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Selection and Application of Exterior Stains for Wood

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Abstract

Exterior stains for wood protect the wood surface from sunlight and moisture. Because stains are formulated to penetrate the wood surface, they are not prone to crack or peel as can film-forming finishes, such as paints. This publication describes the properties of stains and wood, methods for applying stains, and the expected service life of stains.

Keywords: stain, finish, water repellent, preservative

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Introduction

Many homeowners prefer a wood finish that preserves the natural color of wood, such as the penetrating finishes, as opposed to the nonpenetrating film-forming finishes. Examples of these film-forming finishes are paints and other opaque finishes and latex semitransparent stains. For interior wood, clear film-forming finishes, such as polyurethane and spar varnish, provide a natural look. Wood finished with such products is also easy to keep clean. For exterior wood, however, clear film-forming finishes do not last long because of exposure to direct sunlight. Even if the coating is resistant to sunlight, the clear film permits the sunlight to degrade the wood at the coating–wood interface causing loss of coating adhesion. Under such conditions, clear finishes crack and peel from the wood surface after 1 or 2 years, and the wood requires extensive surface preparation before it can be refinished.

Penetrating finishes provide a way to protect the surface of exterior wood while allowing the characteristics of the wood to show through the finish. Penetrating finishes, which include stains, water repellents, and water-repellent preservatives, can be used outdoors. They do not require extensive preparation of the wood surface because they do not crack and peel from the surface. Penetrating finishes can be clear or pigmented. Clear penetrating finishes can both protect the wood surface from weathering and allow the wood's characteristics to show through the finish. However, such unpigmented finishes have a shorter surface life than do pigmented finishes. Nonpenetrating finishes, such as latex semitransparent stains and latex and oil-based opaque stains, are often useful for situations where penetrating stains are inappropriate.

This publication describes the properties and use of stains on wood exposed outdoors. The discussion includes background information on wood properties and treatment of wood with preservatives. Both oil-based and latex formulations of semitransparent and opaque (solid-color) stains are described.

Wood Properties

Factors affecting stain performance are growth ring orientation; the amount of heartwood, sapwood, and juvenile wood; the durability of the wood; weathering; and moisture.

Growth Rings

Growth rings are most easily seen in a cross-sectional view of a log (Fig. 1). The portion of the growth ring formed during the spring (earlywood or springwood) is less dense than the portion formed during the summer (latewood or summerwood). The most drastic density change occurs at the junction of the latewood of one growing season and the earlywood of the next. The width of the growth layer, the thickness of individual cell walls, and the properties of these cells depend on the species, the weather during the growing season, the site where the tree is growing, and the age of the tree.

Heartwood and Sapwood

In addition to growth rings, another feature seen in the cross section of a log is the apparent difference in color of the central heartwood portion compared with the outer sapwood portion (Fig. 1). Although both heartwood and sapwood provide structural support, they serve different functions with regard to the life processes of the tree. Water and nutrient transport, the life support system of the tree, takes place within the inner bark and sapwood.

The heartwood is not involved in moisture transport. It serves only as structural support and a storage area for many of the organic chemicals produced by the living tree. The species-specific chemicals stored in the heartwood are called extractives. In addition to the anatomical differences in wood, these chemicals give each wood species its other characteristic properties, such as color and natural decay resistance. Although a few species, such as redwood and western redcedar, have a reputation for natural decay resistance, only the heartwood of these species provides durability because of the high concentration of certain extractives.

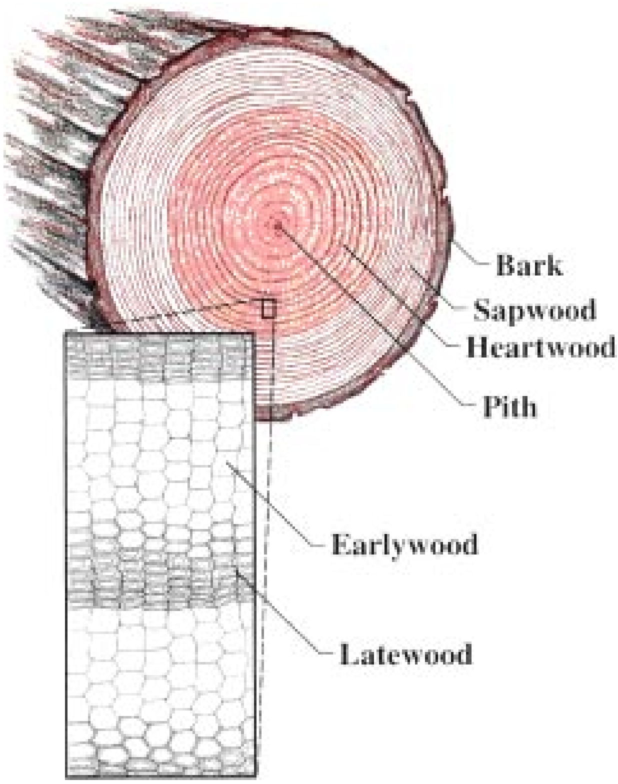

Figure 1—Cross section of a log.

Juvenile Wood

The wood formed during the first few years of a tree's growth (8–10 years for most species) is called juvenile wood. This wood has abnormal properties that may cause large dimensional changes (generally in the longitudinal direction). These dimensional changes can cause severe warping of lumber. While mature wood changes only slightly in longitudinal dimension between its green and dry state (0.05% change), juvenile wood can change 3% to 5%. With dimensional change of this magnitude, fasteners may pull out and the wood may split, bow, twist, cup, or crook.

The pith or center of the tree can most easily be seen on the end grain of a log (Fig. 1). If a particular board contains the pith, it is certain to contain juvenile wood. Wood that contains juvenile wood can warp considerably as it dries because of uneven longitudinal dimensional changes. Warp can be minimized by selecting lumber without the pith.

Durability

Some woods have natural durability (resistance to decay or rot). Others can be made durable through treatment with preservatives. Durable species such as redwood and cedar are commonly used for wood exposed outdoors, such as siding, shakes and shingles, decks, furniture, and fences. Durability is imparted by natural chemicals, which are contained in extractives in the heartwood of these species. Since only the heartwood contains extractives, lumber that contains a high proportion of sapwood does not have the natural durability of lumber that contains a high proportion of heartwood.

Nondurable wood species may be factory-treated with preservative for long-term durability for use in ground contact. These treatments are done in large cylinders, and the preservative chemicals are forced deep into the wood using high pressure. Preservative treatments of wood are done under carefully controlled factory conditions, and the wood usually has a manufacturer's guarantee. Lumber treated with preservatives may also have a quality stamp by an independent inspection agency.

Moisture Effects

Water is one of wood's worst enemies. Whether in the form of vapor or liquid, water can cause shrinking and swelling, which can lead to dimensional changes of the wood and degradation of the finish. Water causes decay or rot of the wood and early failure of the finish, and it accelerates the weathering of wood exposed outdoors.

Shrinking and Swelling

In general, wood shrinks as it loses moisture and swells as it gains moisture. More precisely, wood changes dimension only between an absolutely dry state (completely free of moisture) and its fiber saturation point (the point at which the wood fibers are completely saturated with moisture). For most species, this fiber saturation point typically occurs at about 30% moisture content. At this point, all the water in the wood is bound within the cell wall. At moisture content changes above fiber saturation, the cell cavities take on or lose unbound water but the wood cell walls do not change dimensionally. Below the fiber saturation point, however, the wood changes dimension with changing moisture content. The magnitude of this change is dependent on species and is always different for the three axes (radial, tangential, and longitudinal). A large percentage of wood finish degradation (for example, paint defects, peeling, and cracking) results from moisture changes in the wood and subsequent dimensional instability.

Water Vapor and Water Effects

Shrinking and swelling of wood occur whether the water is in the form of vapor or liquid. For example, wood swells during periods of high humidity and shrinks during periods of low humidity; it also swells and shrinks as it gets wet from liquid water and then dries. If wood is exposed to water vapor, which occurs indoors, the moisture content can reach only the fiber saturation point. This requires exposure to 100% relative humidity for an extended period. Since wood is seldom exposed to this level of relative humidity for long periods, it seldom reaches fiber saturation because of high humidity. However, if the wood gets wet from liquid water, it can quickly reach or even go beyond fiber saturation. Problems with poor performance of wood occur when the moisture content of wood reaches or goes beyond fiber saturation, which is almost always caused by liquid water.

Categories of Wood Finishes

True penetrating wood finishes fall into two general categories: (a) water repellents (WRs) and water-repellent preservatives (WRPs) (Williams and Feist 1999) and (b) solvent-borne oil-based semitransparent stains. The advantage of a penetrating finish compared with a finish that forms a film is that the penetrating finish allows the wood to breathe and the finish does not peel. Water repellents, WRPs, and some stains are formulated so that the solvent carries the binder, preservative (mildewcide), and WR into the wood. Another category of wood finishes is the nonpenetrating stain finishes, which do not penetrate the wood but can be used like paint.

Water Repellents and Water-Repellent Preservatives

Water repellents and WRPs are relatively simple wood treatments that slow the uptake of water and help keep wood dry. The only difference between these finishes is that WRPs include a fungicide or mildewcide. Otherwise, the composition of WRs and WRPs is similar: both contain 10% to 20% binder such as varnish resin or drying oil (linseed or tung oil), a solvent, and a substance that repels water (wax or wax-like chemical). The oil or varnish resin penetrates the wood surface and cures to partially seal the wood surface. The oil or varnish also helps to bind the fungicide–mildewcide and WR to the wood surface. Solvents include organic liquids such as turpentine, naphtha, and mineral spirits or water. The amount of WR varies among brands. Some WRs and WRPs are formulated with a low concentration of WR so that they can be used as a pretreatment for other finishes (about 1% by volume). Others are formulated with a high concentration of WR (about 3% by volume) and are meant to be used as stand-alone finishes.

Water repellents and WRPs are effective when used on wood exposed outdoors above ground. In areas where decay is a serious problem or where wood will be in contact with the ground (wood foundations or fence posts, for example), wood will need far more protection than that afforded by surface treatment with a WR or WRP. In such cases, wood properly protected by treatment with a commercial preservative is recommended. Such pressure-treated wood is normally available at lumber yards and should conform to recognized standards for maximum service life.

Penetrating Stains

If pigments are added to WRP solutions or to similar transparent wood finishes, the mixture is classified as a semi-transparent stain. The pigment provides color and greatly increases the durability of the finish by protecting the wood surface from sunlight. Since semitransparent stains penetrate the wood without forming a continuous layer, they do not blister or peel even if excessive moisture enters the wood. Semitransparent stains permit much of the wood grain to show through; no film is formed unless too many coats are used.

The durability of a stain system is a function of the formulation (amount and type of pigment, resin, preservative, and WR), the surface characteristics of the wood species, the quantity of material applied to the wood surface, and the amount of sunlight to which the finished surface is exposed.

Changes in Stain Formulations

In the 1950s, the USDA Forest Service, Forest Products Laboratory (FPL) developed a natural finish aimed at overcoming the susceptibility of oil-based film-forming finishes to failure through cracking and peeling (Black and others 1979). Research showed that the first application of the FPL natural finish to smoothly planed surfaces that had been fully exposed lasted 2 to 3 years. When the wood was refinished after weathering, the finish lasted much longer. Two coats of the finish on roughsawn or weathered surfaces could last 10 or more years. Semitransparent stains similar to the original FPL natural finish are now being marketed nationwide by hundreds of manufacturers. These formulations are usually based on linseed oil or a modified oil. The oil penetrates the wood extremely well when the finish is formulated with a solvent such as mineral spirits or turpentine (Fig. 2).

Until about 1980, all penetrating stains were oil-based solventborne formulations. These formulations readily penetrate the wood surface and do not form a coating (Fig. 3); therefore, they do not blister and peel, even in excessive moisture conditions. Because stains do not form a coating, the wood does not need to be scraped before refinishing. Thus, the stain is easily maintained on a variety of wood surfaces.

About 1980, manufacturers started to change semitransparent stain formulations because of concerns about solvent evaporating from these finishes. Many solvents react with pollutants in the atmosphere to form ozone, a component of smog. These solvents are collectively known as volatile organic compounds (VOCs). More stringent regulations that will affect paint and stain formulations are currently being developed under the provisions of the New Clean Air Act (1991). Formulations of finishes will continue to change to meet these regulations.

Figure 2—Structure finished with a semitransparent stain.

Figure 3—Western redcedar board. The left half of the board was finished with a solventborne oil-based semitransparent stain; the right half was unfinished.

Changes in stain formulations include decreasing the amount of solvent, resulting in a formulation with a high solids content (high-solids formulations), substituting solvents that do not cause smog, and using waterborne formulations. The penetrating characteristics of low-VOC formulations vary considerably. Many of these reformulated finishes penetrate the wood similar to traditional solventborne formulations, but others tend to form a film.

For high-solids formulations that contain large amounts of natural or synthetic oils, the proper absorption of the finish can be hampered by the sheer volume of oil on the surface of the wood. If the oil is a drying oil, it may dry before absorbing into dense areas, such as wide latewood bands on flat-sawn lumber. The resulting film will appear as shiny areas on the surface. High-solids formulations are still being intensely developed, and improvement in the performance of these products is likely.

There are currently efforts by many stain companies to develop waterborne stains that penetrate wood. These waterborne formulations have been only moderately successful at duplicating the properties of traditional oil-based solventborne stains.

Preparation of Stains

Although directions for making semitransparent stains were published by Black and others (1979), this formulation was possible only because of the availability of pentachlorophenol (penta). This pesticide is no longer available to the consumer. In addition, the mildewcides listed by Black and others (1979) are only available in formulated finishes. Therefore, it is not possible for the consumer to formulate a mildew-resistant semitransparent stain. A wide variety of commercial finishes are available and many of these contain effective mildewcides.

Nonpenetrating Stains

As originally formulated, a stain was synonymous with a penetrating finish. Now, a number of nonpenetrating finishes are marketed as stains. These finishes include latex semitransparent stains and latex and oil-based opaque (solid-color) stains. Because these stains do not penetrate wood as do the solventborne oil-based semitransparent stains, they must be used and applied like paint and other film-forming finishes.

Latex Semitransparent Stains

The appearance of latex semitransparent stains is similar to that of oil-based semitransparent stains, but the latex polymer does not penetrate the wood as does oil. The semitransparent look is achieved by the formation of a thin film. This film is not thick enough to provide durability, and it tends to degrade by flaking from the wood surface.

Latex Opaque Stains

Latex opaque or full-bodied (solid-color) stains are similar to latex semitransparent stains but contain a higher amount of solids (that is, they form a thicker film when applied to the same area per amount of stain). Latex opaque stains do not have the hiding power of a true paint. By the same token, a second application of stain will not hide the original stain. For example, if an opaque stain is applied over wood that is partially unstained and partially stained or painted, these differences may show through the new coating. A second coat of opaque stain will usually eliminate this difference. Latex stains can also show lap marks (but not to the same extent as do solventborne oil-based semitransparent stains) and extractive bleed (particularly with lighter colors). Latex opaque stains have good color retention, are flexible, and are less prone to mildew than are oil-based stains.

Oil-Based Opaque Stains

Oil-based opaque (solid-color) stains are less flexible than latex stains and more prone to crack and flake, particularly if applied as a single coat over flat-grained wood. These stains provide good service life if applied in multiple coats, which build up the film, but they will not give the same appearance as a penetrating stain.

Preservatives

The preservatives used in stains deserve special mention. They should not be confused with the preservatives used for pressure treating wood, such as chromated copper arsenate (CCA). The chemical treatments described here are contained in the finish and are formulated for brush application. They are not available except as formulated in a finish. These chemical treatments can be formulated in WRs, WRPs, or semitransparent stains. Some commonly available preservatives are described in the following list. Some European commercial formulations available in the United States may contain preservatives other than those listed here.

- 3-Iodo-2-propynyl butyl carbamate (commonly called Polyphase) is currently used in several commercial WRP formulations and pigmented stains. It is available in both solvent- and waterborne systems at approximately 0.5% composition by weight.
- 2-(thiocyanomethylthio) benzothiazole (TCMTB) is used alone or in combination with methylene bis (thiocyanate) (MTC or MTB). This preservative can also be effective as a fungicide for WRP and stain formulations. It is available in both solvent- and waterborne systems at ~0.5% concentration by weight.
- Zinc naphthenate is available commercially in WRP formulations and possibly in some new stains, in both solvent- and waterborne formulations. Approximately 2% concentration by weight of zinc metal is recommended.
- Copper-8-quinolinolate is available in commercial WRPs and may be available in stains. This preservative imparts a green–brown color to the wood. Effective concentrations range from 0.25% to 0.675%.
- A mixture of bis (tributyltin) oxide and N-trichloromethylthio phthalimide (the latter also commonly called Folpet) is in a number of commercial stain formulations at 0.5% to 1.0% composition by weight.
- Pentachlorophenol (penta) was used quite extensively in WRP formulations until about 1980. It is no longer readily available to the consumer in the ready-to-use (5% penta) or the concentrated (40% penta) formulation because of its high toxicity and status as a carcinogen. The use of pentachlorophenol is controlled and restricted to registered pesticide applicators.

Two FPL publications on wood finishes regarding the purchase and use of pentachlorophenol are outdated (Black and others 1979, Feist and Mraz 1978). This preservative has been classified by the Environmental Protection Agency as a restricted-use pesticide and is no longer readily available as a preservative for the formulas described in these publications unless the user is licensed to apply pesticides. In addition, pentachlorophenol has been removed from all commercial stain and WRP formulations. All concentrations of pentachlorophenol have been restricted for sale, including the 40% concentrate described in the FPL publications cited here.

Many wood preservatives are being used as substitutes for pentachlorophenol in commercial stain and WRP formulations. However, most of these may be difficult to obtain for mixing into a formulation. These products need to be purchased directly from the manufacturer or from a chemical supply house. Some may be sold only to commercial operators. Registrations of preservatives are under constant review by the Environmental Protection Agency and the U.S. Department of Agriculture. Only preservatives that bear a Federal registration number and carry directions for home and garden use should be used. Because the registration of preservatives is under constant review by State and Federal authorities, a responsible State agency should be consulted as to the current status of the preservative.

Manufacturers' safety and Data Sheets (MSDSs) should be available from paint dealers for WRP solutions and semitransparent stains. These MSDSs should contain information on mildewcides or fungicides contained in these formulations.

Application of Stains

Stains can be applied by brush, pad, roller, or spray equipment. Brushing improves penetration and uniformity of appearance. Be sure to follow the manufacturerr's directions for temperature limitations because stains do not cure properly if the temperature is too low. When staining a house, following the sun around the house and working only in the shade will help to decrease the tendency for lap marks to form. Working on the entire wall while it is in the shade will also prevent uneven penetration caused by variation in surface temperature. The stain may not absorb properly under the eaves or on the north side of buildings (northern hemisphere) where the finish is protected from the weather. Take care to feather the new stain into the old stain under eaves. The north side of the house probably will not need to be stained as often as the other sides.

Oil-Based Semitransparent Stains

The most important difference between solventborne oil-based semitransparent stains and other stains and paints is the ability of the oil-based semitransparent stains to penetrate wood. These stains can be used on new or weathered wood without extensive surface preparation. They can also be used on wood previously finished with other penetrating finishes (WRs and WRPs) after the finished wood has weathered.

They cannot be used on wood that was previously finished with a film-forming finish unless that finish is completely removed.

Solventborne oil-based semitransparent stains are the finish of choice for wood that is fully exposed to the weather (Fig. 4). The finish repels liquid water but allows the wood to breathe (that is, it allows the wood to dry faster after wet or humid weather). Since the stain does not form a film, it cannot peel. It can be used on both smooth and roughsawn wood, but it performs much better on roughsawn wood.

New Wood

On smoothly planed wood surfaces, a single application of semitransparent stain at the rate of 400 to 500 ft^2/gallon (10 to 12 m^2/L) is recommended. A second coat may not penetrate uniformly on smooth surfaces, resulting in glossy and flat areas (Fig. 5). The first coat on a smooth surface may last only 2 to 3 years. However, if the wood is refinished after weathering, the finish may last 8 to 10 years.

When finishing smooth surfaces of high-density species like Douglas Fir and Southern Pine, the surface may be treated with a WRP and allowed to weather for a year before staining. The first coat of stain will then penetrate uniformly and be more durable because weathering makes the surface more absorptive. On surfaces that have been made absorptive by weathering or rough sawing, a gallon of finish should cover 150 to 200 ft^2 (3.5 to 4.5 m^2/L). An effective method is to use wet coats, applying the second coat not more than 1 h after the first. Both coats can then penetrate. If excess stain remains on the surface after an hour, a second coat should not be used. To prevent formation of glossy spots, excess stain remaining on the surface 1 h after application can be removed using rags or brushed to more absorptive adjacent areas. See section on Safety Concerns for caution on handling stain-covered materials like oil-soaked rags. Such materials are a fire hazard.

Refinishing

When refinishing semitransparent stains, the finish should penetrate well into the previously finished surface. If the stain penetrates properly, it will appear flat. If the stain does not penetrate well, it will dry slowly with many glossy areas and probably will not be as durable as it is on new wood. Old varnish and paint films should be completely removed before applying stain. Again, stain that has not penetrated after 1 h should be removed from the surface. For refinishing wood after a previous application of stain has worn away, the stain may penetrate better if thinned with not more than 1 qt of mineral spirits per gallon of stain (≤0.25 L mineral spirits per liter of stain). Follow the manufacturer’s directions.

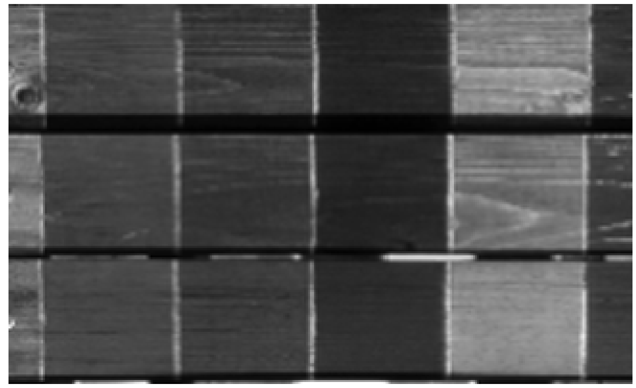

Figure 4—Semitransparent stain after 2 years of exposure near Madison, Wisconsin. From left to right: solventborne modified alkyd stain, waterborne acrylic latex stain, solventborne linseed-oil-based stain, and solventborne tung and linseed-oil-based transparent stain.

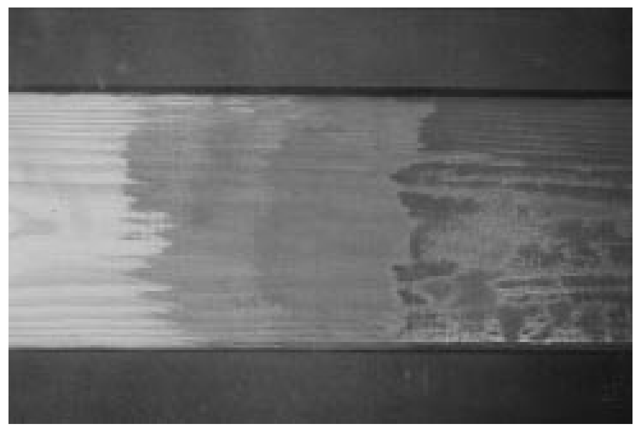

Figure 5—Effect of number of coats on appearance and absorption of finish. Glossy areas (right) were caused by nonabsorption of semitransparent stain resulting from application of too many coats (the two top coats did not absorb).

Specific Considerations

Some oil-based semitransparent stains dry rather slowly; a day of good drying weather is generally required for thorough drying. Lap marks can occur with stains because of their semitransparent nature (Fig. 6). Lap marks are caused by applying the stain over a dry or partially dry area adjacent to the area being finished, resulting in two coats at the juncture of the two areas. To avoid lap marks, the finish should be applied by brushing with the grain of the wood for the full length of the board or course of siding without stopping. The stain should also be stirred frequently during application to maintain uniform suspension of the pigment.

Figure 6—Lap marks on deck finished with a semitransparent stain.

Pollution Prevention

As mentioned previously, many organic solvents interact with other pollutants to form ozone. This is a serious problem in many metropolitan areas. Ozone concentrations peak during the late afternoon of warm and sunny summer days; sunlight catalyzes the reaction. When using finishes that contain these solvents, pollution can be minimized by using the following guidelines:

- Avoid painting on days with an ozone alert.
- Apply solventborne finishes late in the afternoon so that the solvents can dissipate before the next day.
- Limit painting to cloudy and/or cool days.

Advantages

Oil-based semitransparent stains have good color retention and durability on a variety of smooth and rough wood surfaces. They can be applied to all exterior wood. Stains formulated for outdoor use differ from those formulated for indoor use. Stains for outdoor use contain toxic preservatives or mildewcides. Read the label on the original container carefully to determine if the material is allowed and recommended for indoor use. When in doubt, consult the manufacturer to determine which mildewcide was used in the finish and whether it is appropriate for your proposed use.

Latex Semitransparent Stains

Latex semitransparent stains can be used much like solventborne oil-based semitransparent stains, but they do not penetrate the wood surface. As with oil-based stains, more finish can be applied to roughsawn wood, and therefore longer service life is obtained on these surfaces. As with oil-based semitransparent stains, use care to avoid lap marks. Latex stains differ from oil-based stains in their refinishing characteristics; they must be applied to a sound surface.

Refinishing wood that has been finished with a latex semitransparent stain requires substantial surface preparation. If the previous finish has begun to flake or peel or if the wood surface has been degraded through weathering, the surface must be sanded or power washed. If the wood is refinished before the finish begins to flake, a second application of stain will increase the thickness of the film and improve its durability. However, the thicker film will further obscure the original wood. It is better to use a full-bodied opaque stain to provide a film.

Use of latex semitransparent stains should be limited to places relatively protected from the weather, such as siding. It is best if the siding is protected with wide overhangs and if the building does not have high exposed gable-ends.

Latex and Oil-Based Opaque Stains

Nonpenetrating stains can provide excellent service life to wood and wood-based products such as hardboard. However, the wood surface must be carefully prepared if these stains are to be used on weathered wood or over wood previously finished with semitransparent stain. The weathered surface must be removed prior to finishing. Remove by sanding (50–80 grit sandpaper), wet sandblasting, or powerwashing. For best performance, the stain should be applied in multiple coats. Like latex semitransparent stains, both latex and oil-based opaque (solid-color) stains should not be used on structures fully exposed to the weather. Unfinished wood exposed to direct sunlight for longer than 4 weeks may not hold a film-forming finish properly. Opaque stains can be used successfully on smooth and roughsawn siding and composites but should not be used on structures such as decks and fences.

New Wood

As with other film-forming finishes, the coverage of the first coat of opaque stain on smooth wood should be about 400 ft^2 per gallon (10 m^2/L). On roughsawn wood, the coverage should be about 250 ft^2 per gallon (6 m^2/L). Slightly more coverage should be obtained with the second coat. As with other film-forming finishes, the service life of opaque stain depends on the film thickness. Since the thickness on rough wood is considerably greater (less coverage) than that on smooth wood, the service life can be expected to be better. On rough wood, two coats may last 8 to 10 years. On smooth wood, two coats may last only 4 to 5 years. A single coat on smooth wood may last only 2 to 3 years.

If latex stains are used like paint (that is, application of multiple coats to build up a film of 4–6 mil (0.1–0.15 mm)), they provide excellent service life. If multiple coats are used, the first coat can serve as the primer or a high-quality latex primer compatible with the stain can be used for the first coat. As with any latex paint, it is important to follow the manufacturer’s recommendations concerning application, particularly the temperature restrictions. Latex coatings generally require at least 50°F (10°C) for several hours after application to properly coalesce (consult manufacturer’s recommendations).

Since oil-based opaque stains are often formulated with linseed oil, the first coat can absorb into the wood to some extent, particularly if the stain is thinned slightly with mineral spirits. Priming the wood with an oil-based primer will also enhance the performance of the stain. An oil-based primer can be used with either oil-based or latex opaque stains, particularly with light colors where extractive bleed could be a problem. A latex primer can be used only with latex opaque stains. Priming will help eliminate lap marks and decrease extractive bleed. This is especially important with lighter colors of stain. Oil-based stains can be applied at 40°F (5°C) or slightly lower.

Refinishing

Wood finished with an opaque stain can be refinished in the same way as painted wood. The surface must be sound. All loose or flaking stain must be removed, and the surface must be free of dirt. Any areas that have peeled should be sanded and primed; the stain can be used to prime these bare spots. After sanding bare spots, feather the edges of the finish surrounding the peeled area. However, many older finishes contain lead pigments. Sanding wood painted with these finishes without proper protective equipment is a serious health risk. In addition, the residue must be handled as hazardous waste. Contact local authorities concerning regulations for removal and disposal of lead-based paint and for more explcit information on health and safety concerns related to lead-based paint.

Specific Considerations

Like semitransparent stains, opaque stains can show lap marks. To avoid lap marks, use the same techniques used for semitransparent stains. Follow the manufacturer’s recommendations on temperature and length of time between coats.

Advantages

Opaque stains can be used in situations where the appearance of a stain is desired but penetrating stains cannot be used. For example, if a previously applied semitransparent stain has weathered unevenly, it is often difficult to feather the semitransparent stain from the bare (unstained) wood to the stained wood. Opaque stains can be used to cover both areas. As mentioned previously, a second coat is necessary to mask the differences between the stained and unstained areas, or the bare areas need to be primed first. Again, be sure to sand all bare areas to assure good adhesion of the finish.

Removal of Mold and Mildew

Mildew should be removed from wood before it is stained (Fig. 7). Pretreat mildewed wood with a commercial cleaner or a chlorine bleach–water solution prior to refinishing. Allow the wood to dry 1 or 2 days before refinishing.

Proper Disposal of Stain-Covered Materials and Lead-Based Paint

Caution: Solventborne stains usually contain drying oils. As the oils dry, they produce heat, which is sufficient to ignite flammable items like oily rags. This ignition can often occur quickly — even while the rags are left unattended during a lunch break. Dispose of stain-covered materials properly; they are a fire hazard.

Refinishing that requires disturbing, removing, or demolishing portions of a structure that are coated with lead-based paint poses serious problems. The homeowner or contractor should seek information, advice, and perhaps professional assistance for addressing these problems. Contact the Department of Housing and Urban Development (HUD) for the latest information on the removal of lead-based paints. Debris coated with lead-based paint is considered hazardous waste and must be disposed of as such.

Removal of Mildew

Commercially available wood cleaners work quite effectively to remove mildew and other stains on wood. A mildew cleaner can also be made by dissolving 1 part liquid household bleach and some powdered detergent in 2 to 4 parts water.

Suggested formula:

1/3 cup household detergent

1 qt (5%) sodium hypochlorite (liquid household bleach)

3 qt warm water

(1 cup = 0.2 L; 1 qt = 0.9 L)

Caution: Do not use a detergent that contains ammonia; ammonia reacts with chlorine-containing bleach to form a poisonous gas. Many liquid detergents may contain other additives that react with bleach.

Figure 7—Removal of mildew from lumber treated with chromated copper arsenate (CCA): (a) mildew-infected board; (b) mildew removed with a bleach–water solution.

Safety Concerns

Use care when applying stains. The solventborne formulations are volatile, flammable mixtures. Do not breathe their vapors or expose the solutions to flame or sparks. It is wise to wear protective clothing on the hands and arms and to take care that the solution is not splashed in the eyes or on the face. Be especially careful using WRPs because these solutions contain mildewcides, which are toxic.

Store finishes in original containers in a locked space, out of reach of children and pets, and away from foodstuff. Use all finishes selectively and carefully. Follow recommended practices for the disposal of surplus preservatives and preservative containers. Immerse finish-contaminated materials in water, then seal in plastic or an empty can until they can be disposed of properly.

Conclusion

Wood is the material of choice for many structures. As with any building material, how wood is used depends on its properties, such as strength and stiffness, as well as finishing characteristics and maintenance requirements. Problems such as poor finish performance, mildew, checking and splitting, and wood decay can be controlled with proper care and maintenance. Such problems can be avoided or attenuated through knowledge about the factors that affect wood, particularly wood exposed outdoors. If wood structures are given proper care initially and are maintained periodically, they can be functional and structurally sound, as well as aesthetically pleasing, for decades. Natural finishes such as WRPs and semitransparent oil-based stains can greatly improve the durability and appearance of wood exposed outdoors.

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