

TECHNICAL INFORMATION ON BUILDING MATERIALS
FOR USE IN THE DESIGN OF LOW-COST HOUSING

TIBM - 32

THE NATIONAL BUREAU OF STANDARDS
UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON, D. C.

August 29, 1936

PAINT PIGMENTS--YELLOW, BROWN, BLUE, GREEN, AND BRONZE

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 general composition, characteristics, and uses of yellow, brown, blue, green, and bronze pigments.

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

- TIBM - 30 "Paint Pigments--White"
- TIBM - 31 "Paint Pigments--Black, Red, and Lakes"
- TIBM - 33 "Federal Specification Paint Pigments and Mixing Formulas"
- TIBM - 34 "Federal Specification Ready-Mixed Paints, Semi-paste 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

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

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

³Quoted 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.

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

Yellow Pigments--Chrome Yellow

General Composition and Types: Chrome yellows are compounds of lead with chromic acid.

Chrome Yellow Medium is a nearly pure lead chromate.

Chrome Yellow Light, Lemon, or Canary contain a considerable amount of lead sulphate or other insoluble lead salt, intimately mixed with lead chromate.

Chrome Yellow Orange is a basic chromate precipitated from alkaline solutions, ranging in color from pale orange to almost scarlet.

Characteristics: Chrome yellows range in color from deep orange to light yellow. They are colors of considerable brilliance, good color strength and hiding power, fairly durable but slowly affected by atmospheric conditions. Sulphides turn them black. Hence, ultramarine blue containing sulphide must not be mixed with them. They cannot be used with silicate of soda, lime, or other alkaline substances as such substances turn them to an orange or red color.

Federal Specification: See TT-C-291, "Chrome Yellow; Dry, Paste-In-Japan, Paste-In-Oil (Lemon, Medium, Orange)."

Zinc Chromate and Barium Chromate

Characteristics: Both zinc and barium chromate are light yellow in color, quite permanent, but lower in color strength and hiding power than lead chromate. The zinc chrome is not a pure chromate, but appears to be a double salt.

Use: Their use in paints is limited because of cost, although at the present time, the use of zinc chrome in rust inhibitive priming paints for metal is growing.

¹Copies 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).

Yellow Ocher

General Composition: Yellow ochers are natural earths containing hydrated oxide of iron (limonite, $2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$) as the coloring matter. Various ochers contain 10 to 60 percent hydrated oxide, the remainder being siliceous matter or clay.

Characteristics and Grades: In color they vary from pale yellow (citron) to very dark, almost olive. When of good quality, yellow ochers are excellent pigments, are permanent in color, and work well with all vehicles and other pigments. With white they produce fine cream or buff tints. They are used primarily as a tinting color.

French ocher is the best grade. English ocher is darker in color. American ochers range from those that are fairly good, though lacking in opacity, brightness, tinting power, and freedom from grit, to those that are simply mud. Golden ocher is ocher strengthened in color and given a yellow tone through the addition of chrome yellow, which fades after a time, leaving only the natural ocher effect.

Federal Specification: See TT-O-111, "Ocher; Dry, Paste-In-Japan, and Paste-In-Oil."

Raw Sienna

General Composition: Raw siennas resemble yellow ocher in general composition, being earthy substances colored by hydrated iron oxide. There is usually a little manganese oxide present. Best grades are known as "Italian siennas".

Characteristics: Raw siennas are brownish yellow in color, and more transparent than the yellow ochers. With white they produce beautiful cream tints which have greater color strength than ochers.

Use: Raw siennas are invaluable as staining and graining colors. They are undesirable for body colors.

Yellow Oxide of Iron

Production: Yellow oxide of iron is produced on a large scale by precipitating a solution of ferrous sulphate with lime or soda ash, and then oxidizing the ferrous hydroxide by aerating it with hot air.

Characteristics: It is uniform, very soft in texture, and possesses a tinting strength which is several times greater than that of yellow ocher. It contains about 90 percent ferric hydroxide.

Use: Yellow oxide of iron, at the present time, is used extensively as a staining and tinting pigment. It is also used largely in enamels, particularly those of the synthetic rosin type.

Cadmium Yellow

Characteristics and Use: Cadmium yellow is a sulphide of cadmium, used in enamels. It is also prepared as cadmium lithopones, which are cheaper than the pure cadmium sulphide.

Hansa Yellow

Characteristics and Use: Hansa yellow is an organic, yellow pigment dye. It is the most permanent yellow pigment on exposure to sunlight. Although very expensive, it is used to some extent in yellow lacquers and synthetic enamels.

Brown Pigments--Burnt Sienna

Production and Color: Burnt sienna is produced by calcining raw sienna which changes its color to an orange red or subdued red brown of great richness.

Kinds: "House Painters Burnt Sienna" is strong in coloring matter, opaque, and is intended to serve as a tinting color. "Grainers' Burnt Sienna" is chosen for its transparency, richness, clearness, and is used as a body color (characteristic cherry), especially in graining. It is also used extensively for producing the conventional mahogany, in which case, it is generally strengthened in reddish tone by adding rose pink or similar red colors.

Raw Umber

General Composition: Raw umber is a natural earth pigment, similar in composition to the siennas but containing considerable amounts of manganese oxide. Best grades, known as "Turkey umber", come from Cyprus.

Characteristics and Use: Raw umber has a yellowish brown color with an olive tone. It is permanent, mixes well with vehicles, is of medium opacity, and fair strength. It gives drab tints with white, and a great variety of other tints when mixed with colored pigments, for which purpose it is extensively used.

Burnt Umber

General Composition: Burnt umber is calcined raw umber.

Characteristics: It has a rich brown color, which, while darker than raw umber, should be free from redness.

Use: Burnt umber is used for the same purpose as raw umber. However, the tints formed are of a different order of drab.

Metallic Browns or Mineral Browns

Production and Colors: Metallic browns or mineral browns are produced from native ores which, upon roasting, develop colors ranging from bright red brown to dark purple.

Characteristics: They are opaque, fairly permanent, changing but little on exposure and can be mixed with other pigments with good results.

Use: Such browns are extensively used to paint roofs, barns, iron bridges, and similar surfaces where a good substantial covering is required without much regard for beauty of finish.

Vandyke Brown (Cassel Earth or Cologne Earth)

General Composition: Vandyke brown is a pigment of carbonaceous character usually found in or near bogs.

Characteristics and Use: This pigment is soluble in dilute alkali, forming a solution which may be applied to wood and precipitated in the grain with dilute acid giving a very good and permanent walnut stain. When ground in oil and thinned with turpentine, it makes a good walnut oil stain which is not too transparent and is decidedly permanent. However, it does retard very strongly the drying of linseed oil.

"Sap brown" is a commercial dry soluble form of Vandyke brown.

The color of Vandyke brown may also be obtained by using burnt umber, drop black, and Prussian blue, producing a color that is permanent, but lacking the transparency of true Vandyke brown.

Synthetic Brown Oxide of Iron

Production and Characteristics: Synthetic brown oxides of iron are very rich shades of brown pigments made synthetically from iron salts. They are uniform, soft in texture, very strong in tinting strength, and generally contain over 95 percent oxides of iron.

Blue Pigments--Prussian Blue

General Composition: Prussian blue is an oxidized precipitate produced by precipitating potassium ferrocyanide with ferrous sulphate.

Characteristics and Use: Prussian blue, which is a characteristic dark blue in color, is a transparent pigment of great strength, 1 pound giving to a ton of white lead a decided sky blue tint. It is fairly permanent except in contact with alkalis or lime, which decolorize it rapidly. With white pigments it should give a decided blue tint, not purplish or muddy. As Prussian blue is very fine in texture, it does not settle in the vehicle, and hence it is used as a dipping paint.

Federal Specification: See TT-P-691, "Prussian-Blue; Dry, Paste-In-Japan, Paste-In-Oil."

Ultramarine Blue

Production: Ultramarine blue is produced artificially by heating together clay, silica, sodium carbonate, sodium sulphate, charcoal, rosin, and sulphur. The resulting product is then ground, roasted, and washed.

Characteristics: In color this pigment varies from a pure blue to colors bordering on green (green ultramarine). It is bright but of low color strength. Although it is affected by weak acids, it is permanent when exposed to sunlight, alkali, or lime. The sulphur in ultramarine darkens white lead carbonate, and discolors chrome yellow and other colors containing lead.

Use: Ultramarine blue is used largely in house painting for making tints with zinc white.

Federal Specification: See TT-U-451. "Ultramarine-Blue; Dry, Paste-In-Japan, Paste-In-Oil."

Cobalt Blue

General Composition: Cobalt blue is a compound of oxides of aluminum and cobalt.

Characteristics: It has a fine greenish blue color, permanent to light, and is not affected by alkali, lime, or acid. It can be mixed with any other pigment or color. Because of the high price of genuine cobalt blue, the so-called commercial product is a suitable ultramarine blue mixed with a little zinc white to provide a close imitation of cobalt blue.

Blue Lead

General Composition: Blue lead is essentially a basic lead sulphate with an excess of lead oxide mixed with varying small quantities of lead sulphide, lead sulphite, zinc oxide, and carbon.

Characteristics: It is a dark blue-gray pigment, affected by exposure to light which fact is of little importance as blue lead is not used for coloring power. After drying, when mixed as a paint, it is comparatively immune against darkening by coal gas.

Use: Blue lead is used to a considerable extent as a protective coating for metallic surfaces.

Federal Specification: See TT-B-486, "Blue-Lead; Basic-Sulphate, Dry and Paste-In-Oil."

Monastral Blue

Characteristics and Use: Monastral blue is a new, blue pigment dye (copper phthalocyanine) that has appeared on the market, which gives a very beautiful, blue tint. It appears to be destined for use as a printing ink pigment.

Green Pigments--Chrome Green

Production: Chrome green can be made simply by mixing together Prussian blue and chrome yellow. However, in color works, the necessary solutions to produce both Prussian blue and chrome yellow are made up and then mixed together, the resulting chrome green being a very intimate mixture of the blue and yellow.

Characteristics: In tone the mixtures range from very pale yellow green to a very deep blue green. They have great covering power and good color strength, but are not very durable and are subject to the limitations of both Prussian blue and chrome yellow.

Common Grades and Use: "Commercial Greens" are composed of about 75 percent barytes or silicate to 25 percent color. As a body pigment, commercial greens answer very well. Pure Green known commercially as "chemically pure" is preferred for tinting purposes.

Federal Specification: See TT-C-236, "Chrome, Green; Pure, Dry, Paste-In-Japan, Paste-In-Oil."

Chrome Oxide Green

Grades: True Chrome Oxide Green is chromic oxide (Cr_2O_3), a rather expensive, permanent, dull color of satisfactory hiding power. "Guignets' Green" or "Viridian" is a carefully made product of the best grade, which is more or less hydrated and usually contains boric acid. "Chrome Ocher" is a clay stained with chromic oxide. It has little value.

Federal Specifications: See TT-Q-231, "Chrome, Green; Oxide."

Emerald Green

General Composition and Use: Emerald green is poisonous copper acetate-arsenite, known as "Paris Green", which is extensively used as an insecticide. Its use as a paint pigment has almost entirely ceased.

Verdigris

General Composition: Verdigris is a basic acetate of copper.

Characteristics: It possesses a pale bluish green color which is not permanent.

Use: Verdigris is used to some extent for decorative effects, and in marine paints as a protection against barnacles.

Green Earth (Terre Verte, or Verona Green)

General Composition: The so-called green earths are usually complex silicates of magnesium, or other alkali base and ferrous iron.

Characteristics: They are permanent, semiopaque, and their colors are dull bluish green varying to a bluish gray.

Use: Although their chief use is in "distemper" (water paint), they are used somewhat by manufacturers of mixed paints to produce certain neutral greenish tints with white. A good quality of green earth brightened with certain basic coal-tar dyes is used as a cheap lime-proof green color.

Metallic Pigments (Bronzes)

Bronze Paints: Very finely divided metals or alloys are used in the so-called bronze paints.

Aluminum Bronze is metallic aluminum.

Copper Bronze is metallic copper.

Gold Bronze is the term applied to finely divided alloys of copper, zinc, and tin which have colors resembling gold.

Bronze Powders generally contain small amounts of oil or fatty matter such as stearine. They may be dyed with coal-tar dyes, resulting in brilliant reds, greens, blues, purples, etc. The dyed colors are not permanent on exposure to sunlight.

Federal Specification: See TT-A-476, "Aluminum-Powder; (For) Paints (Aluminum-Bronze-Powder)."