1006
1007 . Raw Sienna, No 3.
1008 . Burnt " .
1009 . Raw Umber .
1010 . Burnt " "
1011 . Pale Oxide, O or Red Paint. O.
1012 . Mid " O or Purple O.

1189 Azure Blue E. 26/10/6
Pigment Red E.
1190 ~~Ground Paint, White~~ see 353
1191 Raw Sienna E. ~~Red A~~ ~~[illegible]~~
1192 Raw Umber E ~~— B~~ ~~[illegible]~~
1193 Burnt " E
1194
1195 Navy Green E
1196 Emerald Green E.
1197 Barytes Ground in Oil.
1198 C A O - Hines
1199 Genuine Ground White Zinc N. 4/10/6
1200 Genuine Ground Eng White Lead .
Ordinary
1201 " " Foreign " .
1202 Ground White Lead No 1 .
1203 " 2
1204 " 3
1205 " 4
1206 " O. 29/3/06
1207 Flake White .
1208 Red Lead $ 229 7/4/06
1209 White Lead O.O. 9/4/06
1210 Genuine Ground Zinc S 20

1211 Ground Zinc, No 1
1212 " No 2
1213 " No 3
1214 " No 4
1215 " O
1216 " O O
1217 Vienna White ~~[illegible]~~
1218 Ground Zinc OOO. 22/3/06
1219 French Zinc in Varnish S 24 3/10/6
1220 Patent Driers, No 1
1221 " ~~No 2~~ 1 + 3.
1222 " P.A.
1223 " PB.
1224 " French
1225 Dry French Driers
1226 Patent Driers B.
1227 " 4 P.
1228 " S
1229 " R.A.
1230 Crack & Seam Filler $ 59
1231 Sugar of Lead in Oil Driers 1/8/6.
1232 Floor Wax. $ 58

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0007-SWP-000126627

1233 R. T. T. Size
1234 T. T. Size. 2/3/06.
1235 Priers Wheston Co 31/1/06.
1236 Lt Lead. Color. O 7/6/6
1237 Paste 15/10/6
1238 Spl. Drier £325. Foster Sons 24/1/06
1239 C. W. C. Everett Window Cleaner
1240 Patient Dunro O. (X442D)
1241
1242 Genuine Ground Lead No. (American National Lead Or Lead.)
1243
1244
1245 Lt Oak, Paste Wood Filler 25/1/06
1246 Antique Oak " " 8/6/6
1247 Mahogany Wood Filler 26/9/6.
1248 Walnut Paste Wood Filler 26/6/6
1249 Paste Wood Filler – Golden Oak. "
1250 Decorator Tube Colours. Blue Black.
1251 Ivory "
1252 Lamp "
1253 Antwerp Blue
1254 Azure "

1255 Decorator Tube Colours. Bremen Blue
1256 " Chinese "
1257 " Cobalt "
1258 " Indigo "
1259 " Permanent "
1260 " Prussian "
1261 " Turquoise "
1262 " Ultramarine Blue Pale
1263 " " Deep
1264 " " French
1265 " Brunswick Blue
1266 " Asphaltum.
1267 " Caledonian Brown
1268 " Madder Brown
1269 " Purple "
1270 " Raw Sienna
1271 " Burnt "
1272 " Raw Umber
1273 " Burnt "
1274 " Vandyke Brown
1275 " Cassel Earth.
1276 " Bitumen.

1895	Colours in Turpentine.	Ex Vermilion.	
1896		Neron Red, P.P.B	24/3/06
1897	.	Coronation Pink.	27/4/06.
1898	.	~~Pale Vermilion substitute~~ same as 1883	~~30/1/?~~
1899	.	Crimson Carmine Red B	21/1/06
1900	.	Carmine Red C.	8/1/07
1901	"	Permanent Mail Red	
1902	"	Auto Red	
1903			
1904			
1905	.	Brown Lake	
1906	..	Crimson Henna Lake	
1907	.	Scarlet Lake	
1908	.	Crimson "	
1909	.	Purple "	
1910	.	Maroon "	
1911	.	Scarlet " No	
1912	.	Mid. Purple Lake (Garland Red)	26/3/06
1913	.	Yellow Lake	29/1/06
1914	"	Crimson Madder 7z	9/1/06
1915			
1916		Rose Pink	

1917	Colours in Turpentine	Dutch Pink.	
1918			
1919		Sugar Lead	8/1/07
1920		Zinc White	
1921	.	White Lead	11/1/06
1922	.	Flake White	
1923	.	Cream	26/6/6
1924	.		
1925	.	Yellow Chrome Primrose to Blue Lily	
1926	.	Yellow Chrome, Lemon	
1927	.	" Mid.	
1928	.	" Deep	
1929	.	" Orange	
1930	.	" Dx.	
1931	.	Zinc Yellow	
1932	.	Yellow Chrome Red	9/4/06
1933	.	Red Chrome L.	
1934			
1935	.	Leather Cloth Tints 104	
1936	.	" 103	
1937	.	" 117	
1938	.	" 107	

0007-SWP-043282

0007-SWP-000126629

3000 No 1 First Flat [illegible] Paint, R.M. Hunter Ryland
3001 Fine White Liquid Paint, F189 Hedges.
3002 R.M. Spec White. Armer & Peat
3003 " [illegible] Brown F1134 Amer. Ink Co
3004 " Leaf Green F959a J.F. Butt & Sons
3005 " Yellow Lake Hedges.
3006 R.M. Green, R.M. 5/2/06 Anglo-Amer. Oil Co.
3007 Red Lead, R.M. 2/2/06 " Heckley
3008 Liquid Engine Green 2/3/06 Admiralty
3009 Genu. Gd White Lead, R.M. 2/3/06 Hedges
3010 Liquid Green 5/4/06 Redd Bros
3011 R.M. Lt Indian Red, No B 2 D 10/3/06
3012 " Pale Empress 21/4/06
3013 Deep "
3014 " Spec Lt Stone Sydney 21/3/06
3015 " " Mid " "
3016 " " Dk " "
3017 " " Carriage Red " "
3018 " " Dark Blue Hildard 29/3/06
3019 " " Red " "
3020 " " Stone " "
3021 " " White " "

3022 R.M. Spec. Slate Buesa 29/3/06
3023 " " Dark Green J. Nicholson & Co 3/4/06
3024 " " No 5 Venetian Red Hedges 5/4/06
3025 " Lt. Yellow Ochre " "
3026 No 2 Mid Brunswick Green "
3027 " Deep " "
3028 " Mid Purple Brown "
3029 No 5 Black " "
3030 Mid Stone " "
3031 Super Mid Brunswick, Dark Grass, Harland "
3032
3033 Red Paint, Fido J. Nicholson & Co 20/4
3034
3035 R.M. Orange Red [illegible] 27/4/06
3036 " Lt Drab Ingut & Co 3/5/06
3037 " Mid Sienna Red W. Eddington & Co 5/5/06
3038 " Deep " Nicholson & Co 9/5/06
3039 " Red in varnish (1 minute) Cruickshank 22/5/06
3040 " Regal Red Underground El. Ry "
3041
3042 " No 2 Pale Bronze Green Hedges 31/5/06
3043 " ~~Purple Brown~~ "

0007-SWP-043283

3044 R.M. No: Rail Marker   Hedges 31/1/06
3045 " " Burnt " " "
3046 " Russia No 3 " 8/6/06
3047 " Spec B.P. Green Lambert Howells
3048 " No: Green Mid (F.3.44) D.Kerr 2/4/06
3049 " White Paint (Gen Lead) J. Mawle "
3050 " Coral Tint C.W. Schmidt 2666
3051 Spec. B.P. Pink Primer (Quick Drying) Hope 566
3052 R.M. Lt Drab to their shade. Vic No 3446
3053 Spec. B.P. Car: Green No 1. Cooper 18/4/06
3054 " " Ivory White Vickers "
3055 R.M. Verona Green Sheffield Corp. "
3056 " Grey Liquid R. for Hoops Ransom Rowlls
3057 B.P. Standard Station Tint 27/4/06
3058 Red Lack Marking Paint "
3059 R.M. Gen. Lead Light Stone "
3060 Roof Paint 46 Special
3061 " 44 S.M. 5777
3062 " 48 Special
3063 " 49 S.M. 5778
3064 " 50 Don't make specially S.M. 3652
3065 " 51 Special

3066 Roof Paint 52 S.M. 5655
3067 ~~R.M. Green Paint ...~~ Light Grey (Shade 203)
3068 Roof Paint – White
3069
3070
3071
3072
3073
3074
3075 Floor & Platform Paint 801. S.M. 5457
3076 " 812. 5458
3077 " 813 5452
3078 " 804 5466
3079 " 807 Special
3080
3081
3082
3083
3084 Spec. B.P. Bronze Green
3085 " R.M. Cherry 14/8/06
3086 " " Lt. Chocolate Freeb "
3087 " " Dk. Green "

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0007-SWP-000126631

3088 Special R.M. Light Ochre Fox & Co 4/4/6.
3089 R.M. Oxide of Iron (Ex 731 Thinned) War Dept 11/9/6
3090 " " " " (Ex 736 ") " " "
3091 " Green Paint with Verdigris S.E. Rly 3/1/6
3092 " Red to shade Rx 50 A Quality, Simpson.
3093 " Blue " " " 13 " " "
3094 ~~Walton Brown with oil box~~ 17/7/6
3095 " [illegible] Lon. Rd.
3096 " Stone Ex 395. Walton Lovell.
3097 " Grey-shade No 1. Chamberlain King & Co
3098 " Green " " " "
3099
3100 ~~Liquid Grey Rubber Paint Ex 444~~ 14/9/6.
3101 Black Trunk Paint Ex 258 22/9/6
3102 ~~Yellow ... 284~~ "
3103 Liquid Rubber Tyre Solution Ex 312 5/10/6.
3104 Red Roof Paint x ~~[illegible]~~ 315 Pickrell 8/8/7.
3105 Liquid Grey Paint (X444) S. West Std.
3106 " Brown Roof Paint (X845). Dist: Rly.
3107 " Slate Wagon Paint (X892) Preston - Dublin
3108 " White Paint (X1185-A) Littlewood Bros.
3109 " Olive Green (Graphitint (Released 3167)

3110 Special Quick Drying Liquid Red Paint for Machinery
3111 R.M. Slate Paint. (X1093) Barry Railway
3112 Cure Lead Pink Primer (X1235)
3113 R.M. Red Oxide (X871) Standard Eng. Co.
3114 Graphitint Red - Ready for use (Released 3183)
3115 Liquid Cream Paint (X800) India Store
3116 " Maroon " (X434) " " 11/7/6
3117 R.M. No 3 Steel Color. A. M. Bell Halifax
3118 " " Lt French Grey "
3119 " " Dk " " " "
3120 " " Dove " "
3121 " " Terra Cotta " "
3122 " " Lead " "
3123 " " Drab. " " "
3124 " " Warm: 3117. 9/1/07
3125 " Bus Colour (X1154)
3126 Oil Proof Machine Paint - Dp Steel Grey (X1405) A. Herbert Ltd
3127 R.M. Orange Roof Paint. (X1111) African Trade
3128 " Flat Red Paint (X1334) Stand Eng. Co.
3129 " Oil Proof Machine Paint - Dark Blue
3130
3131

0007-SWP-043285

0007-SWP-000126632

5088	Golden Ochre ground in Oil - F1266. L. Morrell Sons	5110	Ground Dark Century Green J Lumridge Sons
5089	Colours Ground in Oil - Lt Brown Or (F1555a) J & J Colman	5111	
5090	" - Yellow Ochre (X516) Yorkshire Chemical Co	5112	
5091	" - Century Red Lumridge & Sons	5113	
5092	" - Dark Brown F1565 Colman Ltd	5114	
5093	" - Grey Paint. J Lyon Ltd	5115	
5094	" " - Blue Paint - (= parts No 1 Blue Gt = 2 [mixed in oil]) S. Thornley	5116	
5095	Ground A I P. Paint Grey	Bamford	5117	
5096	" Lt. Bk Green No 3	Widger	5118	
5097	" Dp. "	"	5119	
5098	" Mid Bronze · OO.	"	5120	
5099	" Yellow Ochre C.	"	5121	
5100	" Lt. Indian Red	G. L. Lee	5122	
5101	" 80% Zinc White (X1217)	American Hardware Co	5123	
5102	" Mid Bk Green (X1128-A)	Mayle	5124	
5103	" Cheap Funnel Paint (X1239)	C.P.C.	5125	
5104	" Dp Bk Green. (X1129)	Mayle	5126	
5105			5127	
5106	" Light Lead Coloured (X384)	Winterton	5128	
5107	" Indian Red. (X1236).	Thos. Driscoll	5129	
5108	" 80% Genuine White Lead.		5130	
5109	" 60% " " "		5131	

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0007-SWP-000126633

12088 Blended Goods,

12089

12090 " No 1 Reduced Dry White Lead

12091 " " Dry Red Lead

12092 " " 2 " " "

12093 " " 3 " " "

12094 " Reduced Red Lead - 80% R.L.

12095 " " " " - 50% R.L.

12096

12097

12098

12099

12100 " Indian Red, Lt No 2

12101 " " Mid "

12102 " " Deep "

12103 " Turkey Red, B-2

12104 " Jewellers Rouge

12105 " Dk. Lake Toned Indian Red

12106 " Tuscan Red, D.

12107 " Lake Red, H.

12108 " Venetian Red, B

12109 " " " X

12110 Blended Goods, Light Indian Red [illegible]

12111 " Powdered Bole (Armenian) [illegible]

12112 " Crude [illegible] Red [illegible] [illegible]

12113 " Verona Red [illegible]

12114 " Red Lead Special [illegible] A [illegible]

12115 Dry Turkey Red Q Gemmell [illegible]

12116

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Effect Of White Pigments On Physical Properties Of Paint Films

By E. J. Dunn, Jr., and C. H. Baier
Research Laboratories, National Lead Company, Brooklyn

PIGMENTATION is one of the paramount factors in the formulation of house paints to obtain durability. The largest proportion of exterior house paint is based on the use of white pigments and linseed oil. Pigments used in white base house paints may be classified into two groups, namely, (1) reactive pigments or; (2) non-reactive pigments The commonly used reactive white pigments are basic lead carbonate, basic lead sulphate, zinc oxide and leaded zinc oxides. In the second or non-reactive group, the most commonly used pigments are titanium dioxide and zinc sulfide The so-called extender pigments, of which fibrous magnesium silicate is probably the most widely used, are also employed in house paints

It is known that most single pigment paints are not particularly durable. However, if the physical properties of the individual pigments are properly established and advantage is taken of these properties, balanced formulations may be designed to produce durable paint films with a combination of pigments even though individually they may produce poor paint films

To determine what physical properties are imparted by the various individual pigments, it was necessary to make a broad study of single pigment paint films. Physical property measurements included in this study were tensile strength, percent elongation, elasticity, Sward rocker hardness, moisture permeability, moisture sorption, abrasion resistance, shear hardness, adhesion to metal, reflection, gloss and distensibility over a conical mandrel. Microscopic examinations were made of the films and pigments and some chemical determinations were made to show the quantities of reaction compounds or soaps formed both in the paint container and within the paint film as it aged

The pigments used in this investigation were Carter process basic lead carbonate,[1] Thompson Stewart process basic lead carbonate,[1] lead salicylate, basic lead sulfate, zinc oxide, titanium dioxide (rutile type) and fibrous magnesium silicate. These are the pigments commonly used in house paints

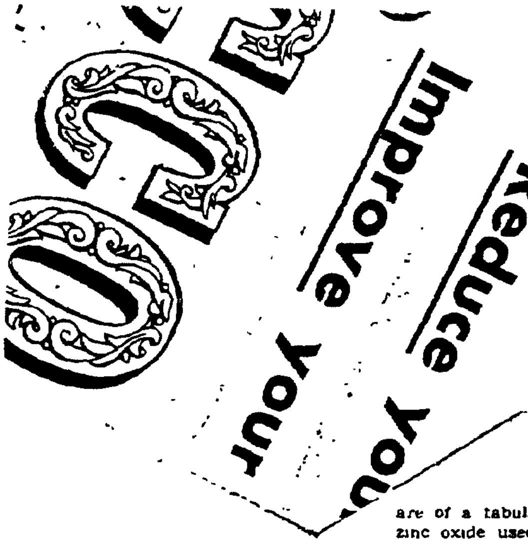
Particle Size

The comparative particle size and microscopical appearance of the six pigments included in this study are illustrated in Figure I.

It is apparent from Figure I that lead salicylate has the coarsest particle size of all the lead pigments. Basic lead sulfate and basic lead carbonate-Carter process are of similar particle size while the TSP white lead is definitely finer All these lead particles have a third or depth dimension much less than the length and breadth of the particle In other words, the particles

(Turn to Page 46)

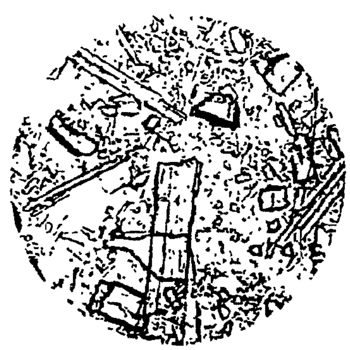
Address given before the Toronto Paint and Varnish Production Club, April 19, 1948, and the New York Paint and Varnish Production Club, September 2, 1948 This paper will appear in some future issue of the "Official Digest"—Editor



are of a tabular or flaky type The zinc oxide used was of average fineness Some threelings, typical of zinc oxide, are evident. As in the case of white lead, zinc oxides are marketed in various ranges of fineness. In fact, a special "rubber grade" of zinc oxide is so fine that it begins to lose its optical properties and is considered unsatisfactory as a house paint pigment.

With respect to the effect of particle size on the physical properties of single pigment paint films, white leads of finer particle size seem to impart somewhat better physical properties In the case of zinc oxide, however, there is some indication that the coarser particle size imparts the better physical properties

Fibrous magnesium silicate is constituted of relatively coarse particles, however, it imparts certain desirable properties that appear responsible for its broad use in house paints Figure II is a photomicrograph of magnesium silicate at a magnification of only 250 diameters, whereas the previous pictures of the other pigments were at 1,000 diameters. This forcefully illustrates the extreme coarseness of this material, compared with the pigments used in house paints



Magnesium Silicate
Fig 2—Photomicrograph 250X

Titanium dioxide is one of the finest particle size white pigments on the market [2] Even at the high magnification apparent in Figure I, the particles are only minute dots, which shows they are only a small fraction of a micron in diameter. Since this product is so fine it is natural to wonder what these particles would look like in an electron micrograph Their appearance is exhibited in Figure III

It is evident from Figure III that the fine particles take on some shape The fine dots show a characteristic angular outline. Electron micrographs of the other pigments indicate the same general shape as the light microscope shows. The hexagonal shaped particles or the acicular shaped particles in the other pigments are sometimes more apparent in an electron micrograph but basically the same particle shape is exhibited

To prepare the single pigment paints for this physical property study, the above six pigments and one extender were ground individually in paste form using refined linseed oil as the grinding medium The pastes were ground on a three roller mill passing the paste through twice to insure a good grind The roller mill was adjusted to give a fine grind The resultant pastes were all reduced to a pigment content of 24 per cent by volume by the addition of more refined linseed oil No free thinner was added, but 3 per cent of liquid drier was used Table I gives the composition of these paints

Lead salicylate is a new lead product used for stabilizing paint films and plastics It is the normal lead salt of salicylic acid It materially increases gloss retention and retards

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Effect Of White Pigments On Paint Films

(Continued from Page 46)

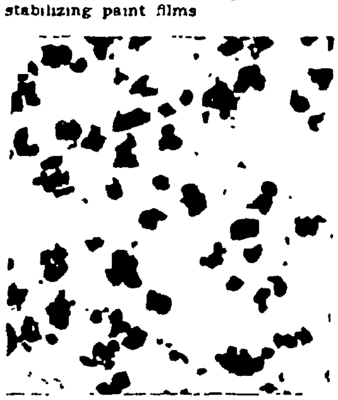
the chalking of oil base paint, especially when used in combination with non-reactive pigments. Due to these characteristics, it prolongs the color fastness of colored or tinted paints where the reactive pigments content is small Lead salicylate also improves the performance of red lead primers in corrosion inhibitive paints, particularly on salt water exposure Lead salicylate was included in this study because of its beneficial properties in stabilizing paint films

Table I

Paint No	Material	% Pigment	% Vehicle	Lbs / Gal
6040	Lead Salicylate	43 74	56 26	10 54
6041	Titanium Dioxide (Rutile)	58 04	41.96	13 96
6042	*Basic Lead Carbonate	68 88	31 12	19 08
6043	**Basic Lead Carbonate	69 26	30.74	19 28
6044	Basic Lead Sulfate	67 27	32 73	18 11
6045	Zinc Oxide	65 01	34 99	16 84
6046	Fibrous Magnesium Silicate	48 47	51 53	11 50

*Carter Process

**Thompson Stewart Process



Titanium Dioxide, Rutile
Fig 3 —Electronmicrograph 10,000X

Another new type lead pigment used in house paints of today is referred to as a basic silicate white lead and is called 45X. Pigment 45X was not included in this comparative physical test program when it was started about three years ago, nevertheless, its importance warrants discussion

Particles of the pigment 45X have been produced on the basis of a new pigment concept [4] In a paint film, the core or central portion of the particles practically never comes in contact with the vehicle Microscopical examination of the particles retained in paint films after five years of exposure shows that the pigment particles retain their original size and shape In view of this a pigment has been developed having a neutral or non-reactive core but with a coating or surface for the particle that is reactive. This is the type of particle that has been produced in 45X A core of silica is surrounded by a thin coating of lead silicate and some lead sulfate. Lead sulfate acts as a light stabilizer for the lead silicate Such a particle conserves metallic lead during the present shortage Our exposure data with this pigment improves as it accumulates

After the above paints were aged for a few days the necessary panels were prepared Six panels approximately 30 inches long by five inches wide were prepared from each paint Two panels were on tinned iron, three on cold rolled steel and one on patapar paper In order to have films of fairly uniform thickness, all paints were applied with an inclined automatic doctor blade [5] After the panels dried, they were primed on the back and edges and were exposed at the National Lead Company exposure test station at Sayville, Long Island Panels were exposed on the fences in a vertical position facing south Periodically, portions of these panels were returned to

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...ssn. Enjoys
...ing Forest
...ennial fellow-
joined forces
and evening
...ting of the
... Lacquer
... Forest
...imately

General Mills, Inc.; Fred McCarthy,
National Lead Company, New York;
L J Kaiser, Reynolds Metals Com-
pany; Frank Cavanaugh, Thompson-
Hayward Chemical Company; Law-
rence Reed, Western Dry Color Com-
pany; Forest Seay, Ralston-Purina
Company; Tom Felton, Shepherd
Chemical Company; John R Garrason,
E. W. Colledge, Inc.; Allen Lilla and
L H Braun

Canadian Paint Export Drop In July

Ottawa, Sept. 14—Canadian exp...
of paints and varnishes ...
$480,000 in July this ...
with $519,000 in July ...
...umped down ...

the Research Laboratories and the various physical properties determined.

Concurrently, wooden fence panel sections were prepared at Sayville to demonstrate the durability of single pigment paint films on wood Figure IV shows the comparison of these panels as they appear on the fences at the age of one month, six months and twelve months

Figure IV shows in general that the reactive pigments are more durable as single pigment films However, when the properties of the non-reactive pigments are balanced and combined with the properties of reactive pigments, very durable paint films may be obtained

Apparatus

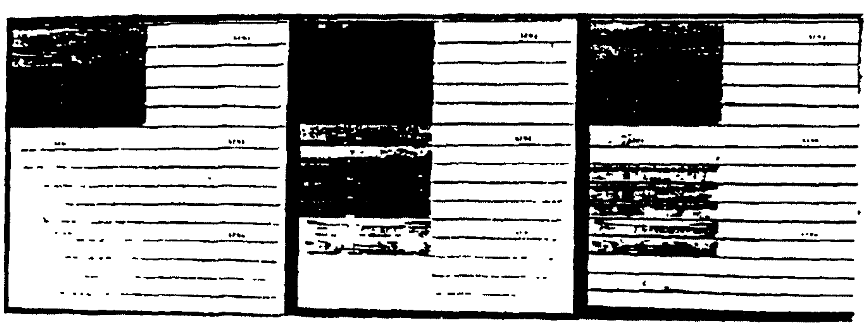
Some of the apparatus used in making the physical property measurements for this investigation is illustrated in Figure 5

A. Hunter Reflectometer
B. Petrographic and Stereoscopic Microscopes
C. Taber Abraser
D. Ames Gauge and Magne Gauge
E. Water Permeability
F. Conical Mandrel
G. Gardner-Parks Tensile Strength and Per Cent Elongation
H. Soap Extraction Apparatus
I. Sward Rocker Hardness Tester.

The Hunter Reflectometer[6] was used for the measurement of 60° gloss and reflectance. The petrographic microscope was used for the particle size and particle shape studies The stereoscopic microscope was used to examine the paint films for the degree of deterioration. The Gardner-Parks instrument[7] was used to determine the tensile strength and the percentage elongation The Sward rocker hardness meter[8] was used to measure the surface hardness. The Taber abraser[9] was used to measure abrasion resistance and shear hardness. The conical mandrel[10] was used to note the point at which the film could be distended before cracking or breaking away from the base to which it was applied. The water permeability was determined by the New York Production Club method.[11] The cups are illustrated at "E" in Figure V. Film thickness measurements were made on all panels using either the Ames Dial Micrometer or the Magne Gauge Extractions of the paint film for chemical determination of soap formation[12] were conducted in the refluxing apparatus shown at "H" in Figure V. Extractions were made with a vehicle con-

Fig 4
Left Half Magnesium Silicate, Titanium Dioxide, and Zinc Sulfide
Right Half Basic Lead Carbonate, Zinc Oxide, and Basic Sulfate

One Month *Two Months* *Twelve Months*



sisting of equimolar parts of ethanol and benzol.

Physical Property Measurements

Such extensive data are gathered from a program of this type that presentation in a concise and meaningful manner offers some difficulty. The important object is to establish the trend of the various values throughout the life of the paint film. How does the hardness or the tensile strength change from month to month? It is not necessary to know the exact data obtained because it is the general rate of change of physical properties, with time, which governs the life of the film.

To portray the manner in which the various physical properties change with time, graphs have been prepared and Figure VI illustrates the change in reflection characteristics of the paint film with time. It is evident that zinc oxide and the two white leads, the reactive pigments, all have a very similar whiteness at the relatively high level of approximately 70 per cent. Lead salicylate, also a reactive lead compound, has a relatively low hiding power and consequently shows a low order of reflection The titanium dioxide panel, which is whiter than all the others initially, and normally stays that way, became mildewed in this series, and as a consequence the whiteness was materially reduced. Magnesium silicate naturally shows a low reflection, but when it chalks heavily the whiteness increases

Figure VII shows the change of gloss with time. The gloss was measured at an angle of 60° Lead salicylate has most unusual gloss retention properties This compound as a single pigment stabilizes a linseed oil film better than any other compound that was tested Zinc oxide, in this series, showed better gloss retention than usual The three lead pigments lost

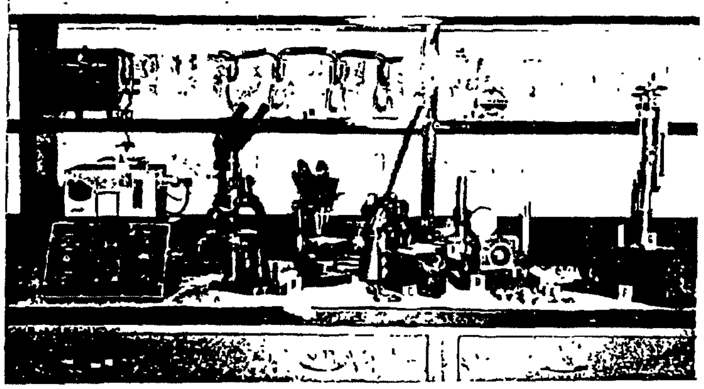


Fig. 5.

their gloss in approximately two months of summer exposure and after three months, all show practically no gloss

Figure VIII shows the results of the Sward rocker hardness tests. Sward rocker hardness is primarily an indication of the condition of the surface of the paint film. Lead salicylate, zinc oxide and Thompson-Stewart Process white lead all produce relatively hard surfaced films. The rate of increase in surface hardness is pronounced, as may be noted in the graph Carter Process White Lead has a somewhat similar rate of increase in surface hardness but it does not attain the degree of hardness of the Thompson-Stewart Process White Lead. Basic lead sulfate, magnesium silicate and titanium dioxide all produce relatively soft surfaced films Their initial rate of increase in surface hardness is quite high, but they would all be classed as comparatively soft surfaced films.

Shear hardness was obtained with the Taber shear point. It is the force required to shear the paint film without cutting through to the metal It is affected more by the through hardness of the film than is the Sward rocker hardness test There are some changes but basically the same pigments show the hardest films Zinc oxide indicates greater through hardness than the other films. It should be noted that the rate of increase in through hardness is very steep, reaching its general maximum in about two months Magnesium silicate, basic lead sulfate and titanium dioxide produce films that are too soft to be practical and show no increase in through hard-

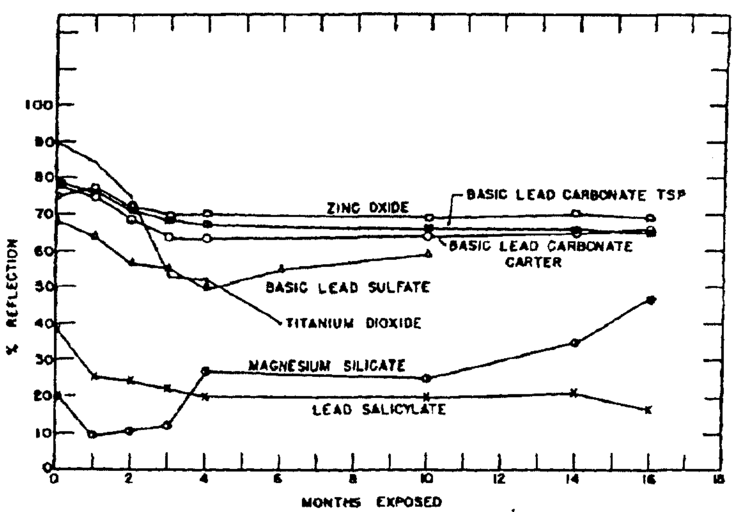


Fig. 6.—Reflection

ness up to the time the film begins to disintegrate.

The tensile strength of these paint films increased to a maximum in about three months which may be noted in Figure X. The strength of these films is appreciable, approaching the range of 40-50 kilograms per square centimeter. After three months, the tensile strength began to decrease. However, if a means were available to accurately measure the tensile strength of very small pieces of paint film, we feel the tensile strength would be increasing for a much longer period of time. It is apparent from Figure X that the reactive pigments impart considerably greater tensile strength to the film.

Similarly it is difficult to determine the percentage elongation of the paint films as separate entitles (that is, stripped from the base metal) for long periods of exposure. The separated paint films are difficult to manipulate. Figure XI shows that the rate of decrease in elongation is quite pronounced. There are some pertinent notations on this graph. First, the lead salicylate film stretches over 100 per cent of its length. That is most unusual in any paint film. Secondly, zinc oxide has a very low percentage of elongation even as an initial film. It appears to be too low for a durable paint film. Most of the lead pigmented films exhibit relatively high percentage elongation, compared with the other pigments.

Paint films also exhibit elastic or resilient characteristics. After the films have been elongated or stretched, as illustrated in Figure X, they tend to return to their original size or length

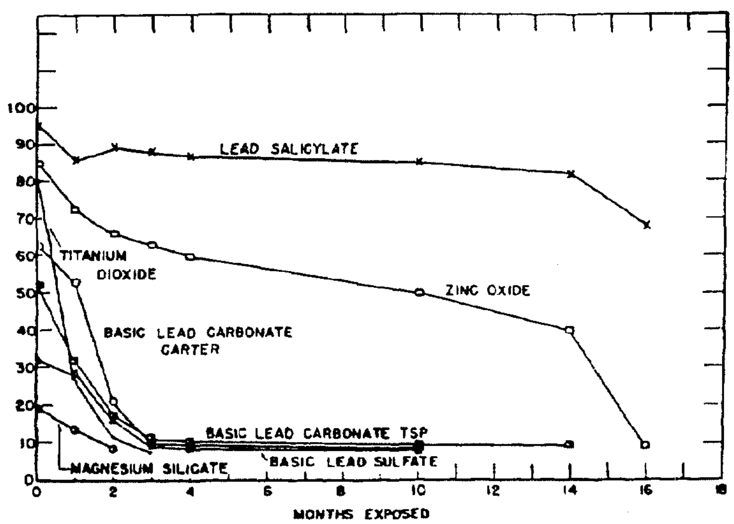


Fig 7 —60° Gloss

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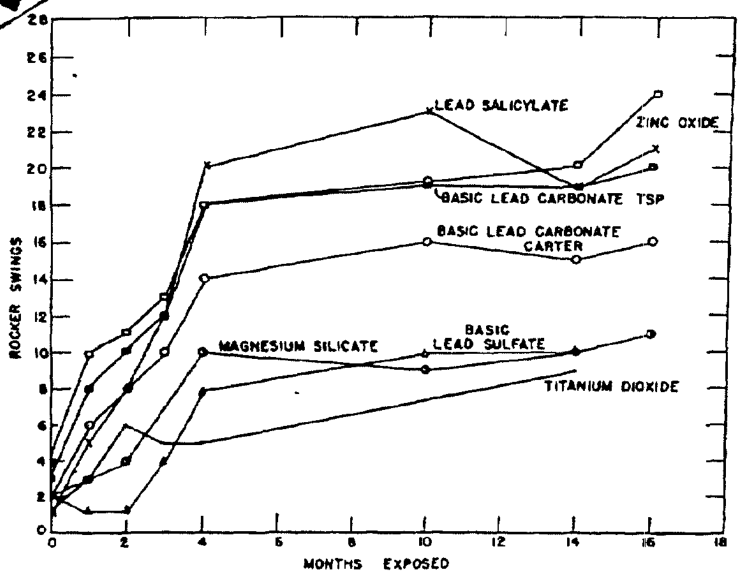

Fig. 8

This elastic characteristic is best illustrated by the data in Table 2

Table 2

Film	% Elongation	% Permanently Extended
Lead Salicylate		
Original	110	11
1 Month	117	35
3 Months	88	25
4 Months	40	7
Titanium Dioxide		
Original	37	1 4
*Basic Lead Carbonate		
Original	50	2 2
1 Month	45	9 5
2 Months	18	5 8
3 Months	6	0
**Basic Lead Carbonate		
Original	30	1 4
1 Month	35	8 5
2 Months	14	4 6
3 Months	13	0
Basic Lead Sulfate		
Original	29	1 5
Zinc Oxide		
Original	7	0
1 Month	3	0
Magnesium Silicate		
Original	18	1 4
1 Month	21	1 4

* Carter Process
** Thompson-Stewart Process

Although Table 2 illustrates the surprising elasticity of paint films, it is evident from the observations that the paint films also have some plastic characteristics Films that are capable of extending from 40 to 100 per cent of their length seldom are able to return of their own accord to their original size However, if the percentage elongation is low, the film usually returns to its original size

Distensibility is a term associated with elongation. The term distensibility has been used to signify the stretch of the paint film when it is supported by the base upon which it is applied Where the films are attached to the base they retain their elongation for a much longer period of time, which means the adhesion of the paint film plays a vital part in the measurement of this physical property. If the paint film disintegrates badly, it is difficult to measure the distensibility. Figure XII makes it evident that practically all the paint films retain enough distensibility (above 10 per cent) to cope with the average expansion and contraction of wood. Wood expands, on the average, up to 4 per cent with the grain and about 10 per cent across the grain Zinc oxide has a low order of distensibility In fact the distensibility may be too low to resist the full expansion and contraction of the wood

Water permeability and the amount of water picked up and held within the paint film appear to affect the durability. Figure XIII shows the water permeability of the film over a period of a year. It is evident that zinc oxide, basic lead carbonate-Carter Process, lead salicylate and basic lead carbonate-TSP have a rather uniformly low rate of transfer of water through the paint film. Basic lead sulfate, titanium dioxide and magnesium silicate transfer appreciably more water initially, and the quantity increases as the film ages. Those films transferring the large quantities of water were the less durable ones when exposed on the fences at Sayville.

The water sorption or the amount of

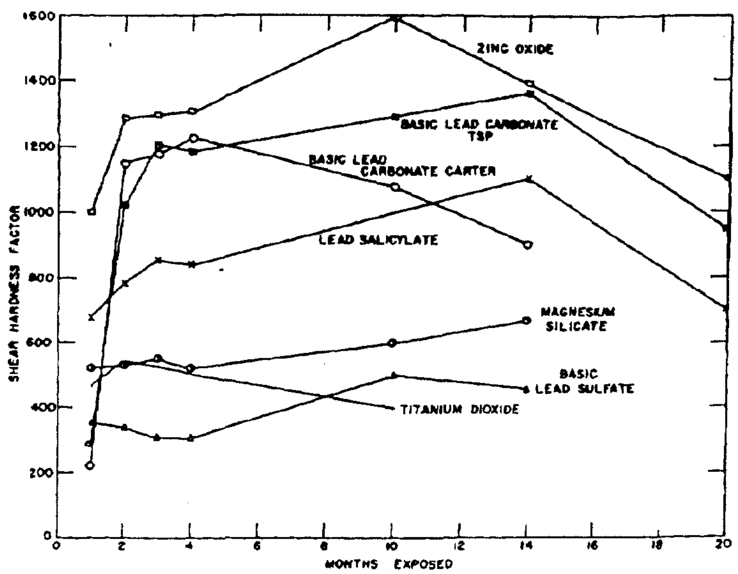

Fig 9 —Taber Shear Hardness

water that these paint films pick up and hold within the film is noted in Table 3

Table 3

Film	Percentage Changes in Weight: 72 Hrs Immersion	After Drying 24 Hrs	Difference % Water Sorption
Basic Lead Sulfate	−2.6	−6.9	4.3
Zinc Oxide	+15.5	−5.7	21.2
Magnesium Silicate	+12.3	−3.6	15.9
Lead Salicylate	−6.4	−16.5	10.1
Titanium Dioxide	+18.5	−5.2	23.7
*Basic Lead Carbonate	−8.2	−8.7	0.5
**Basic Lead Carbonate	−3.8	−4.3	0.5

*Carter Process
**Thompson Stewart Process

From Table 3 it is evident that lead pigments in general have a high resistance to pick up of water within the paint film The other pigments and magnesium silicate pick up appreciable water, the content going as high as 23.7 per cent. This affinity for water, of pigments other than lead, is apparent on the surface of paint films during a rain storm. Lead pigmented films usually cause the rain to appear as droplets on the surface while the other pigmented films are better wet by the water and, therefore, the water usually exists as a film on the surface Further evidence to substantiate the above is the fact that lead pigmented films may show water spots after a

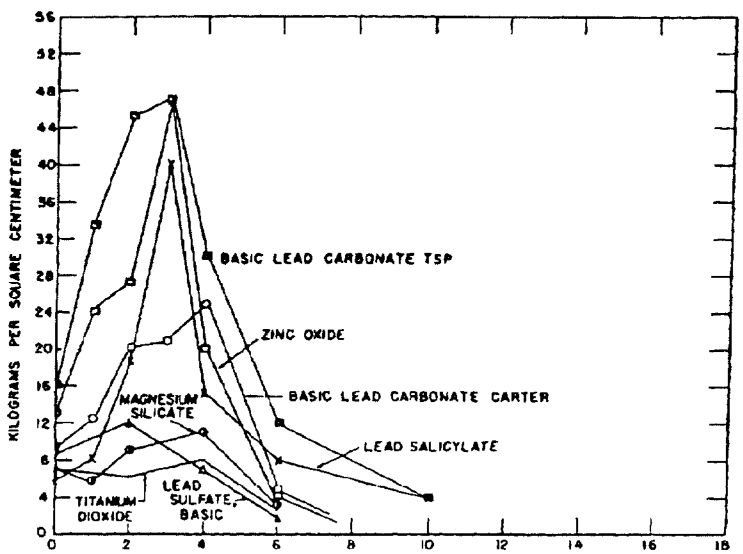

Fig 10 —Tensile Strength

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storm while films containing other pigments do not. In general, those films showing the lowest water sorption were the more durable films.

It is apparent from Table 3 that the water solubilities of all these paint films are similar except for lead salicylate, which has a much higher water solubility. This is due to the compound itself exhibiting a slight water solubility. The films other than lead salicylate show an average of approximately five per cent water solubility, which appears to be due primarily to the vehicle portion of the paint film.

The abrasion resistance, as determined with the Taber abraser, was obtained for these various paint films as exposed over a period of months at Sayville. Actually, these paint films as a group would be classed as the so[ft] type, especially in early stages of their life, so that the abrasive action of the machine may imbed material into the paint film instead of completely wearing it away. However, as may be noted in Figure XIV, some difference in abrasion resistance of these films is observable as the age increases. The harder paint films such as those obtained with the zinc oxide and the lead salicylate show the better abrasion resistance. However, the abrasion resistance of soft type linseed oil base films does not appear to be of great value in a correlation of physical properties.

The adhesion of these paint films to metal, as indicated by the New York Production Club Method, is indicated

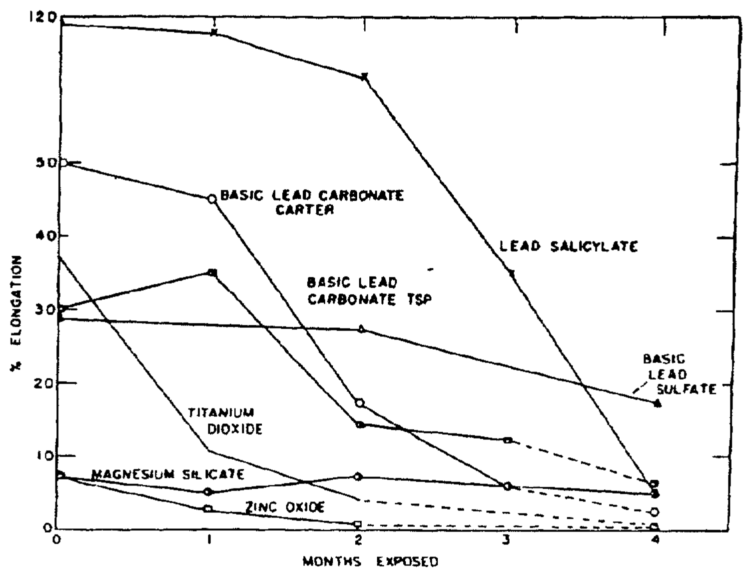

Fig. 11 —Elongation

in Figure XV It is interesting to note that the adhesion increased, as these paint films aged, until the paint films started to show some deterioration. This increase in adhesion seemed to be common to all the paint films but was most pronounced for lead salicylate. The high degree of adhesion for lead salicylate was also most evident in the panels as they aged at Sayville The adhesion of white paint films to wood is a very important property.

Chemical Determinations

After a paint film has dried and set, there are still many chemical reactions taking place The oil film continues to oxidize and set free some short chain acidic compounds, as well as split off some fatty acid from the triglycerides, probably through hydrolysis. These products tend to liquify, plasticize or soften the film. Some paint systems actually become so gummy that they cannot be handled during this softening period

Reactive pigments within the film slowly unite or combine with the decomposition products of the vehicle and prevent extreme softening of the film. The controlled formation of soaps within the film as the film ages actually enhances the life of the paint film Some soap is formed in the liquid paint held in the container, but the soaps that form in the paint film produce the most beneficial effects Some indi-

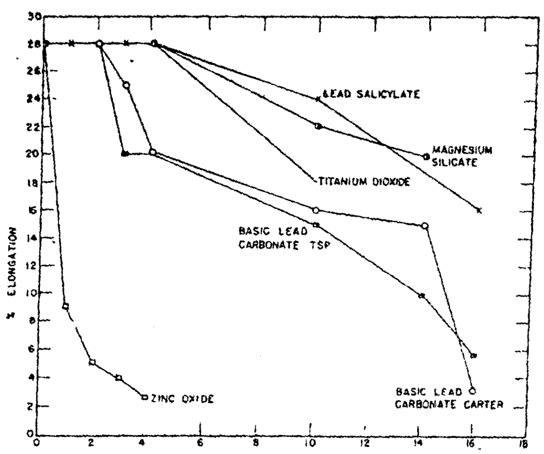

Fig 13 —Distensibility—Conical Mandrel

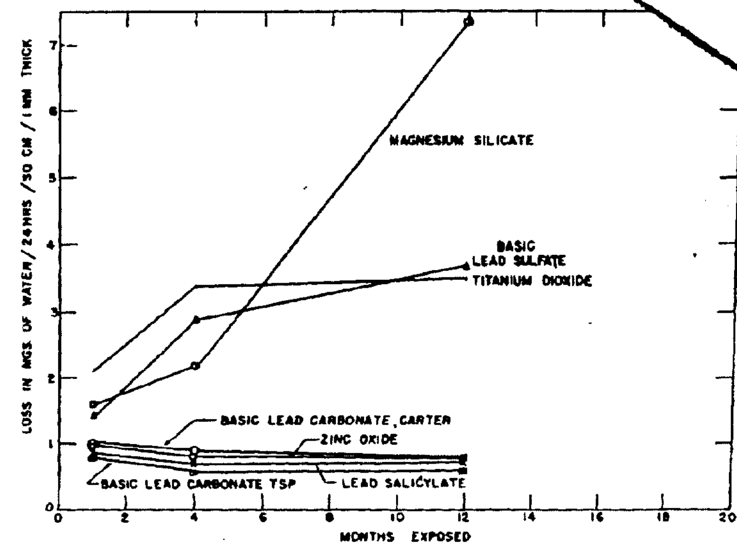

Fig. 13.—Water Permeability

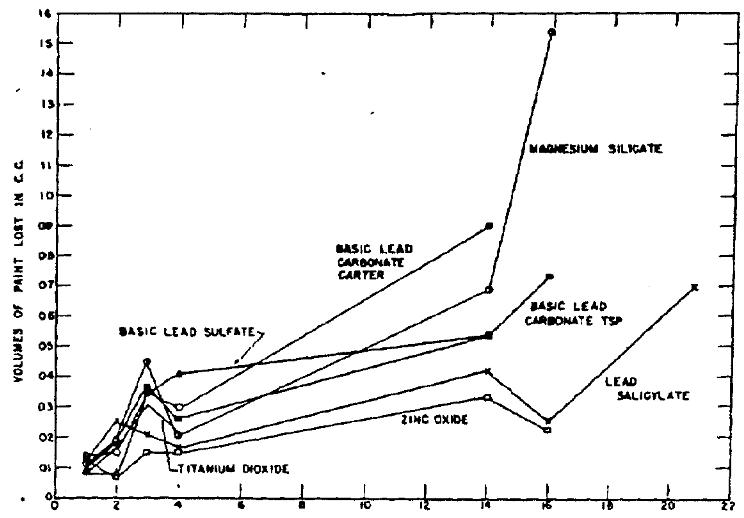

Fig 14

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cation of the quantities of soap formed in the container and in the paint film as it ages may be obtained from Table 4

films age on exposure, the soap content calculated from the soluble portion of the film increases, being a small quantity at two months and

Table 4

Pigment Used	In Paint Container	% Linoleate in Paint Film 3 Months	6 Months	12 Months
**Basic Lead Carbonate	0 05	3 8	13 0	18 4
*Basic Lead Carbonate	0 09	3 6	13 1	18 0
Basic Lead Sulfate	0 08	0 6	8 0	5 0
Lead Salicylate	8 3	18 2	31 5	30 4
Zinc Oxide	0 3	13 3	14 8	19 1
Titanium Dioxide				3.0
Magnesium Silicate Na		.	0 5	2 1
K				2 0
Al				1 0
Mg				2 0

*Carter Process
**Thompson Stewart Process

It is evident from Table 4 that only a small fraction of a per cent of soap is formed in the paint container The high value for lead salicylate is due to limited solubility of that compound in the extraction vehicle As the paint

increasing to a relatively large quantity at twelve months No reliance is placed on the exactness of the quantities of soap reported in Table 4, but considerable importance is attached to the increasing amount of soap found

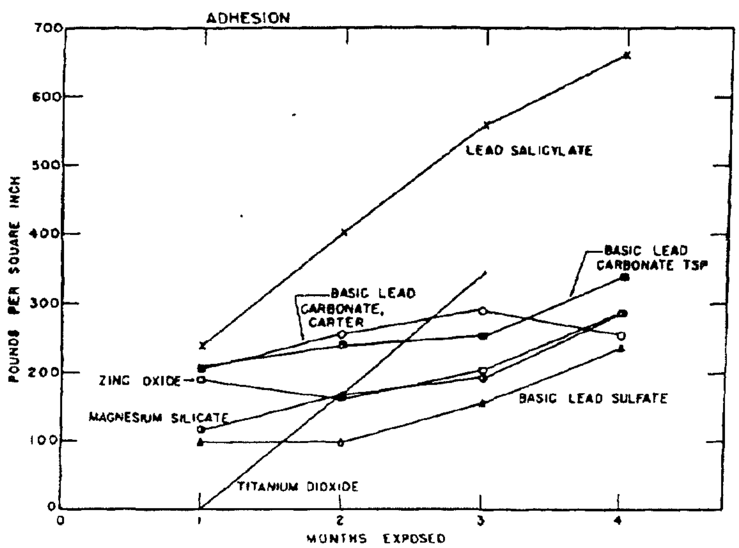

Fig 15 —Adhesion

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as the film ages.

Normally, the acidic decomposition products form in the paint film at a faster rate than the soap formation reaction proceeds This is highly beneficial, as advantage is taken of both the plasticizing action of the acidic compounds and the stabilizing reaction of the soap formation. The beneficial effects of these reactions are probably best illustrated by Figure I which evinces the longer life of Sayville exposed paint films made with the reactive pigments

Conclusions

From the foregoing, it is apparent that the supposedly simple phenomenon of the drying and weathering of a paint film is really exceptionally complex both from the physicist's and the chemist's point of view These data point to the need of a better application of the knowledge of physical property data in the paint industry for the development of improved house paint pigments and to a better compromise of physical properties within the paint film. From the data collected in this work, such improved pigments should impart low water permeability, low water sorption, high visible reflection or high hiding power, good gloss retention, high tensile strength, relatively high percentage elongation and high distensibility. The film should retain some elasticity, have high surface hardness, high shear hardness, good adhesion and high abrasion resistance The pigment should be capable of chemical combination with the reactive acidic components of the disintegrating vehicle to stabilize the film Such a pigment should preferably be of relatively fine particle size and impart chalking characteristics as the basic method of film deterioration The pigment should not only impart these characteristics to the initial paint film but should retain these properties for the major portion of the life of the paint film.

The properties of many modern house paints are obtained by balancing the deficiencies of one pigment by the advantageous attributes of another, for example by counteracting excessively high reactivity of one pigment with the non-reactivity of another pigment. A mixture of pigments may impart better water resistance or lower water permeability than would be expected by considering the arithmetic average of the individual components. Mixing pigments makes possible some control of reactivity thereby aiding the retention of distensibility. Hardness of film is desirable providing distensibility is retained. Hard distensible films usually have better abrasion resistance and maintain better adhesion. In this series of tests, those films with the higher surface hardness were associated with the better gloss retention.

It is evident from this correlation of physical properties why house paint formulations must be well balanced with respect to the pigments used High quantities of zinc oxide would reduce the distensibility with consequent loss of adhesion and would increase the water sorption and have a tendency toward high reactivity and embrittlement. Too much titanium dioxide or magnesium silicate would reduce the water resistance, increase the water permeability, speed the rate of chalking, reduce the reactivity and thereby soften the paint film to such an extent that erosion or washing would take place Excessive quantities of basic lead sulfate would reduce the reactivity, soften the film appreciably and reduce the adhesion Increasing the quantity of white lead is the safest way of varying the average house paint mixed pigment formula. It is definitely better than making additions of basic lead sulfate. However, straight white lead has a slow chalking rate during its early life,

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which delays the "self-cleaning" of the surface.

From the physical property standpoint, it is expected that the present average house paint formulation will persist for some time—at least until the properties of the various pigment components are altered or improved, to allow larger amounts to be incorporated with safety, or until new pigments are marketed that effect a better compromise of physical properties.

It is realized that this physical property study is only a start on a tremendously complex problem and must be continued to include various mixed pigment formulations and painting systems. The correlation of results on mixed pigment paint films and painting systems with the results obtained on the single pigment films should be helpful in the development of better paint films for the paint industry

Acknowledgment

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New PRODUCTS and EQUIPMENT

A PHTHALIC alkyd resin, which is said will not haze in the presence of zinc oxide, has been introduced to the market by U S Industrial Chemicals, Inc., 60 East 42nd Street, New York City 17 Known as "AROPLAZ 1248-M," the new non-hazing resin permits for the first time mirror-like finishes, with high-gloss and gloss-retention, even in the presence of zinc oxide. The product, according to the manufacturer, is applicable for formulation of architectural paints and enamels, especially for use in mill whites for textile mills, and for all maintenance finishes Aroplaz 1248-M is a pure, long-oil, oxidizing alkyd supplied at 70 per cent solids in mineral spirits, and is the result of years of testing and development by U. S I's laboratory and production experts Excellent film characteristics, and especially color-retention of the long-oil architectural variety, have made alkyd resins highly desirable for top-grade white enamels Characteristic weakness of alkyds up to the present time, U S I reports, has been their tendency to develop a surface haze giving the appearance of a thin film of chalk This hazing tendency resulted in diminished gloss to the point of almost appearing flat when viewed at normal angles, and it was particularly pronounced when zinc oxide was used in pigmentation As zinc oxide is absolutely essential to prevent yellowing of white enamels hazing has been a serious drawback to the use of alkyds in such enamels Specifications to which Aroplaz 1248-M conforms are as follows Non-Volatile, 69-71 per cent, solvent, mineral