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WOOD AND SHINGLE STAINS

Contents

I. INTRODUCTION

The Bureau receives numerous requests from the public for information on wood and shingle stains. The purpose of this letter circular is to have readily available information with which to answer questions of a general nature. More detailed information will be found in the list of selected references on page 8 which were among those consulted in the preparation of this publication.

For the purposes of this discussion, stains are divided into two broad classifications. The first group, wood stains, includes those used in the finishing of wooden furniture, interior trim, instrument cases, fruit baskets, and similar surfaces. The second group, shingle stains, includes those suitable for use on comparatively rough exterior woodwork such as shingles, weatherboards, and fences.

II. WOOD STAINS

Although a great variety of wood stains are produced in small amounts for various special purposes, it has been found that, in general, four types are sufficient to meet most needs. Stain manufacturers have, therefore, concentrated on and specialized in the production of these types. With one exception they are classified according to the vehicle in which the coloring matter is dissolved or dispersed: water stains, oil stains, spirit stains and non-grain-raising stains. A short description will be given of each type.

In addition to the stains mentioned, which change the color of wood by means of dyes and pigments, certain chemicals have also been used which produce color changes by reaction with the wood. This type will also be discussed briefly.

Water stains[1] (1) are very dilute solutions (1 to 3 percent)

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[1] The figures in parentheses refer to the references listed on page 8.

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of various types of dyes in water. Such additives as wetting agents, to improve penetration, and water-soluble binders may also be present. The nature of the dye selected depends on the surface to be finished. Stains for high-grade furniture and interior woodwork, for example, must have reasonably good light resistance. This requires the use of acid dyes. Fruit baskets and crates, however, may be stained with the relatively fugitive but brilliant basic dye compositions. Water stains are characterized by low cost, good transparency with ability to accentuate the grain of the wood, and good light resistance. Varnishes may be applied over them with little danger of bleeding, and specially formulated lacquers may also be used for the finish coat. Frequently the stain is allowed to dry for 24 hours and the surface is then sized with a "wash coat" of shellac varnish (1 volume of shellac varnish, 4-pound cut, thinned with 4 volumes of alcohol). Then the raised wood fibers are sanded smooth.

Water stains are usually applied to wood by means of a brush, spray, sponge or swab, a few minutes allowed for penetration into the wood, and the excess then carefully wiped off with cheese cloth. After the stain has dried thoroughly, the surface is lightly sanded because water stains raise the grain of the wood. The whole operation may be repeated as many times as necessary to obtain the desired depth of color. If only one coat of stain is to be applied some finishers prefer to sponge the wood with water first to raise the grain. When dry, the raised grain is sandpapered. Only very light sanding is then necessary after staining, and the risk of cutting through the stain is minimized.

There is usually no difficulty in getting good penetration of water stains into the softwoods, but the hardwoods sometimes offer somewhat of a problem in this respect. One effective method to obtain better penetration in such cases is simply to apply the stain hot.

Modern high speed production methods introduce many variations of the above procedures, including the application of stains by spraying, the use of vacuum or pressure to assure proper penetration, and the use of heat to accelerate drying. Non-grain-raising stains, which will be discussed later, may be used to cut the time required for sanding.

Oil stains are usually subdivided further into two groups - those which penetrate well into the wood and those which do not. Penetrating oil stains are formulated in a manner generally similar to water stains except, of course, that the vehicle is non-aqueous. Oil-soluble dyes are dissolved in aromatic hydrocarbons (or mixtures with aliphatic hydrocarbons) such as toluene or coal tar naphtha containing 5 to 10 percent of resins, drying oils, or varnish. The dye concentration may vary from about 1 to 3 percent by weight.

Such stains produce bright and transparent hues, but they require a sealing coat to prevent bleeding into varnish or lacquer topcoats.

Non-penetrating oil stains are made by dispersing finely ground pigments, preferably of the semi-transparent type such as umbers, siennas, and ochers, in a vehicle which contains drying oil or varnish and thinners. The volatile thinners are often mineral spirits, turpentine, solvent naphtha and the like. The pigmented stains cannot compare in transparency or brilliancy with those containing dyes but they have the advantages of being non-bleeding and extremely fast to light.

Vanderwalker (2) gives the following formulas for pigment-oil stains of the type used for interior wood trim. The yield in each case is about one gallon.

Light Oak

1 1/2 lb. raw sienna (in oil)
1/2 lb. raw umber (in oil)
8 oz. japan drier
1 qt. turpentine
1 qt. benzol, industrial 90 grade
3 pt. boiled linseed oil

Dark Oak

1 lb. raw sienna (in oil)
1/2 lb. burnt sienna (in oil)
1/2 lb. burnt umber (in oil)
1/2 pt. japan drier
1 qt. turpentine
1 qt. benzol, industrial 90 grade
3 pt. boiled linseed oil

Walnut

1 lb. Vandyke brown (in oil)
1 lb. burnt umber (in oil)
1 oz. rose pink (in oil)
1 qt. turpentine
1 qt. benzol, industrial 90 grade
3 pt. boiled linseed oil

Mahogany, Red

1 3/4 lb. burnt sienna (in oil)
1/4 lb. maroon lake or rose pink (in oil)
1 qt. turpentine
1 qt. benzol, industrial 90 grade
3 pt. boiled linseed oil

We have prepared numerous pigmented oil stains in the laboratory and the following are some examples:

Cherry

1 pt. burnt sienna in oil
1 gal. of vehicle A

Dark Walnut

1 pt. Vandyke brown in oil
1 gal. of Vehicle A

Rosewood

1 pt. Vandyke brown in oil
1/4 pt. rose pink in oil
1 gal. vehicle A

Ash

1 pt. raw sienna in oil
Trace of lemon chrome yellow in oil
1 gal. of vehicle A

Light Oak

1 pt. raw sienna in oil
1/4 pt. raw umber in oil
1 gal. of vehicle A

Dark Oak

1 pt. raw sienna in oil
1/2 pt. burnt umber in oil
1/2 oz. burnt sienna in oil
1 gal. of vehicle A

Mahogany

1 pt. Vandyke brown in oil
1/2 pt. rose pink in oil
1 gal. of vehicle A

Vehicle A consists of:

5 volumes of turpentine
4 volumes of boiled linseed oil
1 volume of liquid paint drier

By substituting 1 gallon of floor varnish and 1/2 pint of drier for "Vehicle A", a varnish stain may be produced. This type of stain is used on moderate priced work and on floors. Varnish stain colors the wood, fills it to some extent, and adds a gloss finish. It is used often by the amateur for refinishing furniture and for many other purposes about the house.

Oil stains are applied in the same manner as water stains and the excess wiped off after sufficient time has elapsed to permit penetration. Usually this is longer than the relatively few minutes required for the penetration of water stains. Little or no sanding is required after the stain has dried,as oil stains are not likely to raise the grain. A sealing coat, for example, shellac varnish, however, is necessary with the penetrating type of oil stain to prevent bleeding into conventional finish coats.

Spirit stains are prepared by dissolving 1/2 to 12 percent by weight of certain dyes in very thin solutions of shellac or other suitable resin in alcohol. They are characterized by fast drying, which means that considerable skill is required for satisfactory application to large areas. Uses of this type of stain are somewhat limited as compared with the other types. Because of the alcohol in the vehicle they are useful in refinishing operations where penetration through old finishes is desirable. Other uses are on shipping containers, baskets, toys, the inside of cabinets, and similar surfaces.

Non-grain-raising stains are a recent development designed to eliminate the sanding operation necessary with water stains. They consist of 1/2 to 6 percent solutions of dyes in a small amount of dye solvent, with alcohols and hydrocarbons comprising the remainder of the volatile liquid portion. Careful selection of the liquids used and proper adjustment of their proportions are required to insure satisfactory performance. Because of their time- and labor-saving features and the fact that they yield brilliant, light resistant finishes these stains are finding wide acceptance in the wood-finishing industry. They are patented and are more expensive than other types. They are especially suited for production work where speed is a factor. No particular technique is required in their use.

The chemical type of stain, which is included in this discussion principally for the sake of completeness, is not used today to the extent that it once was. Potassium permanganate was the most important chemical stain of former years. Most shades of brown desired for oak, walnut, and brown mahogany were produced with a stain made by dissolving 4 to 8 ounces of that salt in 1 gallon of water. Other chemicals similarly used included tannic, picric, nitric, sulfuric, and muriatic acids with which could be produced a range of colors from yellow through various shades of brown to black, depending on the acid selected, its concentration, and the wood to which it was applied.

This group should also include the aniline black laboratory bench finish, which is still used. The chemicals and their application are as follows: An aqueous solution of copper sulfate and potassium chlorate (solution A below) is first applied to the area to be stained, and after it has become dry a second solution containing aniline, hydrochloric acid, and water (solution B) is painted over it. After drying the surface is washed with hot water and the whole operation repeated until the wood is dark green. When rubbed with linseed oil a black finish is obtained which can be kept in good condition by occasional additional rubbings with oil. Imperfections requiring putty should not be filled until the wood is stained. Putty colored with lampblack may then be employed. The two solutions used are:

Solution A

Ingredient	Metric Units	English Units
Copper sulfate	125 g	4.2 oz. (avoir.)
Potassium chlorate	125 g	4.2 oz.
Water, to make	1000 ml	1 qt.

Solution B

Aniline	60 g	2 oz.
Hydrochloric acid (conc.)	90 ml	2.9 fl. oz.
Water, to make	500 ml	1 pt.

III. SHINGLE STAINS

Shingle stains are intended for application to comparatively rough exterior wood surfaces. Like pigment-oil wood stains they are very fluid paints, but whereas a wood stain is brushed on and then wiped off to bring out the grain of the wood shingle stains are applied by dipping or brushing and are not wiped off. Shingle stains should not cake or change color in the container and when stirred up should settle very slowly. With the exception of some dark brown stains which are simply refined coal tar creosote with volatile thinners, shingle stains are usually made from very finely ground pigments, drying oils, and volatile thinners. Many commercial shingle stains contain some creosote oil from coal tar or water-gas tar which is supposed to act as a wood preservative. While pressure treatment with creosote is one of the most effective methods of preventing wood from rotting, the small amount that penetrates the wood from a single dip or brush treatment probably has no marked effect.

Uebele (3) gives the following formulas for creosote shingle stains:

Deep Green Stain

15 lb. C. P. chrome green in oil
1 gal. benzine japan drier
4 gal. creosote oil
4 gal. heavy benzine

Mineral Red Stain

17 lb. red oxide ground in oil
1 gal. benzine japan drier
4 gal. creosote oil
4 gal. heavy benzine

Walnut Brown Stain

13 lb. burnt Turkey umber in oil
1/2 gal. benzine japan drier
1/2 gal. 160° benzol
5 gal. creosote oil
3 gal. heavy benzine

Silvery Gray Stain

20 lb. zinc white in bleached linseed oil
1/8 lb. lampblack
1/2 gal. pale liquid drier
1/2 gal. straw-colored cresylic acid
8 gal. heavy benzine

Paint applied over creosote stain is likely to be ruined by the creosote bleeding through. Pigment-oil shingle stains without creosote do not have this disadvantage. They can be made by thinning a good outside oil paint with turpentine and boiled linseed oil, or by mixing pure high grade pigments ground in linseed oil with a suitable vehicle. This may be made from about 4 volumes of boiled linseed oil and 2 volumes of turpentine. The proper proportions are about 1 gallon of vehicle to 1 pint of the pigment-in-oil. A great variety of pigments-in-oil may be used; the following are merely examples of those commonly used in shingle stains:

For deep red brown, use Indian red.

For red, use bright red iron oxide.

For brown, use raw umber or burnt umber.

For green, use chromium oxide green or pure chrome green.

For gray, use zinc oxide, white lead, or a mixture of these, tinted with lampblack.

IV. REFERENCES

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3. Uebele, C. L. - Paint Making and Color Grinding, The Painters Magazine, New York (1913).

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5. Anon. - The Handbook of Painting, National Lead Company, 111 Broadway, New York City.

6. Boynton, F. R. - "How to Match Colors", Ind. Finishing 16, No. 8, 30-3 (1940).

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8. Filkins, R. W. - "Wood Stains and Fillers", Ind. Finishing 17, No. 7, 31-2 (1941).

9. Federal Specifications Board - Federal Specification TT-S-706, Stain; Opaque, Wood, Exterior, Oil (1945). Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price 5 cents.

10. Federal Specifications Board - Federal Specification TT-S-711, Stain; Wood, Interior, Nonbleeding (1945). Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price 5 cents.

11. Westlake, E. - "Wood Finishing", Technical Information Circular No. 7, Federal Security Agency, National Youth Administration

The following list of selected United States patents on the subject of stains may be helpful to the reader:

U. S. Patent 2,105,984
" " " 2,137,830
" " " 2,137,871
" " " 2,137,794
" " " 2,302,760
" " " 2,320,426