TECHNICAL INFORMATION ON BUILDING MATERIALS

TIBM - 30

FOR USE IN THE DESIGN OF LOW-COST HOUSING

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PAINT PIGMENTS—WHITE

This is primarily a digest of the sections of Bureau of Standards Circular No. 69, "Paint and Varnish", (November 17, 1917),[1] and Technologic Paper No. 274, "Use of United States Government Specification Paints and Paint Materials", (December 15, 1924),[2] by P. H. Walker and E. F. Hickson, dealing with common names, general composition, manufacturing processes, characteristics and uses of white pigments and extenders.

The following papers contain additional information relative to paint pigments, oil paints, and water paints:

TIBM - 31 "Paint Pigments—Black, Red, and Lakes"
TIBM - 32 "Paint Pigments—Yellow, Brown, Blue, Green, and Bronze"
TIBM - 33 "Federal Specification Paint Pigments and Mixing Formulas"
TIBM - 34 "Federal Specification Ready-Mixed Paints, Semipaste Paints and Mixing Formulas"
TIBM - 35 "Preparation of Paints from Paste and Dry Pigments"
TIBM - 36 "Preparation of Paints from Semipaste Paints, Thinning Ready-Mixed Paints and Preparation of Water Paints"
TIBM - 43 "Aluminum Paints"

Pigments are "the fine solid particles used in the preparation of paint, and substantially insoluble in the vehicle".[3] In general, it may be

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[1]Out of print. May be consulted in Government depository libraries.

[2]Available from Superintendent of Documents, Government Printing Office, Washington, D. C. (Price 10 cents).

[3]Quoted from "Standard Definitions of Terms Relating to Paint Specifications", American Society for Testing Materials (1933), pp. 735-739.

assumed that pigments composed of very fine particles, having high refractive indices, provide the greatest covering power and opacity.

Classes of Pigments in General Use:

Body Pigments are those which constitute the bulk of the pigment present and give to the paint film its characteristic properties.

Color Pigments are those used primarily to produce a decorative effect.

Extenders are substances possessing few, if any, of the properties required for body pigments; but which are frequently added to paints, in many cases without harmful effect, because of their cheapness or to impart some particular properties peculiar to them.

Federal Specifications are specifications adopted by the Federal Specifications Executive Committee and approved by the Director of Procurement, Treasury Department, for use of all departments and establishments of the Federal Government.[1]

Basic Carbonate White Lead

Common Names: Basic carbonate white lead is also known as white lead, corroded lead, corroded white lead, carbonate of lead, basic lead carbonate, hydrate of lead, hydrocarbonate of lead, lead carbonate, carbonate white lead, and lead.

Types, Production and Characteristics:

Old Dutch Process basic carbonate white lead is prepared by corroding metallic lead with fermenting tan bark and dilute acetic acid forming a white flaky substance which is crushed, screened, ground in water, and either dried to form dry white lead or ground in oil without drying to form pulp mixed white lead. It is composed of very dense and opaque, fine and coarse particles, which possess great hiding power, and work very smoothly when ground in oil as paint.

Carter Process: This process of manufacturing basic carbonate white lead is the same as the Old Dutch process, except that melted lead is first converted into a granular dust and corroded by dilute acetic acid and carbon dioxide. Carter process white lead is usually whiter, finer, and less dense and opaque than that made by the Old Dutch process. The particles are also more uniform in size.

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[1]Copies of all Federal Specifications mentioned in this digest may be obtained from Superintendent of Documents, Government Printing Office, Washington , D. C. (Price 5 cents each).

Precipitation Process: In this process, lead is dissolved in acetic acid in the presence of air, producing a basic acetate solution from which the basic carbonate is precipitated by carbon dioxide. Precipitated white lead is even finer than that produced by the Carter process.

Electrolytic Process: In the Sperry process, used in this country, a lead anode surrounded by a solution of sodium acetate is used, and the cathode is surrounded by sodium carbonate solution. Lead is dissolved from the anode as lead acetate and precipitated as basic carbonate by the sodium carbonate.

General Composition: Basic carbonate white lead is regarded as consisting of two equivalents of lead carbonate and one of lead hydroxide. The commercial product should not vary widely from this composition even though made by different processes.

Use: White lead is the most important of the white pigments. It enters into most light-colored paints, and is the only white pigment that can be successfully used alone in white linseed oil paints intended for outdoor exposure. While both basic carbonate and basic sulphate can be used, the former is generally preferred. The basic sulphate finds its greatest use in ready-mixed paints.

Characteristics of White Lead Linseed Oil Paints: These paints spread and hide well, and dry to somewhat soft films which do not generally decay by cracking, but do chalk--a condition generally satisfactory for repainting. Owing to the soft nature of white lead linseed oil paint surfaces, they show a greater tendency to take up dirt than is the case of harder paint films.

Federal Specification: See TT-W-251a, "White Lead; Basic-Carbonate, Dry, Paste-In-Oil, and Semipaste containing Volatile Thinner."

Basic Sulphate White Lead

Common Names: Basic sulphate white lead is frequently sold under the trade name "Sublimed White Lead", and is sometimes called basic sulphate of lead, sublimed lead, basic lead sulphate, sulphate of lead, or white lead.

Production: It is produced by heating a mixture of powdered anthracite coal and lead sulphide ore in the presence of air which vaporizes and sublimes the lead sulphide as a basic lead sulphate. Ores used in making this pigment always contain some zinc.

General Composition: The pigment usually contains about 15 percent lead oxide, about 5 percent zinc oxide, and 80 percent lead sulphate. A sublimed white lead is also being made today which is free from zinc oxide, containing about 75 percent lead sulphate and 25 percent lead oxide.

Characteristics: Basic sulphate white lead is very fine grained, exceedingly white in color. Its hiding power is slightly less than that of basic carbonate white lead.

Federal Specification: See TT-W-261, "White Lead; Basic Sulphate, Dry and Paste-In-Oil."

Zinc Oxide

Common Names: Zinc oxide is also known as oxide of zinc, zinc white, white zinc, and zinc.

Types, Production and Characteristics:

French Process zonc oxide is prepared by collecting zinc oxide particles formed by heating metallic zinc in a current of air. The finest and whitest particles weighing 150 pounds per barrel are graded as White Seal. The coarser particles weighing 300 pounds per barrel are graded as Green Seal, and Red Seal.

American Process zinc oxide is prepared by heating a mixture of zinc ore and anthracite coal as in the manufacture of basic sulphate white lead. This product is similar to French process zinc oxide, but generally not so white and it may contain small amounts of lead compounds.

Use: Zinc oxide can be used alone in a varnish vehicle for the manufacture of high grade enamel paints. It should not be used alone in oil paints intended for outdoor exposures. Some so-called zinc oxide oil paints intended for outdoor exposures are available commercially. However, those which prove to be most satisfactory always contain large proportions of other pigments, generally white lead, or a mixture of white lead and titanium pigments.

With mildly chalking pigments such as white lead, the hardening effect resulting from mixing them with zinc oxide is distinctly beneficial. In the case of badly chalking pigments such as titanium oxide, it is necessary to add zinc oxide to produce satisfactory paints.

For preparing mixed pigment oil paints for general use, either American process or leaded zinc oxide may be used. French process zinc oxide is preferred for making white enamels, lacquers, printing inks, etc. According to modern tests, French process zinc oxide should not be used in exterior oil paints.

Characteristics of Zinc Oxide Oil Paints: Zinc oxide in oil, unless mixed with white lead and inert pigments, forms a paint that dries to a hard film which is liable to crack rather than decay by chalking.

Federal Specification: See TT-Z-301, "Zinc-Oxide; Dry and Paste-In-Oil."

Leaded Zinc Oxide

Production: Leaded zinc oxide is prepared by a method similar to that used in producing American process zinc oxide, using bituminous coal and carbonate sulphide zinc ores that may contain lead in any proportion up to an amount equal to that of the lead present.

Characteristics and Use: It is very fine grained, possesses fair hiding power, but is not so white as American process zinc oxide. Leaded zinc oxides are used principally in the manufacture of prepared and paste paints. They appear to impart good durability and good tint retention to exterior house paints.

Federal Specification: See TT-Z-321, "Zinc Oxide; Leaded, Dry and Paste-In-Oil."

Lithopones

Common Names: Lithopone is also known as Ponolith, Orr's white, Beckton white, Griffith's white, etc.

Production: It is produced by grinding, drying, and powdering the calcined precipitate of barium sulphate and zinc sulphide resulting from the addition of a solution of barium sulphide to an equivalent solution of zinc sulphate.

General Composition: Best grades of lithopones contain nearly 30 percent zinc sulphide, a little zinc oxide, and the balance barium sulphate. High strength (50% zinc sulphide) lithopones, as well as zinc sulphide, and titanated lithopone containing 15 percent titanium oxide and 85 percent lithopone, are also available today. Ground barytes are added in the lower grades.

Characteristics: Well-made lithopone is very white in color, and very fine in texture. Formerly, some lithopones darkened on exposure to bright light while others retained their color. The modern lithopone is light resistant.

Use: Lithopones are extensively used in paints for inside work, especially in flat wall paints, and enamels. Regardless of the unstable condition of zinc sulphide, it is sometimes used successfully when mixed with basic carbonate white lead. Lithopone is also used to some extent in exterior paints, although the present trend is to use zinc sulphide mixed with leaded zinc oxide and siliceous extending pigments.

Titanium Pigments

Varieties and Compositions: Titanium white pigments are available in three varieties; titanium oxide, containing nearly 99 percent titanium oxide, calcium-base titanium pigment, containing 70 percent calcium sulphate and 30 percent titanium oxide, and barium-base titanium pigment containing 75 percent blanc fixe and 25 percent titanium oxide. A recent siliceous base-titanium pigment, containing 70 percent siliceous pigments and 30 percent titanium oxide has also appeared on the market.

Characteristics: Titanium pigments are extremely opaque, very white in color, and composed of particles very fine in size. The straight titanium oxide is outstanding among the white pigments for its extreme opacity.

Use: These pigments are becoming very important in outside white paints, interior flat wall paints, and interior gloss enamels. In outside white paints, the barium-base titanium pigment is generally used, being mixed with white lead and zinc oxide.

Federal Specifications: See TT-P-101a, "Paints; Titanium-Zinc-Lead and Titanium-Zinc, Outside, Ready-Mixed, White."

Slaked Lime (Calcium Hydroxide)

Production: Slaked lime is produced by the action of water on quicklime or calcium oxide.

Use: The use of slaked lime as a paint pigment is confined to water paints, particularly whitewash.

Barium Sulphate

Forms: Barium sulphate is an important extender, and is known as "barytes" when obtained by grinding mineral baryte or heavy spar which is crystalline and coarse in structure, and settles out from the paint vehicle. The precipitated form known as "blanc fixe" is much finer and stays up better.

Characteristics: It is extremely stable, practically colorless when mixed in oil, possesses little hiding power, does not react with any paint making material, and is not affected by gases or vapors found in air.

Use: Barium sulphate is extensively used as the base upon which colors are precipitated to form lakes. It is also useful for diluting highly colored pigments without modifying the tone.

Silica (Silex) Silicon Dioxide

Forms: Silicon dioxide is another extender in common use. When obtained by crushing and grinding quartz rock, chert, flint, sand, etc., it is composed of very fine sharp particles, and is inert and white, but without hiding power. This form is valuable for use as a base in paste wood fillers, and to provide "tooth" to paints, that is, power to take hold and adhere to wood surfaces.

The second form, known as diatomaceous earth or kieselguhr--a natural deposit of skeletons of microscopic organisms called diatoms--has less "tooth" than ground quartz.

Magnesium Silicate

Production: Magnesium silicate known as "Asbestine" is obtained by grinding waste asbestos.

Characteristics: It is a white pigment of low specific gravity, and more or less fibrous in structure.

Use: Magnesium silicate is used largely for mixing with other pigments to prevent them from settling out of the paint while standing in the container. Other magnesium silicates, such as soapstone, are also ground and used to some extent in paints. They are, however, inferior to ground asbestos in that they do not so effectively prevent the pigment from settling out of the paint.

Kaolin or China Clay

General Composition: Kaolin is hydrated aluminum silicate.

Use: It is largely used in so-called dipping paints to prevent pigments from settling out in the tanks, and as the inert base upon which colors, especially para reds, are precipitated as "lakes".

Gypsum (Terra Alba)

General Composition: Gypsum is hydrated calcium sulphate.

Forms: When calcium sulphate is heated to about 185°C, part of the water is driven off, leaving plaster of Paris, which can absorb water and set. If all the water is driven off by further heating, "dead burnt" calcium sulphate is formed, which does not readily take up water. The "dead burnt" form is used as an extender in Venetian red.

Calcium Carbonate (Natural Chalk)

Grades: Natural chalk is ground, levigated, and graded according to fineness and whiteness into "Paris white", and "gilders' whiting". These are very fine and bulky, and used in paints to aid in the suspension of the pigment and to neutralize acidity. Commercial "whiting", a third grade, is used in calcimine and putty. A surface treated calcium carbonate, having some unusual properties, is available to the paint manufacturer.

Marble Dust

Characteristics and Use: Marble dust is crystalline. It provides "tooth" to paints, but settles out too readily to make its use desirable, except in priming. It is sometimes added to putty to make it work "short". Ground limestone is similar to marble dust, but likely to be less pure.

Precipitated Chalk (Alba Whiting)

Characteristics and Use: It is very white, extremely bulky, and may be used instead of Paris white or gilders' whiting.