BLEACHING WOOD[1]

By

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U.S. Department of Agriculture

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General Information

Thick pieces of wood, such as logs or boards, cannot be bleached satisfactorily all the way through. Wood should be made into the furniture or other find product, and then the surface bleached if desired

Woods differ in the ease with which they can be bleached. Oak, birch, mahogany, ash, maple, beech, and walnut can be bleached fairly easily gum, tupelo, pine, and poplar are said to be very difficult to bleach satisfactorily.

If varnish, stain, or other finishing material is present on wood surface that is to be bleached, it must be removed completely before bleaching is started. Even waxy materials left on the wood by varnish removers may interfere with the action of bleaching chemicals. A final sanding before bleaching is desirable in such cases. Where stain has penetrated into the wood, scraping or sanding until all of the stained wood has been removed is usually necessary. The wood bleaches may not bleach the dyes or pigments used in wood stains.

Many bleaching chemicals are injurious to the skin and eyes. Goggles, heavy rubber gloves, and aprons should be worn when handling and applying wood bleaches, particularly those containing hydrogen peroxide or sodium hydroxide.

Reasons for Bleaching

Woods such as walnut or mahogany, which are naturally dark in color, may be bleached to a lighter color or even to white, and light-colored woods may be made lighter, in conformity with the vogue for light-colored, or blond, furniture.

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[1] Only a limited amount of experimental work on the bleaching of wood has been done at the Forest Products Laboratory. The information presented here is based chiefly on the published literature and on material supplied by makers and users of wood bleaches. This Research Note is a slight revision of Report No. 1705, under the same title, originally written in 1948 by Leslie E. Downs, chemical engineer.

[2] Maintained at Madison, Wis., in cooperation, with The University of Wisconsin.

Individual pieces of wood or veneer that are abnormally dark or that contain dark streaks known as mineral streaks, may be bleached to match the surrounding wood.

Certain alkaline-type glues, such as casein or vegetable, may stain some woods at places where glue touches the surfaces, and the stain may remain after the glue has been scraped off. When thin face veneers are glued with such glues, the glue solvent containing dissolved chemicals may penetrate through the veneer and discolor the face. Such discoloration can be removed by bleaching. If the glue itself, however, has penetrated through large vessels in woods like oak, mahogany, or walnut, and partly fills the pores in the face of the veneer, bleaching will not remove the glue, which usually appears as white specks in the pores. Glue that has penetrated in that manner will not take wood stains and will interfere with proper application of wood filler in subsequent finishing.

Methods of Application

In small-scale work or in bleaching selected areas, such as mineral streaks or dark individual boards or pieces of veneer, the bleaching solution or solutions usually are applied with a cloth swab, a sponge, or a brush.

In large-scale production work, the solutions sometimes are applied with a spray gun. A gun for this purpose should be one with a glass jar, and its construction should be such that the solution can touch no metal except stainless steel or other corrosion-resistant alloy. The gun should be washed immediately after each use by spraying water through it.

Bleaches

Table 1 describes the formulation and application of some of the common bleaches used in production and shop work.

Hydrogen Peroxide Bleach

One of the most powerful, satisfactory, and widely used bleaches in recent years is based on a strong solution of hydrogen peroxide (30 or 35 percent strength). The wood is first coated evenly with a solution of sodium hydroxide (caustic soda, or ordinary 1 ye) containing 4 pounds of the solid per 10 gallons of solution. After this has dried for about 30 minutes, an even coat of the hydrogen peroxide is applied. The sodium hydroxide applied as the first coat renders the hydrogen peroxide unstable, whereupon it decomposes and liberates a large amount of oxygen in a chemically active condition, which does the bleaching. The liquid on the surface should be allowed sufficient time to dry, during which time the bleaching occurs; then the wood should be rinsed thoroughly with cold water. To neutralize any remaining traces of sodium hydroxide, the surface should then be washed or sprayed with a solution

Table 1.--Some of the common bleaches used in production and shop work*

Bleaching chemicals	Recommended formulation	Technique of application	Neutralization	Remarks
1. Sodium hydroxide Hydrogen peroxide	4 lbs. sodium hydroxide in 10 gals. water with 28% or 35% hydrogen peroxide.	Apply sodium hydroxide solution. Dry approximately 30 minutes. Then apply even coat of hydrogen peroxide and allow to dry.	Wash with cold water. Then wash or spray with acid, 1 lb. oxalic or 1 lb. acetic acid in 10 gals. water. Allow to stand 15 minutes. Then rinse with water and dry. Sand to remove raised grain.	Two-solution production bleach. Strong and effective. Can be mixed for 1-solution application, but has a short effective life.
2. Sodium hydroxide Silicate of soda Calcium hydroxide Hydrogen peroxide	11 lbs. flake sodium hydroxide, 10 oz. silicate of soda - 42° Be and 10 oz. calcium hydroxide (hydrated lime) in 10 gals. water with 35% hydrogen peroxide.	Apply as in bleach No. 1 or use as a 1-solution bleach.	same	1- or 2-solution production bleach. Bleach strength better controlled than in No. 1 bleach.
3. Sodium hydroxide Calcium hydroxide Hydrogen peroxide	12-1/2 lbs. flake sodium hydroxide and 10 oz. calcium hydroxide (hydrated lime) in 10 gals. water with 35% hydrogen peroxide.	Apply as in bleach No. 1 or use as a 1-solution bleach.	same	Similar to No. 1 bleach.
4. Sodium hydroxide Silicate of soda Hydrogen peroxide	10 lbs. flake sodium hydroxide and 8-1/3 lbs. silicate of soda - 42° Be in 10 gals. water with 35% hydrogen peroxide.	Apply as in bleach No. 1 or use as a 1-solution bleach.	same	Similar to No. 2 bleach.
5. Sodium hydroxide Epsom salts Hydrogen peroxide	1 volume containing 20 oz. flake sodium hydroxide in 7 pints of water and 9 oz. epsom salts in 1 pint of water with 2 volumes of 28% hydrogen peroxide.	Apply as in bleach No. 1 or use as a 1-solution bleach. Caution: the epsom salt solution should be carefully added to the caustic solution.	same	Similar to other peroxide caustic bleaches but epsom salts help stabilize peroxide in wood with high mineral content, thereby giving greater effectiveness.
6. Hydrogen peroxide Ammonia	28% or 35% hydrogen peroxide with aqueous or dry ammonia from cylinders.	Apply hydrogen peroxide. Place in fuming chamber exposed to ammonia or flow on ammonia solution. Allow to dry.	No neutralization. Light sanding.	Production method faster with greater economy. Not as strong as bleaches No. 1, through No. 5.
7. Silicate of soda Aqua ammonia Hydrogen peroxide	2 qts. silicate of soda - 42° Be and 1 qt. aqua ammonia (28-29% ammonia concentrate) in 3 qts. water with 35% hydrogen peroxide.	Apply ammonia-silicate mixture. Follow with hydrogen peroxide after desired penetration time.	Neutralize with dilute acetic acid solution. Dry and sand.	Production bleach for woods not difficult to bleach. Less effective than caustic-peroxide bleaches.
8. Oxalic acid	4 to 32 oz. oxalic acid crystals in one gal. hot water or 1 gal. denatured alcohol.	Apply even coat of desired concentration until desired bleached effect is attained.	Wash with hot water. Neutralize with 3 oz. borax in 1 gal. water and rinse surface with hot water. Dry and sand.	Weak shop bleach. Denatured alcohol reportedly gives greater bleaching action than water. Removes vegetable and casein glue stains.
9. Oxalic acid Sodium hypophosphite	4 lbs. oxalic acid and 4 lbs. sodium hypophosphite in 1 gal. hot water.	Apply even coat until desired bleached effect is attained.	Neutralize with borax solution (4 lb. in 1 gal. water). Rinse with hot water. Dry and sand.	Shop bleach for removal of mineral streaks, dark spots and iron stains in oak.
10. Sodium bisulfite Oxalic acid	6 oz. sodium bisulfite in 1 gal. water. 8 oz. oxalic acid in 1 gal. water.	Apply sodium bisulfite solution. Allow to dry. Follow with oxalic acid solution and allow to dry.	Wash with hot water. Neutralize oxalic acid with 3 oz. borax in 1 gal. water and rinse surface with hot water. Dry.	Shop bleach for walnut. Not as powerful as sodium hydroxide and hydrogen peroxide. Two-solution system.
11. Sodium hypochlorite (laundry bleach)	5% sodium hypochlorite diluted 1/2 pint in 1 gal. water.	Apply even coat until desired bleached effect is attained.	Wash surface. Dry and sand.	Specialty bleach for light blue stain discoloration. Not recommended for oak or poplar.
12. Potassium permanganate Sodium bisulfite	1 oz. potassium permanganate in 1 gal. water 3 oz. sodium bisulfite in 1 gal. water.	Apply potassium permanganate solution. While still wet, apply bisulfite solution.	Light rinse. Dry and sand.	Specialty bleach for French or Huguenot walnut finish.

containing 1 pound of acetic acid (or 1 pound of oxalic acid) per 10 gallons of water, allowed to stand for 15 minutes, then rinsed thoroughly with water and allowed to dry. After the wood is sanded lightly to remove raised grain the new finish may be applied. Several manufacturers and dealers in hydrogen peroxide of 30 or 35 percent strength are listed in the appendix

Some furniture factories are reported to be using a process that eliminates the sodium hydroxide solution. The wood is wet thoroughly with hydrogen peroxide, then immediately moved to a room or tunnel where it is exposed to ammonia fumes, either from ordinary aqueous ammonia solution or as dry ammonia gas from cylinders. The advantages of this method are said to be speed, economy, and the absence of nonvolatile alkali that must be removed later from the wood by thorough washing by water. One writer states that tests have shown that the ammonia method does not produce as white a bleach as the older method does.

Prepared Bleaches

Perhaps the simplest method of obtaining a reliable bleach and becoming familiar with the correct method of using it, is to purchase a prepared bleach. Such bleaches often come in the form of two solutions, which may be mixed immediately prior to application or used successively. If one application does not give sufficient bleaching, several applications of the second solution or of the mixture can be made. Several manufacturers are able to furnish such bleaches, together with instructions for their use. Manufacturers of prepared bleaches are listed in the appendix.

Oxalic Acid

Oxalic acid is frequently recommended and used where a comparatively mild bleaching action will suffice. Recommendations as to its concentration vary from 4 to 32 avoirdupois ounces of the crystalline or powdered oxalic acid per gallon of hot water, but most of the recommendations appear to fall in the range of 11 to 16 ounces. The acid should be dissolved and used in glass, earthenware, or enameled iron vessels, but not in plain or galvanized iron. It is most effective when used hot, almost boiling, but it can be used unheated. Several applications may be made, until the desired color is reached Then the acid may be removed with hot water, or neutralized with a solution of 3 ounces of borax per gallon of water, then washed with hot water. One published statement declares that " oxalic acid dissolved in denatured alcohol produces a very powerful bleach. "

Miscellaneous Bleaches

A 10 percent solution of sodium hydrosulfite in water can be used by repeatedly wetting the wood with the solution. No final rinsing with water is necessary. Ordinary household laundry bleach, 1/2 pint per gallon of water, will bleach some woods. It should be applied liberally and then allowed to dry. The application should be repeated if necessary, and the wood finally rinsed,

Dark Spots and Mineral Streaks

For dark spots in maple, one recommendation calls for the use of 4 pounds of oxalic acid and 4 pounds of sodium hypophosphite dissolved in water, used hot. In difficult cases a second treatment may be applied consisting of 4 pounds of borax in 1 gallon of water.

Some mineral streaks in oak or other woods cannot be removed with ordinary bleaches. Many finishers paint out these streaks with material tinted to match the surrounding bleached surfaces. This can be done so well that in the finished piece these painted-out dark streaks cannot be found.

Iron Stains in Oak

The surface of oak sometimes becomes discolored with greenish or black stain where it comes in contact with iron in the presence of moisture. These stains result from chemical reaction of the corrosion products of iron with the tannic acid naturally present in oak, forming the insoluble black ferric tannate, which is similar to the coloring matter in certain inks. Oxalic acid will reduce this to the colorless, water-soluble ferrous tannate. The stained surf ace should be given several applications of solution containing at least one pound of oxalic acid per gallon of water, preferably hot. After the stains disappear, the surface should be washed thoroughly with warm water to remove the oxalic acid, and to remove all ferrous tannate which otherwise might later be oxidized back to the black ferric tannate. Formation of iron stains on oak can be avoided if no metal is allowed to touch the wet wood for more than a few seconds, except nonferrous metals such as brass, copper, aluminum, or zinc, or iron that has been plated or coated with some nonferrous metal such as copper, zinc, nickel, chromium, tin, or cadmium.

Glue Stains

Some types of glue stains can be removed by the hydrogen peroxide bleaching process.

Casein and vegetable glue stains can be almost entirely removed by using a solution of 1 ounce of oxalic acid in 12 ounces of water.

Bluestain

Unsightly dark stains known as bluestain or sapstain often appear in the sapwood of woods of some species, if the temperatures and moisture contents are high enough to permit fungi of this kind to grow. If the staining is not too severe, it can be bleached by the hydrogen

peroxide method, but with some difficulty. Ordinary household laundry bleach (5 percent sodium hypochlorite solution) is said to be capable of reducing the intensity of the staining, if it is not too serious to start with.

Bleaching Walnut

Black walnut can be bleached with hydrogen peroxide or prepared bleaches.

In another method, this wood is first coated with a solution of 6 ounces of sodium bisulfite in 1 gallon of water. After the first dries, a second coat consisting of 8 ounces of oxalic acid in 1 gallon of water is applied.

After it is bleached, walnut occasionally has a pink color or pink streaks, which cannot be removed by any amount of bleaching. It may be possible to minimize this difficulty by careful selection of the pieces to be bleached, avoiding any that have a purple cast. One published suggestion is that any pink areas in bleached walnut be sprayed with a weak solution of a green stain of the non-grain-raising type.

Precautions

Washing

Although most of the dried bleaching chemicals and their reaction products probably are removed by the final sanding, or in some cases may not be harmful if left in the wood, it is always preferable, if the production schedule permits, to wash the wood with warm water after the bleaching is completed.

Drying

After bleaching and rinsing, enough time must be allowed for moisture and oxygen to escape from the wood. From 6 to 15 hours of air drying should be sufficient, depending on how heavy a bleaching application was used. Some recommend drying the bleached wood at least 8 hours at 140° F., or air drying 48 hours. Failure to neutralize or remove the residue, or insufficient drying, often results in hundreds of tiny bubbles in the coating applied later, or may even cause blistering of the coating.

Sanding

It usually is necessary to sand the wood lightly after bleaching, washing, and drying, to remove any bleach residue not removed by washing, and to remove raised grain caused by the bleaching. This sanding should be done very lightly, otherwise the thin layer of bleached wood may be cut through in places and unbleached wood brought into view.

Darkening of Bleached Wood

Bleached wood will be gradually darkened by the action of light--even the subdued light indoors-- just as ordinary unbleached wood will, but perhaps less rapidly. Inasmuch as varnishes or other transparent finishes do not exclude light from wood, they will not prevent this darkening. This darkening can be demonstrated by covering half of the surface of a block of wood with black paper (or sawing off half and storing it in a dark place), exposing the wood in a brightly lighted south window for 2 or 3 weeks, then comparing the two halves.

Reports are received occasionally, that portions of the surface of a piece of bleached furniture appear to be returning to the color of unbleached wood. No definite information is available on this, but the layer of bleached wood usually is very thin (Perhaps 1/100 to 1/32 inch in many cases) and it is possible that small amounts of the water-soluble colored substances naturally present in many unbleached woods can diffuse through the thin layer of bleached wood and appear at the surface, particularly when some moisture is present.

Blond Finishes

Blond finishes on maple and other woods may be produced by bleaching, by applying special light-colored finishes that partially conceal the color of the wood, or by a combination of the two processes. Special finishes for the purpose are produced by most of the large industrial finish makers.

Bleached Effect Without Actual Bleaching

A finish lighter in color than the natural color of the wood can be obtained by first applying a white or light-colored paint of very thin consistency, made with opaque pigments of the desired color. A suitable material can be made by mixing enamel undercoater, flat wall paint, or even ordinary house paint with about twice its volume of a mixture of equal parts of boiled linseed oil and turpentine or mineral spirits. Another suitable mixture is wood sealer with enough added color-in-oil or color-in-japan to give the required color and opacity. For a fast-drying material, lacquer enamel may be mixed with twice its volume of a clear lacquer. The coloring material should be spread on the wood surface with a mop, brush, or spray gun, allowed to stand 5 or 10 minutes, and then wiped with clean rags, burlap, or cotton waste to remove excess material and leave only what sinks into the grain of the wood. Lacquer must be wiped immediately after applying, before it has time to harden. In wiping, the first strokes should be across the grain of the wood and the last strokes parallel to the grain of the wood. After the coloring material has had time to dry, further protective finish, such as clear wood sealer, varnish, or lacquer, maybe applied according to the type of finish desired. Further details and variations of such finishes are given in the literature listed at the end of this report.

Oily rags or waste should be burned promptly or kept in tightly closed metal containers until they can be burned, because they take fire easily.

APPENDIX

A. Manufacturers of Hydrogen Peroxide

Among the manufacturer of hydrogen peroxide of the high concentration (30 percent) used in bleaching wood, are the following

J. T. Baker Chemical Company
North Phillipsburg, New Jersey 08865

E. L du Pent de Nemours & Co., Inc.
Du Pont Building
Wilmington, Delaware 19801

Merck & Company, Inc.
1935 Lincoln Avenue
Rahway, New Jersey 07067

B. Manufacturers of Prepared Wood Bleaches

According to Thomas' "Register of American Manufacturers," the following concerns[3] make prepared bleaches for wood:

Amvar Chemical Corporation
1140 N. Branch Street
Chicago, Illinois 60622

Behlen and Brothers, Inc.
10 Christopher Street
New York, New York 10014

Samuel Cabot Inc.
246 Summer Street
Boston, Massachusetts 02210

M. L. Campbell Company
2909 Chrysler Road
Kansas City, Kansas 66115

The Glidden Company
11100 Glidden Avenue
Cleveland, Ohio 44115

Grand Rapids Wood Finishing Co.
61 Grandville Avenue, S.W.
Grand Rapids, Michigan 49502

Guardsman Chemical Coatings, Inc.
Grand Rapids, Michigan 49501

Lawrence-McFadden Company
7430 State Road, Holmesburg
Philadelphia, Pennsylvania 19136

Lilly Industrial Coatings, Inc.
901 W. Union Street
Montebello, California 90640

Maas and Waldstein Company
2121 McCarter Highway
Newark, New Jersey 07104

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[3] The mention of any trade name or proprietary product in this report does not constitute an endorsement of the product by any Government agency.

Mohawk Furniture Fin. Prod., Inc.
Route 30
N. Amsterdam, New York 12010

New Period Lacquer Corporation
109 Imlay Street
Brooklyn, New York 11231

Reliance Universal Inc.
4730 Crittenden Drive
Louisville, Kentucky 40209

The Sherwin-Williams Company
101 Prospect Avenue, N. W.
Cleveland, Ohio 44101

L. R. Van Allen Company
406 N. Wells Street
Chicago, Illinois 60610

BIBLIOGRAPHY

Anonymous

1946. Bleaching hardwood. Furniture Mfr. 61(7): 21. The chief emphasis is on bleaches other than the prepared two-solution commercial bleaches.

1948. Bleaching wood with "Albone" 35 hydrogen peroxide. Peroxygen Prod. Bull. Pp. 9-748. E. I. du Pont de Nemours & Co., Wilmington, Dela. 19801. Five bleaching processes are described, using hydrogen peroxide of 35 percent concentration. Gives many details and safety precautions.

Blackwell, Richard

1947. The use and abuse of wood bleaches. Indus. Finishing 23(7):90-98. The use of commercial two-solution bleaches is described; also, other bleaches that are more convenient but less powerful, such as oxalic acid. Clear or light-colored finishes and their application to wood after bleaching are discussed briefly.

Daly, W. J.

1948. Bleaching wood. Craftsman Press, Seattle, 121 pp., illus.

Hogstrom, Edwin

1946. Bleached finishes. Indus. Finishing 22(4):88-96. Describes the use of two-solution prepared bleaches as well as the production of light-colored finishes without actual bleaching. Details are given for applying " wheat, " "harvest, " and other special types of finish.

Miller, G. H.

1946. Wood bleach and process of making same. U. S. Patent No. 2,397,193. Covers what is essentially a hydrogen peroxide (30 percent) bleach, with the other chemicals being sodium hydroxide, sodium silicate (waterglass), and borax

Pattou, A. B. and Vaughn, C. L.

1944. Furniture, furniture finishing, decoration, and patching. F. J. Drake & Co., Chicago, 551 pp., illus. Bleaching is discussed very briefly. Several light-colored finishes involving little or no actual bleaching are described.