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UNIVERSITY OF LOUISVILLE

The Loss in Drying Power of Black Paints Due to Aging

A Dissertation

Submitted to the Faculty

of the Graduate School

**In Partial Fulfillment of the
Requirements for the Degree of
Master of Chemical Engineering**

Department of Chemical Engineering

By

J. E. Rose

1938

The Loss in Drying Power of Black Paints Due to Aging

Director: Dr. R. C. Ernst.

Approved by Reading Committee:

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Chairman

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CHAPTER I

INTRODUCTION

The drying time of many black paints increases while the paints are stored in containers prior to sale. This investigation is a study of the loss in drying time caused by aging.

This work was concerned with the preparation of drying rate curves for samples of linseed oil having carbon black, lamp black, bone black, and graphite as pigment, and having lead and cobalt naphthenates as driers.

The drying rate curves cover a period of fourteen months and include the data of Bennett (1) for the first two months.

In addition to the preparation of drying rate curves, methods for correcting the loss in drying power, were studied in a comparable manner.

Carbon black, the pigment which showed the greatest loss in drying ability, was used exclusively in the latter part of the investigation.

CHAPTER II

THEORY

Linseed oil is a variable combination of glyceryl esters of saturated and unsaturated fatty acids and contains approximately 93% fatty acids and 7% glycerol in combination. The unsaturated fatty acids are chiefly oleic, linoleic, and linolenic. Small amounts of the saturated stearic acid are also present. Oleic acid, containing one double bond and represented by the formula $C_{17}H_{33}COOH$, does not impart drying qualities to the oil, but is capable of being oxidized at higher temperatures. The unsaturated fatty acids that cause the oil to dry are linoleic, containing two double bonds and having the formula $C_{17}H_{31}COOH$; and linolenic, containing three double bonds and having the formula $C_{17}H_{29}COOH$.

Linseed oil undergoes oxidation and polymerization during the drying period. The oil is capable theoretically of absorbing 18% oxygen, but actually the increase in weight is only 10 - 14% because of the loss of the volatile production of decomposition. The oil oxidizes, thereby adding oxygen to the double bonds.

The absorption of oxygen increases the molecular (4) weight and polarity to a point where molecular growths are formed. At a certain stage these growths become insoluble

in the liquid phase of oil forming small nuclei colloids. As the groups of molecules separate, they adsorb the remaining liquid, thereby forming a solid. The final solid is called linoxyn, and on aging is continuously broken down by further oxidation into fatty acids of smaller molecular weights and into volatile products, such as carbon dioxide.

The natural drying time of linseed oil is three to four days. This time can be reduced to several hours by the addition of metallic catalysts called driers. The three metals commonly used as driers are lead, cobalt, and manganese. It is found that lead acts as a coagulator of the film, exhibiting little of the property known as top-drying. Cobalt and manganese do not show this property of coagulating the film, but act as powerful surface driers.

The addition of lampblack and carbon black to linseed oil very distinctly inhibits the oxidation of the oil. It had generally been thought that this inhibition was the result of the presence of oily or oil soluble impurities in the pigments. Rhodes and Goldsmith (6) showed, however, that this was not the cause, and stated that the effect of the carbon pigments in delaying the oxidation of raw linseed oil was due to continuous adsorption of the intermediate oxidation product which acts as the true catalyst in the drying reaction. They also showed that carbon

pigments only slightly retard the oxidation of freshly prepared paints containing cobalt drier, the inhibiting effect becoming more pronounced as the paints were allowed to stand. This, they stated, was due to the gradual adsorption of the cobalt drier by the pigment.

Gas carbon blacks adsorb large quantities of air on the surface of the particles, containing carbon monoxide, oxygen, and carbon dioxide. It is possible that these gases affect the drying of the oil when made into a paint.

When the right amount of drier was added for correct drying time of freshly prepared paint, the drying period would be too long after the sample had aged. When the correct amount of drier was added for the proper drying rate at the end of the year, a film of the freshly prepared paint would become brittle and not durable.

It would seem, therefore, that the rate of adsorption of drier from the oil vehicle is rather slow, and the black becomes saturated only after a long period.

In order to determine the saturation quantity of drier, a series of tests was run to determine the adsorption of drier by carbon black from a naptha solution of the drier. This series of tests was performed by the Binney and Smith Company (2). Data were obtained with various carbon blacks, using Soligen driers of lead, cobalt, and manganese in a naptha solution. Actual paint grinds would have to be made to establish definitely the proper amount of drier

and proper method for overcoming this difficulty.

A solution to this problem would be to develop a method by which this drier adsorption could be made in a short time. This might be done by treating the pigment with a solution of the required amount of drier previous to grinding, or by adding the proper amount drier to the paint for adsorption before grinding and then the subsequent addition of drier for drying purposes.

Investigations by the Montreal Club (5), on adsorption of drier by inorganic pigments, show by photomicrographs that there is a soap formation which keeps the pigment particles separated, preventing agglomeration or flocculation with zinc oxide. TiO_2 and Fe_2O_3 not having a soap layer on the pigment surface to prevent flocculation formed agglomerates. This flocculation appeared to take place within a few weeks after grinding during which time the metallic soap added as drier was adsorbed to the surface of the pigment. Some of this drier was adsorbed during the time that flocculation was taking place, and became entrapped within the agglomerates thereby being removed from activity. They showed that the lost drying power might be restored if the whole of the adsorbed drier could be liberated from the pigment agglomerates by regrinding.

Jones and Watt (3), dealing with loss of drying strength with carbon black paints, state that carbon black is very susceptible to flocculation. When the pigment is ground

in a vehicle cooked with litharge, flocculation is minimized and the drying time of the paint is stabilized.

The addition of litharge to the vehicle prior to cooking causes the formation of lead soaps which during grinding tend to coat the pigment particles and thereby prevent flocculation and adsorption of added driers.

CHAPTER III

APPARATUS AND PROCEDURE

The apparatus consisted of a chain-o-matic balance and glass plates 9 x 12 upon which films of paint .002 - .0025 inch thick were spread by a "drawing" process.

Two metal gauge strips (.002 inch thick) were placed on the outer edges of each plate; paint was spread thickly on the plate with a small brush, and a metal blade drawn across the plate in contact with the gauge strips. Thus, there was a clearance of .002 inch between the surface of the glass plate and the blade. These films of paint weighed between .15-.25 grams.

The samples were mixtures of linseed oil, pigments, and driers. Carbon black, lampblack, boneblack, and graphite were the pigments, and cobalt and lead Nuodex were the driers. Litharge, potassium hydroxide, Cuprous chloride, and zinc Nuodex were used during the treatment of carbon black in certain mixtures.

The films were dried under constant temperature conditions (25 $\pm$ 1 $^{\circ}$ C) in the presence of light from a daylight type bulb.

CHAPTER IV
PART I
EXPERIMENTAL

The samples investigated, being mixtures of linseed oil with either carbon black, lampblack, graphite, or boneblack, with either lead or cobalt Nuodex as driers were prepared in the following manner. The pigment and oil were weighed and the Nuodex drier, which in solution of a metal naphthene te in naphtha, was added with a graduated pipette. Samples of approximately one-half pint were prepared and ground in a small pebble mill.

The compositions of the various mixtures studied are given in Table I.

The gain in weight method was chosen as the simplest and most direct manner of preparing curves for comparisons. The volatile products of oxidation, not taken into account, were assumed to be a constant factor and for comparative purposes were neglected.

The weight of oil in the film was used as the basis for expressing the increase in weight of the film.

The weight of oil in the sample was obtained in the following manner: 98 grams oil, 1 gram pigment, and 1 gram drier solution gave a mixture of 98% oil content.

The increase in weight divided by the weight of oil gave the percent increase from which the drying curves were plotted.

Time (in hours) was plotted against the percent increase in weight of oil.

The "induction period", used extensively in the descriptions of the curves is the time when sharp % increase in weight begins. See Fig. I.

Figure I.

CARBON BLACK

The drying curves for linseed oil containing carbon black and lead drier are shown in Figures 2 through 7. The oil mixtures that contained cobalt as the drier are shown in Figures 8 through 11.

Figure 2 (1 gram lead and 3.5 grams carbon black per 100 grams oil) showed an increase in induction period from four hours, for a freshly made sample, to a maximum induction period of seventeen hours, for six month's aging. The ninth and fourteenth month's curves receded to an induction period of fourteen hours.

The induction period in Figure 3 (1.5 grams lead and 3.5 grams carbon black per 100 grams oil) for the fresh sample was three hours while the period for the sixth month's sample was eight hours. The ninth month's induction period was nine hours with the fourteenth month at ten hours.

The composition of the samples of Figure 4 was 2 grams lead and 3.5 grams carbon black per 100 grams oil. The maximum increase in induction period was from two and one-half hours (fresh sample) to eight hours for the fourteenth month's sample.

The greater the drier concentration for a certain percentage pigment the less was the loss of drying ability on aging the mixtures.

The compositions of samples of Figures 5, 6, and 7 are respectively 1 - 1.5 - 2 grams lead and 7 grams carbon black. The curves of Figures 5, 6, and 7 were comparable to those in Figures 2, 3, and 4 except that each showed a loss in drying power much greater than the corresponding curves. This was probably the result of faster adsorption of drier by a greater percentage of pigment.

The induction period shown in Figure 8 (.025 grams cobalt and 3.5 grams carbon black per 100 grams oil) increased very greatly from four hours (fresh sample) to the maximum of fifty hours (six month's). The ninth and fourteenth month periods receded to forty and twenty-five hours respectively.

The mixture of Figure 9 (.025 grams cobalt and 7 grams carbon black per 100 grams oil) having more carbon black, displayed a greater loss in drying power than the sample of Figure 8. The increase in induction period was from eight hours (fresh sample) to approximately seventy-five hours, the maximum (six month's aging). The ninth and fourteenth month's samples receded, as in the previous case, to induction periods of fifty-five and forty-five hours respectively.

The content of samples in Figure 10 is .04 grams cobalt and 3.5 grams carbon black per 100 grams oil. This mixture, containing more drier than that of Figure 8 gave a

shorter induction period of the freshly made sample by two and one-half to four hours. However, the induction periods for the six month's sample were approximately the same for both Figures 8 and 10; thus it was shown that this larger percentage of drier was removed from activity during this aging period. The ninth month's sample had an induction period of sixty hours while the fourteenth month's sample had an induction period of twenty-two hours.

As in Figures 3 and 4, a greater amount of pigment exhibited a greater induction period. The fresh sample had an induction period of four hours while the six month's sample had an induction period of approximately seventy-five hours, much greater than that shown in Figure 10. The ninth and fourteenth month's samples, as in Figures 8 and 9 dropped back to sixty-five and forty-five hours respectively.

The carbon black samples showed a distinct loss in drying power. Aging in all cases resulted in a loss of drying ability. However, many of the ninth and fourteenth month's curves dropped behind the maximum induction period which was the sixth month's curve in most cases. The greater percentage of pigment showed a greater loss in drying power, and greater percentages of drier exhibited distinctly smaller losses in drying time except in the cases of the cobalt driers of Figures 9 and 11.

Table 1

Composition* of Linseed Oil, Drier, and Pigment Mixtures

Sample Number	Drier		Pigment		Results Reported in Table No.	Results Shown in Figure No.
1	Lead	1.0 g.	Carbon Black	3.5 g.	2	2
2	Lead	1.5 g.	Carbon Black	3.5 g.	3	3
3	Lead	2.0 g.	Carbon Black	3.5 g.	4	4
4	Lead	1.0 g.	Carbon Black	7.0 g.	5	5
5	Lead	1.5 g.	Carbon Black	7.0 g.	6	6
6	Lead	2.0 g.	Carbon Black	7.0 g.	7	7
7	Cobalt	0.025 g.	Carbon Black	3.5 g.	8	8
8	Cobalt	0.025 g.	Carbon Black	7.0 g.	9	9
9	Cobalt	0.040 g.	Carbon Black	3.5 g.	10	10
10	Cobalt	0.040 g.	Carbon Black	7.0 g.	11	11
11	Lead	1.0 g.	Bone Black	10.0 g.	12	12
12	Lead	2.0 g.	Bone Black	10.0 g.	13	13
13	Lead	1.0 g.	Bone Black	20.0 g.	14	14
14	Lead	2.0 g.	Bone Black	20.0 g.	15	15
15	Lead	1.0 g.	Lamp Black	7.0 g.	16	16
16	Lead	2.0 g.	Lamp Black	7.0 g.	17	17
17	Lead	1.0 g.	Lamp Black	14.0 g.	18	18
18	Lead	2.0 g.	Lamp Black	14.0 g.	19	19
19	Lead	1.0 g.	Graphite	14.0 g.	20	20
20	Lead	2.0 g.	Graphite	14.0 g.	21	21
21	Lead	1.0 g.	Graphite	28.0 g.	22	22
22	Lead	2.0 g.	Graphite	28.0 g.	23	23
23	Cobalt	0.04 g.	Carbon Black 3.5 g. (.1 Aluminum Stearate)		24	24
24	Cobalt	0.04 g.	Carbon Black 3.5 g. (.1 Zinc as Zinc Nuodex)		25	25
25	Lead	1.0 g.	Carbon Black 3.5 g. (.1 Zinc as Zinc Nuodex)		26	26
26	Cobalt	0.04 g.	Carbon Black 3.5 g. (treated with alkaline Cu_2Cl_2)		27	27
27	Cobalt	0.04 g.	Carbon Black 3.5 g. (treated with 25% KOH)		28	28
28	Cobalt	0.04 g.	Carbon Black 3.5 g. (pigment treated with 5% KOH)		29	29
29	Cobalt	0.04 g.	Carbon Black 3.5 g. (.25 lead as litharge)		30	30
30	Cobalt	0.04 g.	Carbon Black 3.5 g. (.5 lead as litharge)		31	31

* The composition of all mixtures is expressed as parts of drier, as metal, and parts of pigment per 100 parts of linseed oil.

Table 2

Drying data for linseed oil containing 1 gram lead and 3.5 grams carbon black per 100 grams oil. (Percent oil, 93.0)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .3452 g. wt. oil, .3205 g.		wt. sample, .1574 g. wt. oil, .1460 g.		wt. sample, .2392 g. wt. oil, .2220 g.	
	Increase in weight, grams	increase in weight of oil	Increase in weight, grams	increase in weight of oil	Increase in weight, grams	increase in weight of oil
12			0.0007	0.5	0.0003	0.1
13			0.0023	1.6	-	-
14	0.0004	0.1	0.0033	2.3	0.0014	0.6
15	-	-	0.0045	3.1	-	-
16	-	-	0.0063	4.3	0.0044	2.0
17	0.0067	2.1	0.0083	5.7	-	-
18	0.0100	3.1	0.0101	7.0	0.0102	4.6
19	-	-	0.0125	8.6	-	-
20	0.0178	5.6	0.0135	9.3	0.0158	7.1
21	-	-	0.0146	10.0	-	-
22	0.0258	8.0	0.0162	11.1	0.0207	9.3
24	-	-	-	-	0.0243	10.9
25	0.0323	10.1	0.0180	12.3	-	-
26	0.0343	10.7	-	-	-	-
27	0.0361	11.3	-	-	0.0261	11.8
28	0.0378	11.8	0.0187	12.8		
30	0.0386	12.0	-	-		
32	-	-	-	-	0.0278	12.5
36	0.0398	12.4	-	-	0.0294	13.2
38	-	-	0.0201	13.8		
40	0.0405	12.7	-	-		
43	0.0412	12.9	-	-		
52	0.0405	12.7	-	-	-	-

FIG. 2 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 3.5 GRAMS CARBON BLACK PER 100
GRAMS OIL

Table 3

Drying data for linseed oil containing 1.5 grams lead and 3.5 grams carbon black per 100 grams oil. (Percent oil, 91.4)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .2996 g. wt. oil, .2738 g		wt. sample, .1418 g. wt. oil, .1295 g.		wt. sample, .2219 g. wt. oil, .2025 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
8	0.0014	0.5				
10	0.0075	2.7	0.0024	1.8	0.0029	1.4
11	0.0139	5.1	0.0048	3.7	-	-
12	-	-	0.0080	6.2	0.0092	4.5
13	0.0217	7.9	0.0122	9.4	-	-
14	-	-	0.0135	10.4	0.0152	7.5
15	0.0266	9.7	0.0149	11.5	-	-
16	-	-	0.0155	12.0	0.0203	10.2
17	-	-	0.0163	12.6	-	-
18	0.0279	10.2	0.0169	13.1	0.0229	11.3
19	-	-	0.0175	13.5	-	-
20	-	-	0.0179	13.8	0.0249	12.3
21	0.0291	10.6	0.0178	13.7	-	-
22	-	-	0.0175	13.5	0.0255	12.6
25	-	-	0.0176	13.6	-	-
26	0.0305	11.2	-	-	-	-
27	-	-	-	-	0.0266	13.1
28	-	-	0.0174	13.4	-	-
31	0.0317	11.6	0.0174	13.4	-	-
32	-	-	-	-	0.0266	13.1
46	0.0320	11.7	0.0169	13.1		
49			-	-	0.0262	12.9

FIG. 3 DRYING RATE OF LINSEED OIL CONTAINING
1.5
1.5 GRAMS LEAD & 3.5 GRAMS CARBON BLACK PER
100 GRAMS OIL

Table 4

Drying data for linseed oil containing 2 grams lead and 3.5 grams carbon black per 100 grams oil. (Percent oil, 89.4)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .2102 g. Wt. oil, .1880 g.	$\%$ Increase in weight, in weight grams of oil	Wt. sample, .1437 g. Wt. oil, .1283 g.	$\%$ Increase in weight, in weight grams of oil	Wt. sample, .2468 g. Wt. oil, .2205 g.	$\%$ Increase in weight, in weight grams of oil
8	0.0024	1.3				
10	0.0072	3.8	0.0099	7.7	0.0101	4.6
11	0.0157	8.4	0.0118	9.2	-	-
12	-	-	0.0141	11.0	0.0182	8.2
13	0.0191	10.1	0.0163	12.7	-	-
14	-	-	0.0166	12.9	0.0223	10.1
15	0.0209	11.1	0.0171	13.4	-	-
16	-	-	0.0173	13.5	0.0252	11.4
17	-	-	0.0172	13.4	-	-
18	0.0223	11.8	0.0172	13.4	0.0263	11.9
19	-	-	0.0171	13.4	-	-
20	-	-	-	-	0.0272	12.3
21	0.0228	12.2	0.0171	13.4	-	-
25	-	-	0.0171	13.4	-	-
27	-	-	-	-	0.0275	12.5
31	0.0230	12.2	0.0169	13.2	-	-
46	0.0224	11.9	0.0158	12.3	-	-
49	-	-	-	-	0.0262	11.9
53	0.0223	11.9				
58	-	-	0.0155	12.1	-	-

FIG. 4 DRYING RATE OF LINSLED OIL CONTAINING
2 GRAMS LEAD & 3.5 GRAMS CARBON BLACK PER 100
GRAMS OIL

Table 5

Drying data for linseed oil containing 1 gram lead and 7 grams carbon black per 100 grams oil. (Percent oil, 89.9)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .2614 g. wt. oil, .2350 g.	% increase in weight of oil	Wt. sample, .1650 g. wt. oil, .1482 g.	% increase in weight of oil	Wt. sample, .2037 g. wt. oil, .1830 g.	% increase in weight of oil
10			0.0003	0.2		
11			0.0006	0.4		
12			0.0022	1.5	0.0005	0.3
14			0.0022	1.5	0.0005	0.3
16			0.0024	1.6	0.0006	0.3
17	0.0006	0.3	0.0026	1.8	-	-
18	0.0006	0.3	-	-	0.0014	0.8
20	0.0006	0.3	0.0047	3.2	0.0034	1.8
22	0.0011	0.5	0.0082	5.5	0.0062	3.4
23	0.0022	0.9	-	-	-	-
24	-	-	-	-	0.0103	5.6
25	0.0086	3.7	0.0136	9.2	-	-
26	0.0128	5.4	-	-	-	-
27	-	-	-	-	0.0154	8.5
28	0.0183	7.8	0.0167	11.3	-	-
30	0.0222	9.5	-	-	-	-
31	-	-	0.0186	12.5	-	-
32	-	-	-	-	0.0203	11.1
36	0.0277	11.8	-	-	0.0218	11.9
40	0.0291	12.4	-	-	-	-
45	0.0297	12.6	-	-	-	-
46	-	-	0.0194	13.1	-	-
49	-	-	-	-	0.0229	12.6
52	0.0297	12.6	-	-	-	-
58	-	-	0.0201	13.6	-	-

FIG. 5 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 7 GRAMS CARBON BLACK PER 100
GRAMS OIL

Table 6

Drying data for linseed oil containing 1.5 grams lead and 7 grams carbon black per 100 grams oil. (Percent oil, 88.3)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .2319 g. wt. oil, .2043 g.	$\%$ increase in weight, of oil	wt. sample, .1265 g. wt. oil, .1118 g.	$\%$ increase in weight, of oil	wt. sample, .2404 g. wt. oil, .2122 g.	$\%$ increase in weight, of oil
11	0.0013	0.6	0.0003	0.3		
12	-	-	0.0016	1.4		
13	0.0013	0.6	0.0026	2.3		
15	0.0016	0.8	0.0032	2.9		
16	-	-	0.0035	3.1	0.0020	0.9
18	0.0054	2.6	0.0052	4.7	0.0045	2.1
20	-	-	0.0078	6.7	0.0098	4.6
21	0.0136	6.6	0.0085	7.7	-	-
22	-	-	0.0097	8.7	0.0140	6.6
24	-	-	-	-	0.0175	8.2
25	-	-	0.0128	11.4	-	-
26	0.0196	9.6	-	-	-	-
27	-	-	-	-	0.0210	9.9
28	-	-	0.0135	12.0	-	-
31	0.0226	11.1	0.0143	12.9	-	-
32	-	-	-	-	0.0236	11.1
36	-	-	-	-	0.0244	11.5
38	-	-	0.0141	12.6	-	-
46	0.0243	11.9	0.0147	13.2	-	-
49	-	-	-	-	0.0256	12.0
50	-	-	.0147	13.2	-	-
53	0.0254	12.4	-	-	-	-

FIGURE 6 DRYING RATE OF LINSEED OIL CONTAINING
1.5 GRAMS LEAD & 7 GRAMS CARBON BLACK PER 100
GRAMS OIL

Table 7

Drying data for linseed oil containing 2 grams lead and 7 grams carbon black per 100 grams oil. (Percent oil, 86.8)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .2928 g. wt. oil, .2540 g.	% increase in weight, grams of oil	wt. sample, .1272 g. wt. oil, .1100 g.	% increase in weight, grams of oil	wt. sample, .2265 g. wt. oil, .1965 g.	% increase in weight, grams of oil
8	0.0001	0.0	-	-	-	-
10	0.0005	0.2	-	-	-	-
11	0.0020	0.8	0.0006	0.6	-	-
12	-	-	0.0020	1.8	0.0008	0.4
13	0.0049	1.9	0.0047	4.4	-	-
14	-	-	0.0059	5.4	0.0016	0.8
15	0.0127	5.0	0.0080	7.3	-	-
16	-	-	0.0092	8.4	0.0046	2.3
17	-	-	0.0111	10.0	-	-
18	0.0211	8.3	0.0119	10.8	0.0096	4.9
19	-	-	0.0127	11.3	-	-
20	-	-	0.0133	12.1	0.0154	7.8
21	0.0250	9.9	0.0138	12.5	-	-
22	-	-	0.0140	12.7	0.0188	9.6
24	-	-	-	-	0.0209	10.6
25	-	-	0.0143	13.0	-	-
26	0.0275	10.8	-	-	-	-
27	-	-	-	-	0.0228	11.6
28	-	-	0.0142	12.9	-	-
31	0.0290	11.4	0.0147	13.4	-	-
36	-	-	-	-	0.0241	12.3
38	-	-	0.0139	12.8	-	-
46	0.0292	11.5	0.0141	12.8	-	-
49	-	-	-	-	0.0239	12.1
53	0.0295	11.6	-	-	-	-
58	-	-	0.0138	12.5	-	-

FIG.7 DRYING RATE OF LINSLEED OIL CONTAINING
2 GRAMS LEAD & 7 GRAMS CARBON BLACK PER 100
GRAMS OIL

Table 8

Drying data for linseed oil containing 0.025 gram cobalt and 3.5 grams carbon black per 100 grams oil. (Percent oil, 96.4)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .2952 g. wt. oil, .2840 g.	% increase in weight, of oil	wt. sample, .2148 g. wt. oil, .2070 g.	% increase in weight, of oil	wt. sample, .2459 g. wt. oil, .2368 g.	% increase in weight, of oil
11			0.0004	0.2		
12			-	-	0.0006	0.3
13			0.0022	1.1	-	-
14			0.0022	1.1	0.0006	0.3
15			0.0022	1.1	-	-
16			0.0019	0.9	0.0006	0.3
18			0.0019	0.9	0.0006	0.3
20			0.0020	1.0	-	-
22			0.0020	1.0	0.0031	1.3
24			-	-	0.0050	2.1
25	0.0005	0.2	0.0024	1.2	-	-
27	-	-	-	-	0.0102	4.3
30	0.006	0.2	-	-	-	-
32	-	-	-	-	0.0222	9.4
36	-	-	-	-	0.0290	12.3
38	-	-	0.0028	1.4	-	-
41	-	-	-	-	0.0321	13.6
45	0.0015	0.5	-	-	-	-
46	-	-	0.0077	3.7	-	-
49	-	-	-	-	0.0321	13.6
50	-	-	0.0119	5.8		
52	0.0068	2.4	-	-		
55	0.0122	4.3	-	-		
58	-	-	0.0238	11.5		
60	0.0204	7.2	-	-		
69	0.0317	11.1	-	-		
85	0.0379	13.3	0.0305	14.8

FIG. 8 DRYING RATE OF LINSEED OIL CONTAINING
0.025 GRAMS COBALT & 3.5 GRAMS CARBON BLACK
PER 100 GRAMS OIL

Table 9

Drying data for linseed oil containing 0.025 gram cobalt and 7 grams carbon black per 100 grams oil. (Percent oil, 93.2)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>	
	wt. sample, .2858 g. wt. oil, .2660 g.		wt. sample, .1728 g. wt. oil, .1610 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
12			0.0007	0.4
13			0.0020	1.3
14			0.0019	1.2
15			0.0022	1.4
16			0.0020	1.3
18			0.0027	1.7
19			0.0031	1.9
20			0.0030	1.9
21			0.0028	1.8
22			0.0035	2.2
25			0.0038	2.4
28			0.0042	2.6
31			0.0049	3.0
34			0.0055	3.5
42			0.0068	4.2
45	0.0014	0.5	-	-
46	-	-	0.0078	4.9
50			0.0085	5.3
52	0.0019	0.7	-	-
55	0.0030	1.1	-	-
58	-	-	0.0109	6.8
60	0.0046	1.7	-	-
69	0.0067	2.5	-	-
85	0.0123	4.6	0.0232	14.4
108	0.0358	13.5	0.0225	14.0

Table 9-A

Drying data for linseed oil containing 0.025 gram cobalt and 7 grams carbon black per 100 grams oil. (Percent oil, 93.2)

Time, Hours	<u>14 months aging</u>		<u>Aged 1 year "ageground"</u>	
	Wt. sample, .2120 g. Wt. oil, .1975 g.		Wt. sample, .2083 g. Wt. oil, .1940 g.	
	Increase in weight, grams	$\%$ increase in weight of oil	Increase in weight, grams	$\%$ increase in weight of oil
5			0.0021	1.1
6			0.0031	1.6
7			0.0051	2.6
9			0.0105	5.4
10	0.0005	0.3	-	-
11	-	-	0.0150	7.7
13	-	-	0.0192	9.9
16	0.0003	0.2	0.0235	12.1
21	-	-	0.0257	13.2
22	0.0003	0.2	-	-
25	-	-	0.0256	13.2
27	0.0012	0.6	-	-
32	0.0015	0.8	-	-
36	0.0028	1.4	-	-
38	-	-	0.0244	12.6
41	0.0072	3.6		
49	0.0177	9.0		
62	0.0280	14.2

FIG.9 DRYING RATE OF LINSEED OIL CONTAINING
0.025 GRAM COBALT & 7 GRAMS CARBON BLACK PER
100 GRAMS OIL

Table 10

Drying data for linseed oil containing 0.04 gram cobalt and 3.5 grams carbon black per 100 grams oil. (Percent oil, 96.2)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>	
	wt. sample, .2455 g. wt. oil, .2360 g.		wt. sample, .2244 g. wt. oil, .2160 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
12			0.0006	0.3
14			0.0018	0.8
16			0.0017	0.8
20			0.0017	0.8
28			0.0017	0.8
31			0.0020	0.9
33	0.0004	0.2	-	-
38	-	-	0.0023	1.1
40	0.0010	0.4	-	-
43	0.0018	0.8	-	-
45	0.0040	1.7	-	-
46	-	-	.0030	1.4
50	-	-	.0037	1.7
52	0.0053	2.2	-	-
55	0.0082	3.5	-	-
58	-	-	0.0061	2.9
60	0.0150	6.4	-	-
69	0.0250	10.6	-	-
85	0.0320	13.5	0.0223	10.3
108	0.0332	14.1	0.0202	9.4

Table 10-A

Drying data for linseed oil containing 0.04 gram cobalt and 3.5 grams carbon black per 100 grams oil. (Percent oil, 96.2)

Time, Hours	<u>14 months aging</u>		<u>Aged 1 year Reground</u>	
	Wt. sample, .2271 g. wt. oil, .2183 g.		Wt. sample, .1877 g. wt. oil, .1802 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
2			0.0005	0.3
3			0.0002	0.1
4			0.0001	0.0
5			0.0005	0.3
6			0.0012	0.7
7			0.0019	1.0
8			0.0054	3.0
9			0.0089	4.9
12			0.0183	10.2
15			0.0256	14.2
22	0.0022	1.0		
24	0.0055	2.5		
27	0.0130	6.0		
32	0.0256	11.7		
36	0.0291	13.3		
41	0.0297	13.6		
49	0.0290	13.3

FIG. 10 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT & 3.5 GRAMS CARBON BLACK PER
100 GRAMS OIL

Table 11

Drying data for linseed oil containing 0.04 gram cobalt and 7 grams carbon black per 100 grams oil. (Percent oil, 93.0)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .2768 g. Wt. oil, .2575 g.	% increase in weight, grams of oil	Wt. sample, .3957 g. Wt. oil, .3678 g.	% increase in weight, grams of oil	Wt. sample, .2119 g. Wt. oil, .1970 g.	% increase in weight, grams of oil
11			0.0001	0.0		
12			0.0010	0.3	0.0009	0.4
13			0.0019	0.5	-	-
14			0.0020	0.5	0.0005	0.2
15			0.0020	0.5	-	-
17			0.0016	0.4	-	-
19			0.0016	0.4	-	-
21			0.0018	0.5	-	-
22			.0016	0.4	0.0008	0.4
24			-	-	0.0007	0.3
28			0.0016	0.4	-	-
32			-	-	0.0010	0.4
38			0.0016	0.4	-	-
40	0.0002	0.1	-	-	-	-
45	0.0013	0.5	-	-	-	-
49	-	-	-	-	0.0082	4.2
50	-	-	0.0027	0.7	-	-
52	0.0015	0.6	-	-	-	-
55	0.0025	1.0	-	-	-	-
58	-	-	0.0038	1.0	-	-
60	0.0050	1.9	-	-	-	-
62	-	-	-	-	0.0229	11.1
69	0.0100	3.9	-	-		
85	0.0192	7.5	0.0427	11.6		
108	0.0356	13.8	0.0441	12.0

FIG. 11 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT & 7 GRAMS CARBON BLACK PER
100 GRAMS OIL

BONE BLACK

It was demonstrated by Figure 12 (1 gram lead and 10 grams bone black per 100 grams oil) that the induction period of the freshly prepared sample was fairly large, being twelve hours, with the sixth month's curve being a maximum at twenty-seven hours. The ninth and fourteenth month's both had induction periods of twenty-six hours. These samples had a smaller drying rate, that is, required a longer time for the gain in weight to reach a maximum, than other previous samples.

The increase in drier concentration, as shown in Figure 13 (2 grams lead and 10 grams bone black per 100 grams oil), caused a smaller loss in drying power and gave a shorter induction period, for the freshly made sample, five hours. The maximum induction period was twenty-three hours (fourteenth month). The drying rates for this sample was distinctly greater than those of Figure 12.

Figure 14 (1 gram lead and 20 grams bone black per 100 grams oil) and Figure 15 (2 grams lead and 20 grams bone black per 100 grams oil) showed that the increase in bone black content did not cause any great loss in drying ability as was the case of carbon black. All samples in both figures had induction periods lying between ten and twentieth hours. The increased drier concentration shown in Figure 15 did not noticeably shorten the induction period.

The bone black mixtures all had fairly long induction periods even for freshly made samples. In the samples shown in Figures 12, 14, and 15 the rates of drying were smaller than those of the samples of previous figures. The drying rates of the samples of Figure 13 were similar to most of the carbon black samples. The increase in pigment content had very little effect on loss in drying power.

Table 12

Drying data for linseed oil containing 1 gram lead and 10 grams boneblack per 100 grams oil. (Percent oil, 87.6)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .3348 g. wt. oil, .2935 g.	% increase in weight of oil	wt. sample, .2189 g. wt. oil, .1905 g.	% increase in weight of oil	wt. sample, .2857 g. wt. oil, .2580 g.	% increase in weight of oil
11			0.0003	0.2	-	-
12			0.0010	0.5	0.0003	0.1
13			0.0018	0.9	-	-
14			0.0024	1.2	0.0004	0.1
18			0.0026	1.4	0.0009	0.3
23	0.0005	0.2	-	-	-	-
24	-	-	-	-	0.0023	0.9
25	0.0009	0.3	0.0028	1.5	-	-
27	-	-	-	-	0.0038	1.5
28	0.0032	1.1	0.0040	2.1	-	-
30	0.0050	1.7	-	-	-	-
31	-	-	0.0062	3.3	-	-
32	-	-	-	-	0.0095	3.8
36	0.0122	4.1	-	-	0.0135	5.4
38			0.0129	6.8	-	-
41			-	-	0.0198	7.9
42			0.0167	8.8	-	-
43	0.0219	7.5	-	-	-	-
46			0.0195	10.1	-	-
49			0.0216	11.4	.0276	11.0
50			-	-	-	-
52	0.0309	10.5	-	-	-	-
62	-	-	-	-	0.0334	13.4
69	0.0387	13.2	-	-		
85	0.0409	13.9	0.0249	13.0

FIG. 12 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 10 GRAMS BONE BLACK PER 100 GRAMS
OIL

Table 13

Drying data for linseed oil containing 2 grams lead and 10 grams bone black per 100 grams oil. (Percent oil, 84.6)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .2918 g. wt. oil, .2465 g. %	Increase in weight, in weight grams of oil	wt. sample, .2535 g. wt. oil, .2140 g. %	Increase in weight, in weight grams of oil	wt. sample, .2628 g. wt. oil, .2220 g. %	Increase in weight, in weight grams of oil
11			0.0006	0.3		
12			0.0012	0.6	0.0005	0.2
13			0.0021	1.0	-	-
14	0.0001	0.0	0.0021	1.0	0.0005	0.2
16	-	-	0.0020	0.9	0.0005	0.2
17	0.0006	0.3	-	-	-	-
18	0.0013	0.5	0.0026	1.2	0.0012	0.5
20	0.0018	0.7	0.0033	1.5	0.0024	1.1
22	0.0046	1.9	0.0046	2.2	0.0040	1.8
23	0.0069	2.8	-	-	-	-
24	-	-	-	-	0.0076	3.4
25	0.0132	5.3	0.0099	4.6	-	-
26	0.0160	6.5	-	-	-	-
27	-	-	-	-	0.0142	6.4
28	0.0203	8.2	0.0161	7.6	-	-
30	0.0240	9.7	-	-	-	-
31	-	-	0.0224	10.5	-	-
32	-	-	-	-	0.0239	10.8
33	0.0272	11.0	-	-	-	-
36	0.0295	12.0	-	-	0.0273	12.3
38	-	-	0.0273	12.8	-	-
40	0.0307	12.4	-	-	-	-
45	0.0315	12.8	-	-	-	-
49	-	-	-	-	0.0296	13.3
50	-	-	0.0284	13.2	-	-
52	0.0314	12.7	-	-	-	-

FIG. 13 DRYING RATE OF LINSEED OIL CONTAINING
2 GRAMS LEAD & 10 GRAMS BONE BLACK PER 100
GRAMS OIL

Table 14

Drying data for linseed oil containing 1 gram lead and 20 grams bone black per 100 grams oil. (Percent oil, 80.5)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .1562 g. Wt. oil, .1257 g.	% increase in weight of oil	Wt. sample, .2306 g. Wt. oil, .1855 g.	% increase in weight of oil	Wt. sample, .2481 g. Wt. oil, .1995 g.	% increase in weight of oil
10			0.0004	0.2		
11			-	-	0.0002	0.1
12			0.0012	0.6	0.0010	0.5
14			0.0023	1.2	0.0032	1.6
16			0.0041	2.2	0.0051	2.6
17	0.0022	1.7	-	-	0.0059	2.9
18	0.0030	2.4	0.0063	3.4	0.0066	3.3
19	-	-	-	-	0.0084	4.2
21	-	-	-	-	0.0097	4.9
22	0.0046	3.7	0.0100	5.4	0.0122	6.1
23	0.0052	4.2	-	-	-	-
24	-	-	0.0119	6.4	-	-
25	0.0068	5.4	-	-	0.0145	7.3
26	0.0074	5.9	-	-	-	-
27	-	-	0.0145	7.8	-	-
28	0.0086	6.8	-	-	0.0169	8.5
30	0.0095	7.6	-	-	-	-
31	-	-	-	-	0.0186	9.3
32	-	-	0.0189	10.2	-	-
36	0.0123	9.8	0.0217	11.7	-	-
38	-	-	-	-	0.0239	12.0
40	0.0139	11.0	-	-	-	-
45	0.0148	11.8	-	-	-	-
46	-	-	-	-	0.0262	13.3
49	-	-	0.0245	13.2	-	-
50					0.0271	13.6
52	0.0157	12.5				
62			0.0254	13.7

FIG. 14 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 20 GRAMS BONE BLACK PER 100
GRAMS OIL

Table 15

Drying data for linseed oil containing 2 grams lead and 20 grams bone black per 100 grams oil. (Percent oil, 78.0)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .2344 g. wt. oil, .1830 g.	% increase in weight of oil	wt. sample, .1683 g. wt. oil, .1310 g.	% increase in weight of oil	wt. sample, .1951 g. wt. oil, .1520 g.	% increase in weight of oil
10			0.0038	2.9		
12			0.0048	3.7	0.0004	0.2
14			0.0066	5.0	0.0011	0.7
16			0.0069	5.3	0.0025	1.6
17	0.0009	0.5	0.0075	5.8	-	-
18	0.0018	1.0	0.0080	6.1	0.0052	3.4
19	-	-	0.0086	6.6	-	-
20	0.0028	1.5	0.0096	7.4	0.0071	4.7
22	0.0053	2.9	0.0110	8.4	0.0094	6.2
23	0.0063	3.4	-	-	-	-
24	-	-	-	-	0.0113	7.4
25	0.0088	4.8	0.0133	10.2	-	-
26	0.0106	5.8	-	-	-	-
27	-	-	-	-	0.0139	9.1
28	0.0126	6.9	0.0153	11.7		
30	0.0146	8.0	-	-		
31	-	-	0.0180	13.7		
32	-	-			0.0172	11.3
36	0.0186	10.2			0.0188	12.4
38	-	-	0.0205	15.6		
40	0.0207	11.3				
45	0.0226	12.3				
46	-	-	0.0221	16.8		
49	-	-			0.0199	13.1
50	-	-	0.0218	16.7		
52	0.0226	12.3

FIG. 15 DRYING RATE OF LINSEED OIL CONTAINING
2 GRAMS LEAD & 20 GRAMS BONE BLACK PER 100
GRAMS OIL

LAMP BLACK

The samples of Figure 16 (1 gram lead and 7 grams lamp black per 100 grams oil) exhibited an induction period of four hours for the freshly made sample to a maximum period of eight hours (fourteenth month).

Figure 17 with samples of the composition 2 grams lead and 7 grams lamp black per 100 grams oil indicated no decrease in time of induction over the samples of Figure 16.

The increased pigment content of the samples of Figure 18, containing 1 gram lead and 14 grams lamp black per 100 grams oil caused a considerable loss in drying time of this mixture. The initial induction period was three hours while the maximum period was fifteen hours (fourteenth month).

There was a distinct decrease in induction periods of the aged samples of Figure 19 (2 grams lead and 14 grams lamp black per 100 grams oil) over the corresponding samples of Figures 18. This was the result of increased drier content.

The lamp black samples all displayed moderate losses in drying power except for those of Figure 18 which had the largest ratio of pigment to drier. Those of Figure 18 had a fairly large increase in drying time.

Table 16

Drying data for linseed oil containing 1 gram lead and 7 grams lamp black per 100 grams oil. (Percent oil, 90.8)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .2196 g. Wt. oil, .1992 g.	Wt. sample, .2196 g. Wt. oil, .1992 g.	Wt. sample, .1687 g. Wt. oil, .1528 g.	Wt. sample, .1687 g. Wt. oil, .1528 g.	Wt. sample, .2092 g. Wt. oil, .1898 g.	Wt. sample, .2092 g. Wt. oil, .1898 g.
	Increase in weight, grams	$\%$ increase in weight of oil	Increase in weight, grams	$\%$ increase in weight of oil	Increase in weight, grams	$\%$ increase in weight of oil
7	0.0012	0.6			0.0004	0.2
8	0.0032	1.6			-	-
10	0.0087	4.4	0.0042	2.8	0.0054	2.9
11	0.0127	6.4	0.0066	4.3	-	-
12	-	-	0.0096	6.3	0.0109	5.8
13	0.0181	9.1	0.0130	8.5	-	-
14	-	-	0.0150	9.8	0.0154	8.1
15	0.0212	10.6	0.0164	10.7	-	-
16	-	-	0.0171	11.2	0.0195	10.3
17	-	-	0.0182	11.9	-	-
18	0.0234	11.7	0.0186	12.2	0.0211	11.1
20	-	-	0.0198	13.0	0.0227	12.0
21	0.0248	12.4	0.0200	13.1	-	-
22	-	-	0.0200	13.1	0.0231	12.2
25	-	-	0.0206	13.5	-	-
27	-	-	-	-	0.0243	12.8
31	0.0260	13.0	0.0204	13.4	-	-
38	-	-	0.0198	13.0	-	-
46	0.0257	12.9	0.0194	12.7	-	-
48	-	-	-	-	0.0237	12.5

% INCREASE IN WEIGHT OF OIL

FIG. 16 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 7 GRAMS LAMP BLACK PER 100 GRAMS
OIL

Table 17

Drying data for linseed oil containing 2 grams lead and 7 grams lamp black per 100 grams oil. (Percent oil, 86.8)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .2929 g. wt. oil, .2540 g.	% increase in weight, of oil	wt. sample, .1683 g. wt. oil, .1460 g.	% increase in weight, of oil	wt. sample, .2678 g. wt. oil, .2320 g.	% increase in weight, of oil
7	0.0035	1.4	-	-	-	-
8	0.0080	3.1	-	-	-	-
10	0.0182	7.2	0.0113	7.7	0.0090	3.9
11	0.0227	8.9	0.0136	9.4	-	-
12	-	-	0.0164	11.2	0.0180	7.8
13	0.0260	10.2	0.0185	12.7	-	-
14	-	-	0.0190	13.0	0.0219	9.5
15	0.0277	10.9	0.0196	13.4	-	-
16	-	-	0.0195	13.4	0.0257	11.1
17	-	-	0.0196	13.4	-	-
18	0.0293	11.5	-	-	0.0268	11.5
19	-	-	0.0196	13.4	-	-
20	-	-	-	-	0.0277	11.9
21	0.0295	11.6	0.0198	13.6	-	-
22	-	-	0.0198	13.6	0.0280	12.1
25	-	-	0.0195	13.4	-	-
26	0.0299	11.8	-	-	-	-
27	-	-	-	-	0.0284	12.3
31	0.0305	12.0	0.0193	13.3	-	-
36	-	-	-	-	0.0281	12.1
38	-	-	0.0186	12.7	-	-
46	0.0303	11.9	0.0180	12.3	-	-
49	-	-	-	-	0.0272	11.7

FIG. 17 DRYING RATE OF LINSEED OIL CONTAINING
2 GRAMS LEAD & 7 GRAMS LAMP BLACK PER 100
GRAMS OIL

Table 18

Drying data for linseed oil containing 1 gram lead and 14 grams lamp black per 100 grams oil. (Percent oil, 84.5)

<u>6 months aging</u>			<u>9 months aging</u>		<u>14 months aging</u>	
wt. sample, .2985 g.			wt. sample, .1724 g.		wt. sample, .2267 g.	
wt. oil, .2522 g.			wt. oil, .1458 g.		wt. oil, .1915 g.	
Time, Hours	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
10	0.0001	0.0				
11	0.0009	0.4				
12	-	-	0.0010	0.7	0.0008	0.4
13	0.0017	0.7	0.0024	1.7	-	-
14	-	-	0.0029	2.0	0.0008	0.4
15	0.0034	1.3	0.0033	2.3	-	-
16	-	-	0.0033	2.3	0.0030	1.6
18	0.0084	3.3	0.0056	3.8	0.0044	2.3
20	-	-	0.0083	5.7	0.0090	4.7
21	0.0156	6.2	0.0097	6.7	-	-
22	-	-	0.0115	7.9	0.0122	6.4
24	-	-	-	-	0.0164	8.5
25	-	-	0.0152	10.4	-	-
26	0.0240	9.5	-	-	-	-
27	-	-	-	-	0.0199	10.4
28	-	-	0.0182	12.5	-	-
31	0.0284	11.2	0.0196	13.4	-	-
32	-	-	-	-	0.0235	12.3
36	-	-	-	-	0.0245	12.8
38	-	-	0.0204	14.0	-	-
46	0.0309	12.3	0.0202	13.9		
49	-	-	-	-	0.0252	13.2
53	0.0325	12.9	-	-	-	-

FIG. 18 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 14 GRAMS LAMP BLACK PER 100
GRAMS OIL

Table 19

Drying data for linseed oil containing 2 grams lead and 14 grams lamp black per 100 grams oil. (Percent oil, 81.7)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .2981 g. Wt. oil, .2435 g.	% increase in weight, grams of oil	Wt. sample, .2355 g. Wt. oil, .1920 g.	% increase in weight, grams of oil	Wt. sample, .2467 g. Wt. oil, .2016 g.	% increase in weight, grams of oil
7	0.0021	0.9				
8	0.0048	2.0				
10	0.0155	6.4	0.0117	6.1	0.0060	3.0
11	0.0195	8.0	0.0144	7.5	-	-
12	-	-	0.0181	9.4	0.0127	6.3
13	0.0237	9.7	0.0217	11.3	-	-
14	-	-	0.0225	11.7	0.0170	8.4
15	0.0253	10.4	0.0235	12.2	-	-
16	-	-	0.0240	12.5	0.0210	10.4
17	-	-	0.0247	12.8	-	-
18	0.0275	11.3	0.0247	12.8	0.0219	10.9
20	-	-	-	-	0.0229	11.4
21	0.0281	11.5	0.247	12.8	-	-
22	-	-	0.249	12.9	0.0231	11.5
25	-	-	0.0249	12.9	-	-
26	0.0285	11.7	-	-	-	-
27	-	-	-	-	0.0239	11.9
28	-	-	0.0246	12.7	-	-
31	0.0288	11.9	0.0250	13.0	-	-
36	-	-	-	-	0.0233	11.6
38	-	-	0.242	12.6	-	-
46	0.0291	12.0	0.0237	12.3	-	-
49	-	-	-	-	.0228	11.4
53	0.0296	12.4	-	-	-	-

FIG. 19 DRYING RATE OF LINSEED OIL CONTAINING
2 GRAMS LEAD & 14 GRAMS LAMP BLACK PER 100
GRAMS OIL

GRAPHITE

The drying rate curves for linseed oil containing lead drier and graphite were given in Figures 20, 21, 22, and 23 and were of the following composition:

Figure 20 -- 1 gram lead and 14 grams graphite per 100 grams oil.

Figure 21 -- 2 grams lead and 14 grams graphite per 100 grams oil.

Figure 22 -- 1 gram lead and 28 grams graphite per 100 grams oil.

Figure 23 -- 2 grams lead and 28 grams graphite per 100 grams oil.

In none of these figures was the increase in induction period greater than from two and one-half hours (fresh samples) to a maximum of seven hours. Increasing the percent of drier or pigment did not noticeably change the corresponding drying rates.

Table 20

Drying data for linseed oil containing 1 gram lead and 14 grams graphite per 100 grams oil. (Percent oil, 84.7)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .3383 g. Wt. oil, .2856 g.	% increase in weight, of oil	Wt. sample, .1447 g. Wt. oil, .1225 g.	% increase in weight, of oil	Wt. sample, .2464 g. Wt. oil, .2085 g.	% increase in weight, of oil
7	0.0061	2.1			0.0065	3.1
8	0.0103	3.6			-	-
10	0.0200	7.0	0.0094	7.6	0.0149	7.1
11	0.0243	8.5	0.0111	9.0	-	-
12	-	-	0.0134	10.9	0.0209	10.0
13	0.0282	9.8	0.0159	13.0	-	-
14	-	-	0.0166	13.5	0.0238	11.4
15	0.0305	10.6	0.0175	14.3	-	-
16	-	-	0.0175	14.3	0.0260	12.5
17	-	-	0.0177	14.4	-	-
18	0.0325	11.3	-	-	0.0273	13.1
19	-	-	0.0177	14.4	-	-
20	-	-	-	-	0.0278	13.3
21	0.0333	11.6	-	-	-	-
22	-	-	0.0177	14.4	-	-
24	-	-	-	-	0.0282	13.5
25	-	-	0.0176	14.3	-	-
26	0.0340	11.9	-	-	-	-
28	-	-	0.0172	14.0	-	-
31	0.0347	12.1	0.0176	14.3	-	-
36	-	-	-	-	0.0279	13.4
38	-	-	0.0168	13.7	-	-
46	0.0350	12.2	0.0163	13.3	-	-
49	-	-	-	-	0.0268	12.4

FIG. 20 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 14 GRAMS GRAPHITE PER 100 GRAMS
OIL

Table 21

Drying data for linseed oil containing 2 grams lead and 14 grams graphite per 100 grams oil. (Percent oil, 81.9)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .3051 g. wt. oil, .2495 g.	% increase in weight, of oil	wt. sample, .4234 g. wt. oil, .3463 g.	% increase in weight, of oil	wt. sample, .2904 g. wt. oil, .2380 g.	% increase in weight, of oil
7	0.0109	4.4			0.0073	3.1
8	0.0154	6.2			-	-
10	0.0221	8.9	0.0280	8.1	0.0165	6.9
11	0.0241	9.7	0.0297	8.6	-	-
12	-	-	0.0320	9.2	0.0211	8.9
13	0.0259	10.4	0.0247	10.0	-	-
14	-	-	0.0353	10.2	0.0224	9.4
15	0.0272	10.9	0.0362	10.5	-	-
16	-	-	0.0364	10.5	0.0233	9.8
17	-	-	0.0373	10.8	-	-
18	0.0274	11.0	0.0373	10.8	0.0241	10.2
20	-	-	-	-	0.0243	10.3
21	0.0276	11.1	0.0378	10.9	-	-
22	-	-	0.0381	11.0	-	-
24	-	-	-	-	0.0243	10.3
25	-	-	0.0382	11.0	-	-
26	0.0279	11.2	-	-	-	-
28	-	-	0.0379	10.9	-	-
31	-	-	0.0389	11.2	-	-
36	-	-	-	-	0.0240	10.2
38	-	-	0.0385	11.1	-	-
43	-	-	0.0379	10.9	-	-
46	0.0284	11.4	-	-	-	-
49	-	-	-	-	0.0230	9.7

FIG. 21 DRYING RATE OF LINSEED OIL CONTAINING
2 GRAMS LEAD & 14 GRAMS GRAPHITE PER 100 GRAMS
OIL

Table 22

Drying data for linseed oil containing 1 gram lead and 28 grams graphite per 100 grams oil. (Percent oil, 75.7)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	wt. sample, .3216 g. wt. oil, .2433 g.	% increase in weight, grams of oil	wt. sample, .2877 g. wt. oil, .2177 g.	% increase in weight, grams of oil	wt. sample, .2362 g. wt. oil, .1785 g.	% increase in weight, grams of oil
5	0.0019	0.8				
7	0.0095	3.9				
8	0.0131	5.4			0.0094	5.3
10	0.0207	8.5	0.0179	8.2	-	-
11	0.0236	9.7	0.0204	9.4	0.0170	9.5
12	-	-	0.0227	10.5	-	-
13	0.0271	11.2	0.0255	11.7	0.0204	11.4
14	-	-	0.0265	12.2	-	-
15	0.0286	11.8	0.0273	12.5	0.0219	12.3
16	-	-	0.0274	12.6	-	-
17	-	-	0.0276	12.7	0.0230	12.9
18	0.0297	12.4	0.0279	12.8	-	-
19	-	-	0.0280	12.9	0.0234	13.1
20	-	-	-	-	-	-
21	0.0302	12.4	0.0280	12.9	0.0233	13.1
22	-	-	0.0283	13.0	-	-
25	-	-	0.0282	13.0	-	-
26	0.0307	12.6	-	-	-	-
27	-	-	-	-	-	-
28	-	-	0.0280	12.9	0.0234	13.1
31	0.0309	12.7	0.0283	13.0	-	-
38	-	-	0.0278	12.8	-	-
46	0.0310	12.7	0.0270	12.4	-	-
49	-	-	-	-	0.0215	12.0

FIG. 22 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD & 28 GRAMS GRAPHITE PER 100 GRAMS
OIL

Table 23

Drying data for linseed oil containing 2 grams lead and 28 grams graphite per 100 grams oil. (Percent oil, 73.3)

Time, Hours	<u>6 months aging</u>		<u>9 months aging</u>		<u>14 months aging</u>	
	Wt. sample, .3358 g. Wt. oil, .2482 g.	% increase in weight, of oil	Wt. sample, .2283 g. Wt. oil, .1674 g.	% increase in weight, of oil	Wt. sample, .2393 g. Wt. oil, .1750 g.	% increase in weight, of oil
5	0.0006	0.2				
7	0.0127	5.1			0.0087	5.0
8	0.0163	6.6			-	-
10	0.0214	8.6	0.0186	11.0	0.0154	8.8
11	0.0236	9.5	0.0193	11.5	-	-
12	-	-	0.0203	12.1	0.0180	10.3
13	0.0244	9.8	0.0218	13.1	-	-
14	-	-	0.0221	13.2	0.0187	10.7
15	0.0254	10.2	0.0225	13.4	-	-
16	-	-	0.0224	13.4	0.0192	11.0
18	0.0258	10.4	0.0221	13.2	0.0195	11.1
21	0.0264	10.6	0.0218	13.1	-	-
22	-	-	0.0218	13.1	0.0196	11.7
25	-	-	0.0216	12.4	-	-
26	0.0264	10.6	-	-	-	-
27	-	-	-	-	0.0197	11.3
28	-	-	0.212	12.6	-	-
31	0.0262	10.5	-	-	-	-
38	-	-	0.0207	12.4	-	-
46	0.0263	10.6	0.0201	12.0	-	-
49	-	-	-	-	0.0184	10.5

FIG.23 DRYING RATE OF LINSEED OIL CONTAINING
2 GRAMS LEAD & 28 GRAMS GRAPHITE PER 100 GRAMS OIL

SUMMARY

From the figures previously shown it was clearly indicated that carbon black caused the greatest losses in drying power of the linseed oil mixtures of black and drier. Bone black, lamp black, and graphite followed in order as exhibiting losses in drying power. Bone black caused a fairly large loss of drying ability with a small rate of drying. Lamp black gave moderate losses in drying ability. The decrease of drying was very small in the case of graphite.

Carbon black, causing the greatest losses in drying power and being the most commonly used pigment of those investigated, was chosen as the pigment with which to work in the study of methods of preventing or decreasing the loss in drying power.

PART II

EXPERIMENTAL

Methods for decreasing or preventing the losses in drying power on aging carbon black paints were studied.

The various methods of treating the black are given below:

- A. Grinding the pigment in oil with zinc naphthenate, litharge, and aluminum stearate in the expectation that films of the soaps would form around the pigment particles, thus decreasing the adsorption of the drier.
- B. Treating pigment with solution to remove adsorbed carbon monoxide and carbon dioxide which may be possible sources of the losses of drying ability.

The regrinding of certain aged samples was investigated. Compositions of these samples are given in Table I.

The mixture of Figure 24 contains .1 gram aluminum stearate, .04 grams cobalt, and 3.5 grams carbon black per 100 grams oil. The stearate was ground with the pigment in the oil and the drier was added with additional grinding. Three months aging showed an increase in induction period from two to four and one-half hours. This is a very small increase compared to Figure 10 which contains the same amount of cobalt and carbon black. The increase in induction periods for two months of Figure 10 is from two and one-half to fifteen hours.

Figure 25 exhibits drying rates of samples containing .1 gram zinc, .04 gram cobalt, and 3.5 grams carbon black per 100 grams oil. The zinc, as Nuodex, was ground with the black in oil and cobalt drier was added as in the previous case. The increase in induction periods for the sample which had ages three months was from two to four hours. These samples exhibited a very slight decrease in loss of drying power as compared to the samples of Figure 24.

In Figure 26 (.1 gram zinc, 1 gram lead, and 3.5 grams carbon black per 100 grams oil) the formulation of the sample was identical to those of Figures 24 and 25. An induction period increase from four hours (fresh sample) to eight hours (three month's sample) was shown. These periods were considerably greater than either of the two previous samples which had cobalt for the drier. Figure 2,

having the same amount of lead drier and carbon black displayed only a slightly greater increase for the first two months.

To study the effect of adsorbed gases on the pigment particles, the carbon black was treated with solutions of ammoniacal cuprous chloride and potassium hydroxide of the same concentration as those used in gas analysis work for absorbing carbon monoxide and carbon dioxide respectively.

For treatment to remove carbon monoxide the pigment was kept in contact with cuprous chloride and given intermittent grinding. The pigment was then washed thoroughly, dried, and made into a sample containing .04 gram cobalt and 3.5 grams carbon black per 100 grams oil. Drying curves of this mixture are shown in Figure 27. The induction period increase is from two and one-half hours (fresh sample) to seven hours (two month's sample). The untreated pigment mixture of the same composition, Figure 2, displayed induction periods for the fresh sample of two and one-half hours, and for the two month's sample, fifteen hours. This indicated that the treatment for removal of carbon monoxide very definitely decreased the loss of drying power.

Treatment for removal of carbon dioxide was performed in the same manner as for the treatment for removing the carbon monoxide. Twenty-five percent potassium hydroxide

was used for the treatment of the carbon black. Figure 28 exhibits drying rates of this mixture which was of the same composition as that of Figure 27. For the fresh sample the induction period was two and one-half hours and for the two month's sample five hours as compared with two and fifteen hours of the sample mixture with untreated black, Figure 1.

A sample having the composition as the two previous samples but with pigment treated with a 5% solution of potassium hydroxide, has drying curves in Figure 29. One month's aging showed an increase from one to two hours in the induction periods as compared to the increase of two and one-half to fourteen hours for one month's sample taken from Bennett (1).

Figure 30 (.25 gram lead as litharge, .04 gram cobalt, and 3.5 grams carbon black per 100 grams oil) and Figure 31 (.5 gram lead as litharge, .04 gram cobalt, and 3.5 grams carbon black per 100 grams oil) displayed curves of samples in which litharge was ground previous to the addition of a drier. Both had approximately the same increase in induction period one to two hours for one month's aging.

Year old samples of Figures 9 and 10 were reground and the drying curves both receded greatly. In Figure 9 the drying curve was approximately that of the freshly made sample while in Figure 10 the induction period was eight hours as compared to fourteen hours for the two month's sample.

Table 24

Drying data for linseed oil containing .1 gram aluminum stearate, .04 gram cobalt, and 3.5 grams carbon black per 100 grams oil.
(Percent oil, 96.0)

Time, Hours	<u>Freshly made sample</u>		<u>1 months aging</u>	
	wt. sample, .1256 g.	wt. oil, .1205 g.	wt. sample, .2109 g.	wt. oil, .2025 g.
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
1	0.0003	0.2		
2	0.0003	0.2		
3	0.0069	5.7	0.0007	0.3
4	0.0131	10.9	0.0082	4.0
5	0.0151	12.5	0.0170	8.4
6	0.0155	12.9	0.0208	10.3
7	0.0156	12.9	0.0224	11.0
8	0.0158	13.1	0.0229	11.3
9	-	-	0.0238	11.8
10	-	-	0.0234	11.6
11	0.0158	13.1	0.0233	11.6
12	-	-	-	-
13	0.0154	12.8	-	-
14	-	-	-	-
15	-	-	-	-
16	-	-	0.0233	11.6
20	0.0149	12.4	-	-
22			0.0230	11.4
28			0.0229	11.3
34			0.0230	11.4

Table 24-A

Drying data for linseed oil containing .1 gram aluminum stearate,
 .04 gram cobalt, and 3.5 grams carbon black per 100 grams oil.
 (Percent oil, 96.0)

Time, Hours	<u>2 months aging</u>		<u>3 months aging</u>	
	Wt. sample, .2026 g. Wt. oil, .1945 g. %	Increase in weight, in weight grams of oil	Wt. sample, .1888 g. Wt. oil, .1811 g. %	Increase in weight, in weight grams of oil
2	0.0007	0.4		
3	0.0004	0.2		
4	0.0002	0.1	0.0002	0.1
5	0.0053	2.7	0.0028	1.5
6	0.0156	8.0	0.0109	6.0
7	0.0209	10.7	0.0172	9.5
8	0.0229	11.8	0.0198	10.9
9	0.0234	12.0	0.0213	11.8
10	-	-	0.0217	12.0
11	0.0241	12.4	-	-
12	-	-	0.0222	12.3
13	-	-	0.0223	12.3
14	-	-	0.0224	12.4
15	0.0239	12.3	-	-
16			-	-
20			-	-
22			0.0225	12.4
28			-	-
34			-	-
48			0.0215	11.9

FIG. 24 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT, 0.1 GRAM ALUMINUM STEARATE, &
3.5 GRAMS CARBON BLACK PER 100 GRAMS OIL

Table 25

Drying data for linseed oil containing .1 gram zinc, .04 gram cobalt, and 3.5 grams carbon black per 100 grams oil. (Percent oil, 92.0)

Time, Hours	<u>Freshly made sample</u>		<u>1 months aging</u>	
	Wt. sample, .1435 g. Wt. oil, .1320 g.		Wt. sample, .1880 g. Wt. oil, .1729 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
4	0.0004	0.2	0.0001	0.0
5	0.0022	1.7	0.0008	0.5
6	0.0067	5.1	0.0011	0.6
7	0.0092	7.0	0.0029	1.7
8	0.0107	8.1	0.0062	3.6
9	-	-	0.0113	6.5
10	-	-	0.0137	7.9
11	0.0160	12.1	0.0168	9.7
12	-	-	-	-
13	0.0172	13.0	-	-
14	-	-	-	-
15	-	-	-	-
16	-	-	0.0228	13.2
20	0.0184	13.9	-	-
22			0.0233	13.5
28			0.0237	13.7
34			0.0235	13.6

Table 25-A

Drying data for linseed oil containing .1 gram zinc, .04 gram cobalt, and 3.5 grams carbon black per 100 grams oil. (Percent oil, 92.0)

Time, Hours	<u>2 months aging</u>		<u>3 months aging</u>	
	wt. sample, .1460 g. wt. oil, .1342 g.		wt. sample, .1963 g. wt. oil, .1805 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
6	0.0001	0.1		
7	0.0014	1.0	0.0002	0.1
8	0.0047	3.5	0.0017	0.9
9	0.0081	6.0	0.0039	2.2
10	-	-	0.0080	4.4
11	0.0134	10.0	0.0117	6.5
12	-	-	0.0150	8.3
13	-	-	0.0181	10.0
14	-	-	0.0205	11.4
15	0.0183	13.6	-	-
16			-	-
20			-	-
22			0.0265	14.7
28			-	-
34			-	-
48			0.0258	14.3

FIG.25 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT, 0.1 GRAM ZINC, AS NUODEX, &
3.5 GRAMS CARBON BLACK PER 100 GRAMS OIL

Table 26

Drying data for linseed oil containing .1 gram zinc, 1 gram lead, and 3.5 grams carbon black per 100 grams oil. (Percent oil, 94.9)

Time, Hours	<u>Freshly made sample</u>		<u>1 months aging</u>	
	Wt. sample, .1378 g. Wt. oil, .1308 g.		Wt. sample, .1680 g. Wt. oil, .1593 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
2	0.0001	0.1		
3	0.0080	6.1	0.0006	0.4
4	0.0140	10.7	0.0086	5.4
5	0.0159	12.2	0.0156	9.8
6	0.0166	12.7	0.0182	11.4
7	0.0168	12.9	0.0194	12.2
8	0.0169	12.9	0.0195	12.3
9	-	-	0.0199	12.5
10	-	-	0.0194	12.2
11	0.0169	12.9	0.0195	12.3
12	-	-	-	-
13	0.0165	12.6	-	-
14	-	-	-	-
15	-	-	-	-
16	-	-	0.0187	11.7
20	0.0160	12.3	-	-
22			0.0182	11.4
28			0.0180	11.3
34			0.0180	11.3

Table 26-A

Drying data for linseed oil containing .1 gram zinc, 1 gram lead, and 3.5 grams carbon black per 100 grams oil. (Percent oil, 94.9)

Time, Hours	<u>2 months aging</u>		<u>3 months aging</u>	
	Wt. sample, .1691 g. Wt. oil, .1607 g.		Wt. sample, .1934 g. Wt. oil, .1835 g.	
	Increase in weight, grams	$\%$ increase in weight of oil	Increase in weight, grams	$\%$ increase in weight of oil
2	0.0006	0.4		
3	0.0005	0.3		
4	0.0041	2.5	0.0007	0.4
5	0.0138	8.6	0.0080	4.4
6	0.0184	11.4	0.0158	8.6
7	0.0196	12.2	0.0200	10.9
8	0.0206	12.9	0.0213	11.6
9	0.0205	12.8	0.0220	12.0
10	-	-	0.0222	12.1
11	0.0204	12.7	-	-
12	-	-	0.0221	12.1
13	-	-	-	-
14	-	-	0.0226	12.3
15	0.0201	12.5	-	-
16			-	-
20			-	-
22			0.0224	12.2
28			-	-
34			-	-
48			0.0218	11.9
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FIG.26 DRYING RATE OF LINSEED OIL CONTAINING
1 GRAM LEAD, 0.1 GRAM ZINC, AS NUODEX, & 3.5
GRAMS CARBON BLACK PER 100 GRAMS OIL

Table 27

Drying data for linseed oil containing .04 gram cobalt and 3.5 grams carbon black, treated with ammoniacal cuprous chloride.

(Percent oil, 96.0)

	<u>Freshly made sample</u>		<u>1 months aging</u>		<u>2 months aging</u>	
	wt. sample, .2019 g.		wt. sample, .1615 g.		wt. sample, .2210 g.	
	wt. oil, .1938 g.		wt. oil, .1550 g.		wt. sample, .2120 g.	
Time, Hours	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
1	0.0001	0.0				
2	0.0006	0.3	0.0006	0.4	0.0001	0.0
3	0.0083	4.2	0.0006	0.4	-	-
4	0.0168	8.7	0.0007	0.5	0.0001	0.0
5	0.0212	10.9	0.0025	1.6	0.0008	0.4
6	0.0224	11.6	0.0088	5.7	0.0016	0.8
7	0.0228	11.8	0.0146	9.4	0.0030	1.4
8	0.0232	12.0	0.0180	11.6	0.0061	2.9
9	0.0233	12.0	0.0188	12.1	0.0110	5.2
10	0.0227	11.7	-	-	0.0163	7.7
11	0.0228	11.8	0.0196	12.7	0.0203	9.6
12	-	-	-	-	0.0229	10.8
13	-	-	-	-	0.0248	11.7
14	-	-	-	-	0.0253	11.9
15	-	-	0.0196	12.7	-	-
16	0.0223	11.5			-	-
20	-	-			-	-
22	0.0220	11.3			0.0254	12.0
28	0.0222	11.4			-	-
34	0.0223	11.5			-	-
48					0.0249	11.8

FIG. 27 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT & 3.5 GRAMS CARBON BLACK
(TREATED WITH AMMONIACAL CUPROUS CHLORIDE)

Table 28

Drying data for linseed oil containing .04 gram cobalt and 3.5 grams carbon black, treated with 25% potassium hydroxide. (Percent oil, 96.0)

Time, Hours	<u>Freshly made sample</u>		<u>1 months aging</u>		<u>2 months aging</u>	
	Wt. sample, .1619 g.	Wt. oil, .1553 g.	Wt. sample, .1667 g.	Wt. oil, .1660 g.	Wt. sample, .2222 g.	Wt. oil, .2135 g.
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
1	0.0001	0.1	0.0035	2.2		
2	0.0001	0.1	0.0124	7.8		
3	0.0043	2.8	0.0176	11.0		
4	0.0124	8.0	0.0198	12.4	0.0007	0.3
5	0.0170	10.9	0.0213	12.3	0.0051	2.4
6	0.0187	12.0	0.0216	13.5	0.0123	5.8
7	0.0196	12.6	0.0213	13.3	0.0190	8.9
8	0.0198	12.7	0.0214	13.4	0.0229	10.7
9	0.0198	12.7	0.0214	13.4	0.0245	11.5
10	0.0191	12.3	-	-	0.0256	12.0
11	0.0194	12.5	0.0214	13.4	0.0258	12.1
12	-	-	-	-	-	-
13	-	-	-	-	0.0266	12.5
14	-	-	-	-	0.0264	12.4
15	-	-	0.0213	13.3	-	-
16	0.0188	12.1			-	-
20	-	-			-	-
22	0.0184	11.8			0.0268	12.6
28	0.0182	11.7			-	-
34	0.0184	11.8			-	-
48					0.0266	12.5

INCREASE IN WEIGHT OF OIL

FIG. 28 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT & 3.5 GRAMS CARBON BLACK
TREATED WITH 25% KOH

Table 29

Drying data for linseed oil containing .04 gram cobalt and 3.5 grams carbon black, treated with 5% potassium hydroxide. (Percent oil, 96.0)

Time, Hours	<u>Freshly made sample</u>		<u>1 months aging</u>	
	"t. sample, .2222 g. wt. oil, .2136 g.		"t. sample, .1839 g. wt. oil, .1765 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
1	0.0097	4.5	0.0001	0.0
2	0.0171	8.0	0.0016	0.9
3	0.0211	9.9	0.0100	5.5
4	-	-	0.0170	9.5
5	0.0253	11.8	0.0202	11.2
6	0.0258	12.1	-	-
7	0.0258	12.1	0.0225	12.5
9	0.0259	12.1	-	-
10	-	-	0.0231	12.8
13	0.0265	12.4	-	-
14	-	-	0.0228	12.6
21	0.0255	12.4	-	-
22	-	-	0.0227	12.6
38	0.0245	11.5	-	-
62			0.0217	12.0

FIG. 29 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAMS COBALT & 3.5 GRAMS CARBON BLACK
TREATED WITH 5% KOH

Table 30

Drying date for linseed oil containing .25 gram lead, as litharge, .04 gram cobalt, and 3.5 grams carbon black. (Percent oil, 95.8)

Time, Hours	<u>Freshly made sample</u>		<u>1 months aging</u>	
	Wt. sample, .2283 g. Wt. oil, .2186 g.		Wt. sample, .1866 g. Wt. oil, .1788 g.	
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
1	0.0049	2.2		
2	0.0140	6.4	0.0011	0.6
3	0.0190	8.7	0.0064	3.6
4	-	-	0.0144	8.1
5	0.0241	11.0	0.0189	10.6
6	0.0244	11.2	-	-
7	0.0247	11.3	0.0213	11.9
9	0.0250	11.4	-	-
10	-	-	0.0217	12.1
13	0.0254	11.6	-	-
14	-	-	0.0221	12.4
21	0.0248	11.3	-	-
22	-	-	0.0219	12.3
38	0.0243	11.1	-	-
62	-	-	0.0210	11.7

FIG.30 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT, 0.25 GRAM LEAD, AS LITHARGE,
& 3.5 GRAMS CARBON BLACK PER 100 GRAMS OIL

Table 31

Drying data for linseed oil containing .5 gram lead, as litharge, .04 gram cobalt and 3.5 grams carbon black. (Percent oil, 95.6)

Time, Hours	<u>Freshly made sample</u>		<u>1 months aging</u>	
	wt. sample, .1658 g.	wt. oil, .1584 g.	wt. sample, .1732 g.	wt. oil, .1658 g.
	Increase in weight, grams	% increase in weight of oil	Increase in weight, grams	% increase in weight of oil
1	0.0070	4.4	0.0001	0.0
2	0.0135	8.5	0.0050	3.0
3	0.0163	10.3	0.0131	7.9
4	-	-	0.0178	10.7
5	0.0197	12.4	0.0196	11.8
6	0.0196	12.4	-	-
7	0.0198	12.5	0.0206	12.4
9	-	-	-	-
10	-	-	0.0209	12.6
13	0.0197	12.4	-	-
14	-	-	0.0209	12.6
21	-	-	-	-
22	-	-	0.0208	12.6
38	0.0185	11.7	-	-
62	-	-	0.0197	11.9

FIG. 31 DRYING RATE OF LINSEED OIL CONTAINING
0.04 GRAM COBALT, 0.5 GRAM LEAD, AS LITHARGE,
& 3.5 GRAMS CARBON BLACK PER 100 GRAMS OIL

SUMMARY

Samples of Figures 24 and 25 treated with aluminum stearate and zinc Nuodex respectively, and having cobalt as a drier, exhibited a very definite decrease in the loss of drying power as compared to Figure 10 untreated pigment.

Pigment of samples shown in Figures 27 and 28 were treated for removal of carbon monoxide and carbon dioxide respectively. Both indicated a decrease in loss of drying ability over the untreated pigment (Figure 10) with treatment for removal of carbon dioxide apparently giving a slightly better result than treatment for removal of carbon monoxide.

Litharge was used to treat carbon black for the same reason that aluminum stearate and zinc Nuodex were used-- to form a film around the pigment particles for keeping drier from being adsorbed and agglomerates from forming. The litharge treatment gave definite improvement to loss of drying power.

Part of the lost drying power was regained by regrinding certain aged samples indicating that some of increase in drying time was caused by entrapment of the drier in agglomerates (5).

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