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WOOD FINISHING: WATER REPELLENTS AND WATER-REPELLENT PRESERVATI--ETC(U)
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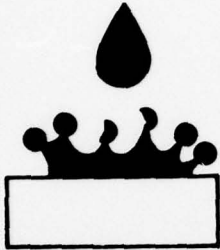
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FOREST PRODUCTS LABORATORY
FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
MADISON, WIS. 53705

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**WOOD FINISHING:
WATER REPELLENTS AND
WATER-REPELLENT
PRESERVATIVES** Revision.



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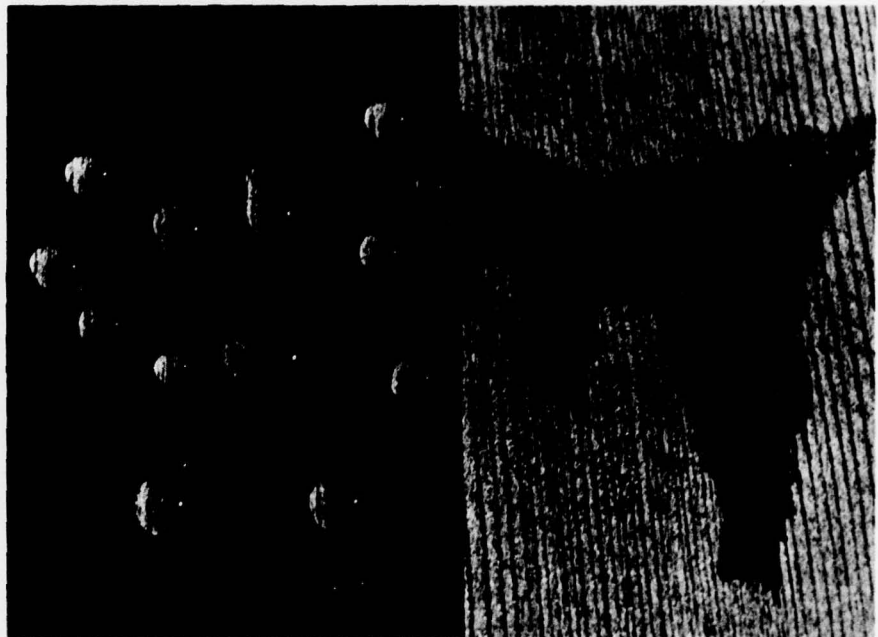


Figure 1.—Closeup view of wood surfaces. Left - Surface brush treated with water repellent resists penetration by liquid water. Right - Untreated wood surface absorbs water quickly.
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1/ Formerly titled "Wood Finishing: Water-Repellent Preservatives."
2/ The Laboratory is maintained at Madison, Wis., in cooperation with the University of Wisconsin.

In many ways, water is one of wood's worst enemies. Water plays a key role in the rapid weathering of wood exposed outdoors, in the performance of exterior finished wood, and in the decay or rotting of wood. Properly seasoned wood that stays dry is not subject to decay, to premature failure of paints and finishes, or to many of the other serious problems associated with weathering.

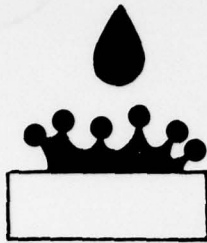
Fortunately, there are some relatively simple wood treatments that can be used to slow down the pickup of water and help keep wood dry. These treatments are called water repellents (WR). When a preservative is added to a WR, it is called a water-repellent preservative (WRP). The composition of these two treating materials is very similar; both contain a substance that repels water (usually paraffin) →

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wax or related material), a resin or drying oil, and a solvent such as turpentine or mineral spirits. Addition of a preservative such as pentachlorophenol or copper naphthenate to a water repellent helps to protect wood surfaces against decay and mildew organisms.

Homeowners can avoid many exterior wood-finishing problems by first treating with a WR or WRP solution to guard against damage to the wood and paint caused by water and by decay and stain fungi (mildew). WR or WRP treatment of wood is recommended both before painting and also as a natural finish for wood. Use of the WRP is recommended in areas where mildew growth is a problem or where decay may occur.

(The WR and WRP treatments are very 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 a surface treatment with a WR or WRP. In such cases, wood properly protected by treatment with a commercial preservative is recommended. Such treated wood is normally available at a lumberyard and should conform to recognized standards for maximum service life.)

A WR or WRP should be applied to all exterior wood that is normally painted. In a new house, lumber treated by the manufacturer (particularly for millwork items such as window frames) should be used, if possible, and all cut ends should be

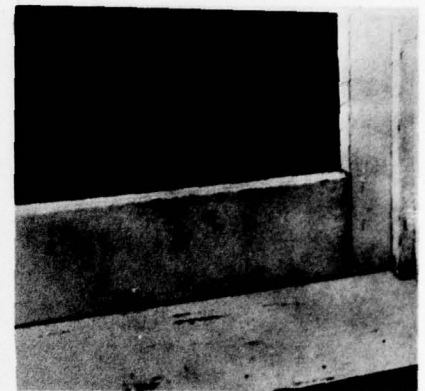
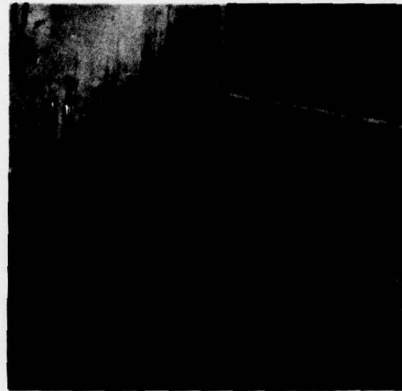


Figure 2.—Experimental window sash and frames after 5 years' rain and weathering. Left - The sash and frame were not treated before painting. Rain that entered the joints caused extensive paint peeling and excessive swelling of the wood. It has also caused cracking of the putty and serious decay in the sash, which must now be replaced. Right - Before painting, the sash was dipped for 3 minutes in WRP. The solution was brushed on the frame. The wood is in good condition, and the paint has weathered normally to the point where repainting is needed.

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treated on the job by brushing or, preferably, dipping. If untreated lumber is used, all exterior surfaces should be treated.

Most WRP's are intended for exterior use because the preservatives in them, particularly pentachlorophenol, are toxic. Users must read the label on the original container carefully to determine if the material is allowed and recommended for indoor use. When in doubt, only a WR should be used, even outdoors, in case toxic chemicals should cause any problems such as contact with people, animals, or plants. The WR's, too, should be allowed and recommended for indoor use. The warning at the end of this publication has further information.

How Does a WR or WRP Work?

A WR or WRP is a solution that gives wood the ability to repel liquid water, such as rain and dew (fig. 1). They do this because they contain a waxlike substance. By repelling water, they resist decay and stain by denying fungi that cause these conditions the moisture they need to live. A WR or WRP also reduces water damage to the wood, such as the excessive swelling and shrinking that leads to cracking and warping. They protect paint from the blistering, cracking, and peeling that often occur when excessive water penetrates the wood. As mentioned earlier, a WRP also contains a fungicide—often pentachloro-

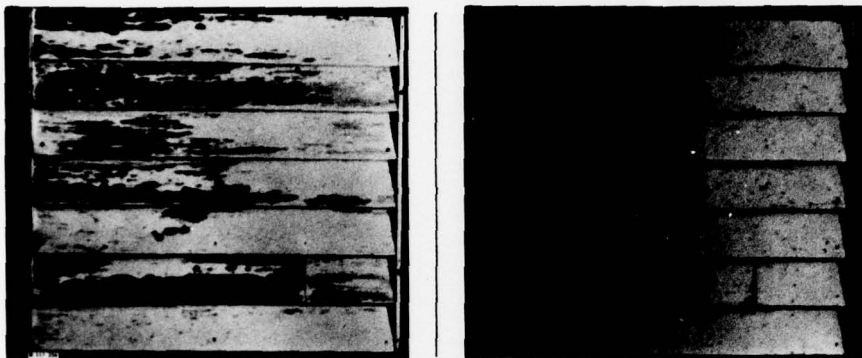


Figure 3.—Experimental panels of bevel siding after 5 years' rain and weathering. Left - The siding was not treated before painting. Rain that entered the butt and lap joints has caused serious paint peeling. Right - Before painting, the siding was dipped for 10 seconds in WRP. The paint has weathered normally to the point where repainting is needed.

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phenol—that kills any surface mildew living on the wood.

There is a further benefit from a WR or WRP treatment of exterior wood species that contain colored water-soluble extractives, such as redwood and western redcedar. When water soaks into these woods through the paint and then dries out again, the colored substances are sometimes left on the paint surface. WR or WRP treatment will help reduce this type of paint discoloration by preventing water-soaking.

The effectiveness of a surface treatment with WR or WRP has been confirmed in outdoor exposure studies conducted at the Forest Products Laboratory and at the USDA Forest Service Southern Forest Experiment Station in New Orleans, La. The differences between WRP-treated and untreated window sash and frames (fig. 2) and bevel siding (fig. 3) are

significant after exposure to severe weather conditions. The treated siding was dipped for 10 seconds, and the treated window sash for 3 minutes in a WRP solution similar to that described at the end of this report. This is the degree of treatment usually given by manufacturers. The treated window frame and sill (fig. 2) were brushed with the WRP solution, an easy treatment for any homeowner or painter. Treating by dipping, however, can be expected to be more thorough and effective than brush application. The units shown in figure 2 are still being tested after 20 years of exposure. Window units treated with a WR (prepared as described at the end of this report) are also in good condition after 20 years' exposure (fig. 4) even though all the original paint has weathered away. Untreated painted window units decayed severely and actually fell off the test fence after only 6 years' exposure (fig. 5).

Applying WR or WRP to Wood

Applying WR or WRP solution to the surface of unfinished wood by brushing or by dipping is an effective treatment for siding and exterior millwork (doors, window sash, door and window frames, sills, moldings, fascia), for wood fencing, and for lawn furniture.

The following steps are suggested for application to new wood:

- (1) If treated siding or millwork is purchased, only freshly cut surfaces need to be brush or dip treated.
- (2) Wood that has not been factory treated can be treated by either brushing or dipping. Dipping is more effective. Care should be taken to treat ends of boards and joints between boards. Open joints should be caulked after treating and priming.
- (3) Freshly treated wood must be allowed to dry. If the treatment is applied with a brush, 2 days of warm favorable drying weather must be allowed before painting. If dipped for 10 seconds or more, 1 week of favorable drying weather is necessary before painting. If enough time is not allowed for most of the solvent to dry from the wood, the paint applied over it may be slow to dry, or may discolor or dry with a rough surface that looks like alligator leather.

When applying WR or WRP to previously painted wood, loose paint must be removed, the WR or

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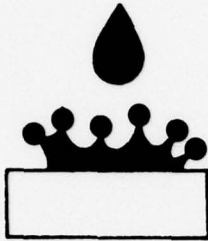


Figure 4.—Closeup view of water-repellent-protected window unit and frame after 20 years' exposure. Firm wood resists penetration by the knife blade. M 145 288-16

WRP should be brushed into the joints only, and excess solution wiped from the paint surfaces with a rag. Two days of favorable warm drying weather must be allowed before repainting.

Whether treatment is to new wood or previously painted wood, particular care should be taken to apply the solution well at the ends of boards, at joints between boards, and to all newly exposed wood such as drill holes. Some homeowners do not realize that water will climb by capillary flow up the back of bevel siding from the lap joints. WR or WRP applied to lap joints of the siding does a good job of preventing capillary flow. Accordingly, places

that should be treated well include the butt and lap joints of horizontal siding, edges and top and bottom ends of vertical siding, and the edges and corner joints in window sash, sills, window frames, doors, and door frames. Often bottoms of doors and window sash are overlooked. These are areas where water can penetrate deeply and cause extensive damage if not treated. Treatment with WR or WRP will eliminate many such problems later.

Using WRP As An Exterior Natural Finish

The color and appearance of weathered wood can be affected, to

a marked degree, by mildew. In most parts of the country, mildew grows on the wood surface and gives it a dark gray, blotchy, and unsightly appearance. In contrast, in very dry climates or in coastal regions where salt atmospheres may inhibit the growth of mildew, weathered wood often has a clean, silvery appearance.

The color of weathered wood is influenced to a lesser degree by highly colored wood extractives in such woods as western redcedar and redwood. These extractives gradually diffuse to the surface and produce a dark-brown color. This color may persist in protected areas not exposed to direct sun and rain. The extractives can be removed by scrubbing with detergent and rinsing.

A clean golden-tan color can be achieved in the weathering of wood by treating the surface to retard the accumulation of wood extractives and mildew. The treatment, originally recommended by the California Redwood Association,^{3/} consists of applying a WRP to the wood surface. This method of finishing also is recommended for other siding species and for natural finishing of exterior plywood, brushed plywood, and low grades of lumber that do not hold paint well. The treatment also reduces warping and cracking and prevents water staining at edges and ends of wood siding. The WR can be used for this purpose, but will not protect against mildew growth and subsequent graying.

^{3/} CRA, San Francisco, Calif.

The first application of the WRP is usually short-lived. When the wood surface starts to show blotchy discoloration caused by extractives and mildew, it should be cleaned by mild scrubbing with a detergent, followed by rinsing with water. Then another liberal brush application of water-repellent preservative solution should be applied.

Frequently, it is necessary to clean and re-treat smoothly planed wood surfaces after the first year of exposure. After cleaning and re-treating, the treatment should last much longer and need be refinished only when the surface starts to show an uneven discoloration pattern or small black spots indicating the start of mildew. The treatment will be more durable on weathered or rough-sawn surfaces because they absorb a greater quantity of solution than does a smooth surface.

Pigments in the form of colors in oil and tinting colors can also be added to the WRP solution to give a desired color effect and improve durability. A quantity of 4 to 6 fluid ounces of color per gallon of solution is usually adequate. Pigmented WRP should be applied to the full length of a course of siding without stopping, to avoid the formation of lap marks. Lap marks would also be minimized by applying two coats, the second coat applied before the first dries. Penetrating pigmented stains such as described in USDA Forest Service Research Note FPL-046 "Forest Products Laboratory Natural Finish," are considered much more durable than the WRP-type finish and can always be applied to wood previously finished with the WRP after the WRP-treated



Figure 5.—Closeup view of decayed untreated window unit frame. Window unit fell apart after 6 years' exposure.

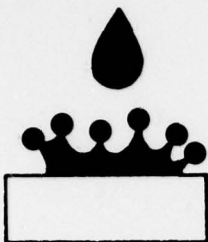
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wood has had 1 year or more of weathering.

When wood weathers naturally, it is important to use nails that are highly resistant to rusting. Iron nails rust rapidly and produce a severe brown or black discoloration around the nail. Stainless steel and aluminum nails are corrosion-resistant and prevent such difficulties.

It is recommended that, for use in climates where mildew growth may be a problem—such as the southeastern part of the United States—WRP's should be

prepared using exterior-grade varnish. Better performance of a WRP for these areas can be achieved by increasing the amount of pentachlorophenol to 2-3/4 cups per gallon.



Typical WR and WRP Solutions

Ingredients

WR and WRP solutions are widely made and distributed commercially and are available in most paint and lumber stores. Formulas for preparing these wood treatments are:

<u>Ingredient</u>	<u>Approximate quantity for 1 gallon of</u>	
	<u>Water repellent (WR)</u>	<u>Water-repellent preservative (WRP)</u>
Pentachlorophenol concentrate		
10:1 (40%) <u>a/</u>	None	1-3/4 cups
Boiled linseed oil <u>b/</u>	1-1/2 cups	1-1/2 cups
Paraffin wax	1 oz	1 oz
Solvent (turpentine, mineral spirits, or paint thinner)	Add to make 1 gal	Add to make 1 gal

a/ Other preservatives used commercially include copper naphthenate, copper-8-quinolinolate, and bis (tri-n-butyltin) oxide. Recent Forest Products Laboratory exposure studies show that pentachlorophenol is a more effective mildewcide than copper naphthenate, which in turn is better than copper-8-quinolinolate or bis (tri-n-butyltin) oxide. In some states, PCP concentrate may be a restricted pesticide and unavailable.

b/ Exterior-grade varnish can be used in place of boiled linseed oil. If so, use twice the volume shown for linseed oil.

Mixing

Melt the paraffin wax in the top unit of a double boiler or some other container heated by hot water.

DON'T USE A DIRECT FLAME OR HEAT NEAR A FLAME SUCH AS THE PILOT LIGHT ON A STOVE—THE PARAFFIN WAX WILL IGNITE.

The solvent should be at room temperature (60° to 80°F) before mixing. While vigorously stirring the solvent, slowly pour in the melted paraffin. After the paraffin wax and solvent are mixed, add—in order—linseed oil or varnish (and penta concentrate if WRP). Stir until the mixture is uniform.

The ingredients may separate if the solution is stored at low or freezing temperatures. If this happens, warm the solution to room temperature and stir to redissolve the ingredients.

Safety First

In mixing and applying WR or WRP, care should always be exercised. The safest place to do the mixing is **outdoors**. The solutions are volatile, flammable mixtures. Don't breathe their vapors or expose them 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 especial-

ly careful using WRP, as these solutions contain toxic materials.

CAUTION: Wood preservatives (a type of pesticide) can be injurious to man, animals, and plants. Therefore, for safe and effective usage, it is essential to follow the directions and heed all precautions on the labels. Some wood preservatives are toxic to humans and animals and may be root poisons and defoliants for plants. It is, therefore, advisable to wear rubber gloves and protective masks (approved for use with pesticides) and to cover nearby plant life when using any material, such as the FPL Natural Finish or a water-repellent preservative, containing preserv-

ative chemicals. The application of preservatives using any spray method can be especially hazardous and extra precautions must be taken. Avoid spraying whenever possible.

DO NOT USE ANY PRESERVATIVES INDOORS UNLESS THEY HAVE BEEN SPECIFICALLY APPROVED AND RECOMMENDED FOR SUCH USE.

Store preservatives in original containers under lock and key—out of reach of children and pets—and away from foodstuff. Use all preservatives selectively and carefully. Follow recommended practices for the disposal of surplus preservatives and preservative containers.

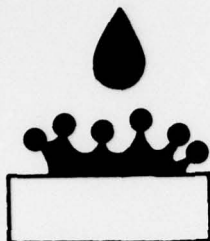
NOTE: Registrations of preservatives are under constant review by the Environmental Protection Agency and the Department of Agriculture. Use only preservatives that bear a Federal registration number and carry directions for home and garden use. Because the registration of preservatives is under constant review by State and Federal authorities, a responsible State agency should be consulted as to the current status of this preservative.

For Further Information

Several Forest Service Research Notes touch on various phases of wood finishing. Single copies of these are available from the Forest Products Laboratory, Forest Service, U.S. Department of Agriculture, Box 5130, Madison, Wis. 53705.

USDA Forest Service Research Notes:

FPL-046 Forest Products Laboratory Natural Finish
FPL-0123 Wood Finishing: Painting Outside Wood Surfaces
FPL-0126 Wood Finishing: Temperature Blistering of House Paints
FPL-0127 Wood Finishing: Intercoat Peeling of House Paints
FPL-0128 Wood Finishing: Mildew on House Paints
FPL-0129 Wood Finishing: Cross-Grain Cracking of Oil-Base House Paints
FPL-0131 Wood Finishing: Discoloration of House Paint by Blue Stain
FPL-0132 Wood Finishing: Discoloration of House Paints by Water-Soluble Extractives in Western Redcedar and Redwood
FPL-0133 Wood Finishing: Finishing Exterior Plywood
FPL-0135 Wood Finishing: Weathering of Wood
FPL-0232 How to Refinish Wood Siding with Latex Paints



RESEARCH NOTE FPL-0124

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The Federal Specification, TT-W-572B (May 28, 1969), "Wood Preservative: Water-Repellent," describes technical specifications and standards requirements for the water-repellent preservative. Single copies of this specification are available free of charge at the U.S. Government General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Auburn, Wash.

