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Composition of White Lead and Paints.

BY

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COMPOSITION OF WHITE LEAD AND PAINTS.

G. S. FRAPS, PH. D., CHEMIST.

It is estimated that about 70,000,000 gallons of mixed paints are sold in the United States each year. If this estimate is correct, Texas would use mixed paints to the value of about \$3,000,000 annually. Add to this the white lead and other unmixed paint materials which are used in the State, and we see that the annual expenditure for paint and paint materials is a very large sum. On account of the magnitude of the interests involved, and for the further reasons that paints are sometimes very inferior mixtures and the purchaser has no means of ascertaining the nature of the material purchased without an expensive analysis, a number of States have passed laws governing the composition of paints offered for sale in their borders. The first of these was North Dakota. Minnesota, South Dakota, and Iowa have followed suit.

The object of this bulletin is to present the composition of certain Texas paints which have been subjected to analysis and to discuss paints and paint laws. These laws require the composition of the paint to be stated upon the package.

PAINT MATERIALS.

Paint materials may be divided into two classes: First, those which are generally recognized as standard paint materials; second, those which are of disputed value or which can be considered only as adulterants. The first class includes white lead, zinc oxide, pure linseed oil, turpentine, and pure colors. In the second class belongs carbonate of lime, silicates, barytes, petroleum products, water, etc.

STANDARD PIGMENTS AND OILS.

White Lead.—White lead is probably the eldest and most important of all our pigments. It is used in a white paint for color and body. In other paints it is used to give body. It possesses good color, body, covering power, and permanency. It mixes easily with oil and forms a paint that flows easily from the brush, whereas, most other pigments do not work well. It appears to enter into combination with linseed oil, and form a coating of great permanency.

Zinc Oxide.—This is also called zinc white and "Chinese white." It is somewhat variable in composition. It forms a very permanent pigment and has better coloring power than white lead. Its chief fault is want of body, that is to say, it does not hide the surface over which it is spread.

Zinc oxide is at present recognized as a standard paint material, but is usually mixed with more or less white lead. The proportion in which the zinc should be mixed is a subject of considerable difference of opinion among paint men. Some desire no zinc oxide, preferring only pure white lead. Others use 50 per cent or more of zinc oxide.

Linseed Oil.—Linseed oil is recognized as the most suitable oil for paints. For example, Jenkins, in "Paint Color Mixing," says: "It is quite necessary that pure linseed oil should be used in the manufacture of all paints, although there are one or two substances on the market which may be employed in very cheap work. No attempt should be made to execute a really good job unless

pure linseed oil is used." Manufacturers of mixed paints, as a general rule, advise their customers to use nothing but pure linseed oil as a thinner.

Linseed oil has a property of drying or hardening in a suitable length of time, forming a varnish-like mass, which cements the particles of the pigment to one another and to the surface to which they are applied. If an oil is used which does not have this property of hardening and cementing, the paint is liable to become chalky and rub off.

Turpentine.—A small amount of turpentine is considered necessary in paint. Paint authorities, as a whole, recommend the use of pure turpentine and no substitute, and paint manufacturers also advise the use of pure turpentine to thin their paints.

A *dryer* is usually added to make the linseed oil harden more rapidly. Dryers usually consist of resinates or linoleates of lead or manganese, or borate of manganese. The terms "dryer" and "Japan" are used interchangeably. The dryers are usually made by heating litharge, red lead, oxide of manganese, or borate of manganese, with linseed oil or resin, and dissolving the melted mass in turpentine or benzine or both. Dryers are carriers of oxygen, causing the linseed oil to oxidize and harden.

MATERIALS OF DISPUTED VALUE AND ADULTERANTS.

The materials described below are considered as having comparatively low value in paints. When used in large quantities they may usually be considered as adulterants, or the paint may be considered as an inferior paint made of cheap materials. It is quite possible, however, that under certain circumstances a small amount of some of these materials may be of value. Some paint manufacturers claim that a small quantity of carbonate of lime is of advantage in paints. Others, however, say such an addition is only a disadvantage except as it serves to lower the cost of the paint.

Carbonate of Lime.—Carbonate of lime is also known as Paris white, Spanish white, English white, whiting, and marble dust. These materials, however, are not all the same thing, but are different qualities of carbonate of lime. Whiting is chalk which has been ground to a very fine powder and settled in powder to free it from coarse particles. Paris white is a finer quality of whiting. Marble dust is a very cheap form of carbonate of lime, obtained by grinding marble.

Whiting when mixed with oil loses its white color and becomes a dirty gray color. It costs about one-tenth as much as zinc oxide, or white lead.

Silica.—This is prepared by grinding quartz to a very fine powder. It has very little body, but possesses considerable covering power when very finely ground. It costs about one-fourth as much as white lead.

China Clay.—China clay is widely distributed in nature and requires purification only before it is ready to be used. It costs about one-tenth as much as white lead.

Barytes.—Barytes is barium sulphate. It is also called Blanc Fixe. Barytes is a very important white pigment, ranking next to white lead and zinc oxide in the extent of its use. It has little body, and does not work well in oil. It has a high specific gravity, and this is one reason why it is used to adulterate white lead, which also has a high specific gravity. Barytes is found as such and is prepared for use by grinding. Precipitated barytes is also used. Barytes costs about one-seventh as much as white lead.

Sabin, in "Technology of Paint and Resin," says: "These barium compounds

are the least objectionable, being in fact subjects chemically inert, and of stable composition; but they are practically without coloring power, being nearly transparent in oil, and while they probably help to protect the wood, they are really used to cheapen the paint and commonly to increase the profits to the maker and no benefit at all to the dealer or consumer."

As we shall see in the following pages, "white lead" sometimes consists entirely of barytes. This is a fraud, pure and simple.

Linseed Oil Substitutes.—Linseed oil, as we have stated, is the best oil for use in mixing paints. Resin oils and other substitutes are sometimes used. The disadvantage of other oils is that they do not harden sufficiently to hold the pigment thoroughly on the surface painted, and so the covering does not resist the action of disintegrating influences as well as it should. We have stated that paint manufacturers, as a rule, advise the use of pure linseed oil to thin their paints. In view of such recommendation, they can hardly defend the use of linseed oil substitutes in their paints.

Benzine.—Benzine is sometimes used in place of turpentine. The intent of its use appears to be to cheapen the paint. As paint manufacturers advise the use of pure turpentine only, little can be said in defense of the use of a benzine thinner.

Water.—Water is added to some paints, the object being to cheapen the paint and make it look thicker. The thick appearance causes people to believe that they are getting more for their money. Prof. E. F. Ladd found the vehicle of one sample of paint to contain as much as 24 per cent water, and another sample to contain as much as 22 per cent. A small amount of water may occur naturally in paints.

Since the passage of the North Dakota law water is no longer present in brands which formerly contained water when sold in North Dakota.

COMPOSITION OF WHITE LEAD SOLD IN TEXAS.

Eleven samples of white lead in original packages were collected by us and subjected to analysis. The following four samples were found of high purity: Collier's, Carter's, Harrison's, and Houston Paint Company's.

The analyses of the other seven samples are shown in Table I. Five of the seven samples contained 75 per cent or more of barium sulphate. Two of these five did not contain any white lead at all, and the remaining three did not contain over 5 per cent. The other two white leads, so called, contained about 30 to 45 per cent white lead; the remainder of the pigment consisted mostly of zinc oxide and carbonate of lime.

Four of the samples of white lead referred to above were sold in small packages, but they were sold as white lead, and nothing else. The other three were sold in larger packages and undoubtedly represent adulterated white lead which has been sold in quantity for painting purposes. It is evident that, while pure white lead can be purchased in the State, there are a number of pigments sold under this name which either are not white lead at all, or are highly adulterated.

TABLE I.—PERCENTAGE COMPOSITION OF ADULTERATED WHITE LEAD (PIGMENT).

	1286	1291	1292	1572	1574	1604	1664
White lead.....	None	None	3.31	5.04	1.75	45.16	31.79
Zinc oxide.....	16.67	8.73	10.70	10.35	12.63	26.94	27.85
Barium sulphate ..	80.68	80.52	76.93	81.71	81.02	15.28	27.66

	1286	1291	1292	1572	1574	1604	1664
Oxide of iron and alumina .....	.....	.....	.....	1.46	1.13	.73	.55
Carbonate of lime..	0.20	4.12	5.30	1.84	1.51	8.47	10.58
Clay .....	.....	6.30	3.05	.....	2.50	2.51	.....
Magnesium carbonate....	.....	.....	.....	.....	.....	1.50	.26
Silica	1.35	.....	6.01	.....	.....	.....	.....

COMPOSITION OF OUTSIDE WHITE PAINTS.

Eleven samples of ready mixed paints, outside white in color, were subjected to analysis. One of these paints carried a label showing its composition. As two samples of these were made by the same manufacturer, ten manufacturers are represented.

Three of these samples appear to be pure lead and zinc paints, so far as the pigment is concerned, and their composition is approximately as follows:

1494 contains 42 per cent white lead to 57 per cent zinc oxide.

1573 contains 25 per cent white lead to 75 per cent zinc oxide.

1575 contains 30 per cent white lead and 70 per cent zinc oxide.

It will be noted that these samples contain relatively large amounts of zinc oxide.

Five of the remaining seven paints contain 10 to 15 per cent carbonate of lime and the other two contain 36 to 51 per cent barium sulphate. The analyses of the paints are given in Table II. It is claimed by some paint men that carbonate of lime is of advantage in a paint. The only claim which can be made for barium sulphate is its cheapness.

TABLE II.—COMPOSITION OF PIGMENT—ADULTERATED OUTSIDE WHITE.

	1418	1421	1492	1493	1576	1603	1665	1667
White lead.....	35.96	39.51	14.66	41.81	43.91	44.64	10.95	38.02
Lead sulphate.....	.....	.....	15.45	.....	.....	.....	.....	.....
Zinc oxide.....	41.35	49.10	36.58	42.97	39.58	34.12	32.86	21.02
Barium sulphate..	3.93	.....	15.65	.....	4.68	.....	51.71	36.73
Oxide of iron and alumina	1.19	.49	.52	.67	.61	.31	1.48	1.38
Clay .....	.69	.....	.94	.....	.....	.80	.....	.85
Carbonate of lime.	14.82	11.32	13.58	14.55	10.33	14.30	1.47	2.03
Carbonate of magnesium .....	.30	.10	1.86	.60	.....	.....	.....	.....
Silica.....	.....	.....	.....	.....	.....	4.70	.87	.....
Insoluble .....	.....	.17	.....	.19	.....	.....	.....	.....

The Vehicle.—The character of the vehicle of some of these paints is shown in Table III. Two of the paints contain a large excess of volatile oils. Four of the paints contain benzine with the turpentine. One contains mineral oil, and some appear to contain some resin oil mixed with the linseed oil.

TABLE III.—CHARACTER OF VEHICLE.

Laboratory No.	Percentage of		Remarks.
	Volatile.	Non-Volatile.	
1421	11.11	89.89	
1492	14.95	85.05	
1493	13.58	86.42	
1532	15.61	84.39	
1576	8.53	91.47	
1603	7.58	92.42	Benzine and mineral oil present.
1665	27.13	72.87	Benzine.
1667	10.10	89.89	Benzine present.
1573	11.49	88.51	Benzine present.
1575	8.59	91.41	
1287	20.71	79.29	

OTHER PAINTS.

Three other paints were examined, as described below. All three were adulterated:

Sample 1288 is a brown paint, adulterated with 15 per cent carbonate of lime and 15 per cent clay.

Sample 1294 is a lead chromate paste, adulterated with 58 per cent barytes.

Sample 1532 is a light green paint, containing 13.55 per cent carbonate of lime.

OTHER TEXAS ANALYSES.

Bulletin No. 44 of this station by H. H. Harrington and P. S. Tilson (1897), discusses paints and painting materials, and presents the analyses of three white leads and eight mixed paints. One of the three white leads was found to be pure; the other two contained 67 to 74 per cent barium sulphate, and only 1.6 and 9.8 per cent white lead. They were thus shown to be highly adulterated.

Of the eight mixed paints, one might be called pure. The pigment contained 82 per cent zinc oxide. Of the remaining seven paints, three contain over 37 per cent limestone; one contains 56 per cent barium sulphate; two contain 14 per cent barium sulphate, and one contains 13.5 per cent lime and clay. These paints must be regarded as of inferior quality, or adulterated, according to the claims made for them by the manufacturer. However, every mixed paint is usually claimed to be the "best made."

DISCUSSION OF RESULTS.

We did not examine these paints for all possible adulterants. For example, water, which was found in a number of paints tested in North Dakota, was not estimated.

It appears that "white lead" is sold in Texas that does not contain any white lead at all, and that adulterated leads are also sold. Pure lead can be purchased.

It appears that mixed paints containing materials of inferior value are sold and some of these paints must be considered as highly adulterated.

It appears that in the majority of cases consumers of white lead, mixed paints, and other paint materials, have no means of knowing anything about the quality of the materials which they use.

The remedy for this condition of affairs would be to require the composition of the white lead or paint to be stated on the label in unambiguous terms. The purchaser of paints would then be able to judge whether or not he desired a paint of such character. Some of the more progressive paint manufacturers are already placing such a statement upon their products. This should be required of all, and paints and paint materials should be inspected to see that such statements are correct.

PAINT LAWS.

The object of paint laws are as follows:

First. To place each purchaser of paint or paint materials in possession of exact information of its character and composition.

Second. To see that such information is correct.

Third. To secure and diffuse such information regarding paints as to aid the consumer to select the materials best suited to his purpose.

The North Dakota paint law requires a statement of composition only when the paint is not composed of pure white lead and zinc oxide, pure color, linseed oil, turpentine and dryer.

The Texas feeding stuff law requires exact information to be given regarding every feed stuff sold in the State, whether the feed is pure or not. In the opinion of the writer, a paint law should afford the purchaser exact information in regard to paint and paint materials offered for sale in the State, no matter what ingredients the paint is composed of. The purchaser would then be able to select the character of paint desired. A paint composed of pure white lead and zinc oxide might not contain these two in the desired proportions. Some painters desire pure white lead, others wish only a small proportion of zinc oxide, while others do not object to a large quantity. The purchaser should be given exact information in regard to his paint, and be allowed to make his own choice.

SUGGESTIONS CONCERNING PAINT LAWS.

In the opinion of the writer, the following suggestions should be incorporated in paint laws:

1. The exact composition of all paints or paint materials should be printed on a label or tag attached to the package.

2. The statement should be expressed in terms approved by the officer in charge of the law.

3. A penalty should be provided for any statement concerning the paint or paint material which is false or misleading, whether such statement is made on the tag or label, package, in advertisement, or elsewhere.

4. The officer in charge of the law should be authorized and required to publish the analyses, and other information regarding the paints and paint materials in bulletins, reports or elsewhere.

ACKNOWLEDGMENTS.

Messrs. A. C. Deiler and J. T. Cruse are responsible for the analyses printed in this Bulletin. The author also derived some assistance from the reports and bulletins of the North Dakota Experiment Station. The methods of analysis used were for the most part those described in "Mixed Paints, Color, Pigments and Varnishes," by Ladd and Holley.

SUMMARY AND CONCLUSIONS.

1. Eleven samples of so-called white lead were examined. Four were pure and seven adulterated or substitutes. Two did not contain any white lead and three did not contain over 5 per cent.

2. Fourteen samples of mixed paints were examined. Four were pure lead and zinc paints. Six samples contained 10 to 15 per cent carbonate of lime, three contained 36 to 58 per cent barium sulphate, and one contained 15 per cent carbonate of lime and 15 per cent clay.

3. Two of these paints contained benzine as an inferior substitute for turpentine; some appeared to contain linseed oil adulterated with resin oil, and one contained linseed oil adulterated with a mineral oil.

4. Some paints and white lead examined by this station in 1897 were found to be highly adulterated or of inferior quality.

5. Paint laws should require a statement of the composition of every paint or paint material offered for sale, and a penalty should be fixed for any false or misleading statement concerning paints wherever made.

6. Suggestions are made regarding paint laws.