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

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-
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
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, 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.

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

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 145288-16

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.

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Using WRP As An Exterior Natural Finish

The color and appearance of weathered wood can be affected, to
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 refinised 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 WRF-treated 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.

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

M 145288-8
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:

### Approximate quantity for 1 gallon of

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Water repellent (WR)</th>
<th>Water-repellent preservative (WRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pentachlorophenol concentrate 10:1 (40%) [a]</td>
<td>None</td>
<td>1-3/4 cups</td>
</tr>
<tr>
<td>Boiled linseed oil [b]</td>
<td>1-1/2 cups</td>
<td>1-1/2 cups</td>
</tr>
<tr>
<td>Paraffin wax</td>
<td>1 oz</td>
<td>1 oz</td>
</tr>
<tr>
<td>Solvent (turpentine, mineral spirits, or paint thinner)</td>
<td>Add to make</td>
<td>Add to make</td>
</tr>
<tr>
<td></td>
<td>1 gal</td>
<td>1 gal</td>
</tr>
</tbody>
</table>

[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 beat 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 especially 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.

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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
ALTERNATIVES TO PENTACHLOROPHENOL IN THE FPL NATURAL FINISH
AND IN WATER-REPELLENT PRESERVATIVES

The USDA Forest Service Research Notes, FPL-046, “Forest Products Laboratory Natural Finish”, and FPL-0124, “Wood Finishing: Water Repellents and Water-repellent Preservatives”, are out-of-date regarding the purchase and use of the wood preservative, pentachlorophenol (penta). Penta 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 FPL-046 and FPL-0124 unless the user is a licensed pesticide applicator. In addition, penta has been removed from most, if not all, commercial stain and water-repellent preservative (WRP) formulations. All concentrations of penta have been restricted for sale including the 40% concentrate described in the publications.

Many wood preservatives are being used as substitutes for penta in commercial stain and WRP formulations. Most of these, however, may be difficult to obtain for mixing into your own formulation. These products would have to be purchased directly from the manufacturer, or from chemical supply houses. Some may be sold only to commercial operators. Wood preservatives are under regular review by State and Federal authorities; regulations pertaining to their purchase and use have been changing.

While it may be difficult to purchase preservatives to mix your own stain or WRP formulation, the original publications may still be used as guidelines for selecting a commercial product. Check with a paint dealer for WRP solutions and semi-transparent stains that contain a water repellent and a preservative (also referred to as a mildewcide or fungicide). Or, a paint dealer or chemist who is licensed to handle and mix preservatives may be able to prepare a similar formulation for you. Some alternative preservatives are effective at lower concentrations than penta; check to ensure that the proper amount is added to yield the recommended percentage composition (by weight).

Some observations on the chemical systems currently in use or contemplated for use in stains and WRP’s are:

1. A mixture of bis (tributyltin) oxide and N-trichloromethylthio phthalimide, (the latter also commonly called “Folpet”). This combination of chemicals is in a number of commercial stain formulations, at a 0.5 to 1.0% composition by weight.

2. 3-Iodo-2-propynyl butyl carbamate (commonly called “Polyphase”). Now used in several commercial clear and WRP formulations and pigmented stains. Available in both solvent- and water-borne systems. Approximately 0.5% composition by weight is recommended by the manufacturer for best performance.

Forest Products Laboratory
One Gifford Pinchot Drive
Madison, WI 53705-2398

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(OVER)


5. Copper-8-quinolinolate. Available in commercial WRP’s and may be available in stains. Also has a green-brown color. Effective concentrations range from 0.25% to .675%.

6. 2-(Thiocyanomethylthio) benzothiazole (TCMTB), alone or in combination with methylene bis (thiocyanate) (MTC or MTB). Currently in use as anti-sapstain chemical treatments for green lumber. May also be effective as a mildewcide for WRP and stain formulations. Available in both solvent- and water-borne formulations. Concentrations required are 0.5% by weight of each component.

Some European commercial formulations available in the United States may contain preservatives other than those listed above. Other chemicals may be introduced and used in the United States.

**CAUTION:**

The pesticides - wood preservatives, mildewcides, and fungicides - reported on and recommended here were registered for the uses described at the time this publication was prepared. Registrations of pesticides are under constant review by the Environmental Protection Agency. Therefore, consult a responsible State agency on the current status of any of these pesticides. Use only pesticides that bear a Federal registration number and carry directions for home and garden use.

Pesticides used improperly can be injurious to humans, animals, and plants. Follow the directions and heed all precautions on the label. Avoid inhalation of vapors and sprays; wear protective clothing and equipment if specified on the label.

If your hands become contaminated with a pesticide, do not eat, drink, or smoke until you have washed. In case a pesticide is swallowed or gets in the eyes, follow first aid treatment given on the label and get prompt medical attention. If a pesticide gets onto your skin or clothing, remove the clothing immediately and wash skin thoroughly.

Store pesticides and finishes containing pesticides in their original containers out of reach of children and pets, under lock and key. Follow recommended practices for disposal of surplus finishing materials and containers. Scraps of chemically treated wood or finished wood should never be burned, either for heat or for disposal. Toxic fumes may be released.

87-013 -2- September 3, 1987
PARTIAL LIST OF MANUFACTURERS AND DISTRIBUTORS OF WATER REPELLENTS AND
WATER-REPELLENT PRESERVATIVES

Water-Repellent Preservatives--Paintable after drying

Clear Natural Wood Preservative, V401--Hallman Paints, Inc.,
501 South Bird St., Sun Prairie, Wis. 53590

Cuprinol #10--Darworth, Inc., Box K, Tower Lane, Avon, Corn. 06001

Cuprinol #20--Darworth, Inc., Box K, Tower Lane, Avon, Corn. 06001

Marine Woodlife--Roberts Consolidated Industries, 600 North Baldwin Park Blvd., City of Industry, Calif. 91749

Pentaseal--Zehrung Corp., 2201 NW. 20th Ave., Portland, Oreg. 97209

Penta-Tox DP--Baird and McGuire, Inc., Holbrook, Mass. 02343

Penta-Wood-Seal--Samuel Cabot, Inc., 1 Union Street, Boston, Mass. 02108

Penta W.R.--Chapman Chemical Co., Box 9158, Memphis, Term. 38109

PQ-15 R.T.U.--Chapman Chemical Co., Box 9158, Memphis, Term. 38109

Seal-Tox--Forman Ford, Inc., 1200 Mendelssohn Ave., North, Minneapolis, Minn. 55427

Seal-Treat--W. M. Barr Co., Inc., Box 1879, Memphis, Term. 38101

Woodie Penta--Savogram Co., Box 130, Norwood, Mass. 02062

Woodlife and Woodlife II--Roberts Consolidated Industries,
600 North Baldwin Park Blvd., City of Industry, Calif. 91749

Woodtox--Wood Treating Chemicals Dept., Koppers Co., Inc., 5137 Southwest Avenue, St. Louis, Mo. 63110

ZAR, Clear Wood Preservative and Water Repellent--United Gilsonite Laboratories, Box 70, Scranton, Pa. 18501

Water-Repellent Preservatives--Not Paintable Unless Weathered Outdoors (Natural Finish)

Mitrol PQ-675 or Woodguard--Chapman Chemical Co., Box 9158) Memphis,
Tenn. 38109

Moorwood, 08800, Penetrating Clear Wood Finish and Preservative,
Benjamin Moore & Co., Montvale, N-J. 07645

Real-Wood, Exterior Wood Preservative--Star Bronze Co., Box 568,
Alliance, Ohio 44601

(OVER)
Water Repellents--Paintable After Drying

Thompson’s Water Seal--E. A. Thompson Co., Inc., P.O. Box 99037, San Francisco, Calif. 94109

Weldwood Waterproofing Sealer--Roberts Consolidated Industries, 600 North Baldwin Park Blvd., City of Industry, Calif. 91749

Chemstop Wood Waterproofing--Tamms Industries Co., 1222 Ardmore Avenue, Itasca, Ill. 60143

Water Repellents--Not Paintable Unless Weathered Outdoors (Natural Finish)

Aquatrol, and CWF, Clear Wood Finish--The Flood Co., Hudson, Ohio 44236

Weldwood P.A.R. Clear--Roberts Consolidated Industries, 600 North Baldwin Park Blvd., City of Industry, Calif. 91749

Woodlife Clear Wood Finish--Roberts Consolidated Industries, 600 North Baldwin Park Blvd., City of Industry, Calif. 91749

This list is prepared merely for the information of correspondents, and the inclusion of names in it implies no endorsement as to quality and prices. Information as to brands, prices, methods of use, etc., may be obtained upon writing to the manufacturers.

This list is undoubtedly incomplete. Other names will be added to it upon request.

U.S. Department of Agriculture Forest Service Forest Products Laboratory P.O. Box 5130 Madison, Wis. 53705

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