COOPERATIVE EXTENSION SERVICE
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Preservative Treatment of Greenhouse Wood

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Since wood is commonly used in construction of benches, flats, doors, and structural frames for greenhouses, its preservation is highly desirable. Unfortunately, the high-moisture environment of the greenhouse contributes to rapid decay of wood materials. Complete structural deterioration of untreated framing material in as little as 3 years is not uncommon. For this reason, wood used for the structural framework should be either (1) of a resistant species or (2) of a non-resistant species that has been preservative treated. Careful selection of wood can make the life of your greenhouse 5 to 10 times longer, with very little added cost.

Decay-Resistant Wood

Several tree species have a high natural resistance to decay; however, these species are becoming increasingly scarce. Sound heartwood material, which is the most resistant, is quite difficult to obtain. For effective durability, only the most resistant species should be used. Table 1 lists several wood species and their expected life when in contact with the ground (data is for 5- to 6-inch round fence posts). Considerably longer life might be expected for wood that does not contact the ground.

A resistant species such as redwood is often used for greenhouse construction. If it is substituted for Southern yellow pine or Douglas fir, be sure that members are one size larger, because Redwood is a somewhat weaker wood and splits more easily. Other resistant varieties of equal strength can be substituted if their expected life (see Table 1) is acceptable for the needs and investment of the individual.

Preservative-Treated Wood

Since high-grade resistant materials are difficult to obtain in structural sizes, the less durable species of wood are often used. They must be treated with a preservative, however, if reasonable service is to be expected. Treated lumber in many localities will be no more expensive than untreated durable species. (In many cases, cost is less). Depending upon the type of preservative and preserving method, treatment should enable even the least resistant species of lumber to last as long as the most durable untreated lumber. In most cases it will last considerably longer. Wood species also vary in strength; some of the more resistant species are not as strong as the less resistant species commonly treated with preservatives.

Use paint as a surface finish for certain types of preservative-treated wood or resistant species to improve the appearance and light reflection by using light colors. Avoid oil base paints, as they will blister and peel. Use the exterior acrylic and latex paints that allow moisture-vapor “breathing” for more durability.

Types of Preservative

Two basic types of preservatives are oil-borne and water-borne salt-type.

Oil-borne Preservatives: The common oil-borne preservatives are creosote and pentachlorophenol (penta). Although these preservatives are highly durable, commonly available, and reasonably priced, they are poor selections for greenhouse use because they are highly toxic to plant growth. Direct contact with plants is not necessary to produce injury, since fumes from oil-borne treated material can severely damage plants. In addition, these preservatives are harmful to the plasticizer in many film plastics, and direct contact of the plastic on the material can result in premature failure of the film. The oil-borne preservatives are also more difficult to paint and present an added problem in glue construction methods.

Water-borne Salt-type Preservatives: Most water-borne salt-type preservatives are essentially non-toxic. A slight toxicity to young roots coming in direct contact with newly-treated lumber may occur. Consequently, if water-borne preservatives are used for construction of flats, a period of weathering before use is desirable. The relative toxicity of some of the common preservatives is shown in Table 2.

Of the water-borne preservatives, acid copper chromate (Celcure), chromated zinc chloride (CZC), chromated copper arsenate (CCA), and fluor chrome arsenate phenol (FCAP) are the most common. For these materials, a retention rate of the preservative, after treatment and redrying of the lumber, is 0.25 to 0.75 pounds per cubic foot of wood. These retentions can only be achieved by the pressure-treatment method. Since the durability is directly related to the retention rate, other treatment methods are not recommended.

Some of the water-borne salt-type preservatives are subject to leaching and therefore not recommended for ground contact use. The more common types of water-borne preservatives and their minimum standard retention rates for above ground and ground contact use are listed in Table 3.

Application of the Preservative

Pressure Method

Commercial treatment normally utilizes "pressure" methods. Wood is placed in a sealed chamber and the preservative is forced into it by a vacuum-pressure process. By this "pressure" method, high retention rates and deep penetrations are possible. In structural lumber, complete penetrations are normally achieved, and all parts of the material -- even the center -- are preserved. Subsequent checking or cutting does not result in the exposure of untreated material.

Cold Soaking Method

Cold soaking, where lumber is completely immersed in a preservative, is less effective than pressure treatment, due to limited penetration of the preservative. Penetration will be enhanced if the wood is dry and contains a high percentage of sapwood. However, even after soaking for periods of 24 hours or longer, the retention and penetration in 2-inch material will be considerably less than by pressure methods.

Brush Treatment

Brush treatment results in only the very outer layer of wood fibers being treated and is completely ineffective in preserving fibers within the center. Any checking or machining readily exposes untreated material. Although such treatment may be of some limited value, the increased life of the material will be minimal when compared to pressure-treated material.

Retention Rate

Studies have shown that the effectiveness of the treating process is directly related to the amount of preservative held by the wood. Using brush treatment, 2-inch thick materials will retain approximately 12 gallons of penta preservative per thousand board feet; using pressure treatment, retention rate is about 167 gallons. The comparison is equally true for the water-borne salt-type preservatives. This shows the advantage of the pressure treatment method for retention and preservation.

Softwood species are most commonly preservative treated. Hardwood species vary in their absorption of various preservatives and depth of penetration. A treating company can provide specific information on various species and preservatives.

Characteristics of Treated Wood

Expected Life

Many tests have been conducted by the Forest Products Laboratory on stakes and fence posts using various preservatives and treatments. Table 4 shows the effect of pressure treatment compared with soak, dip, and untreated methods using penta.

Table 4 shows that the pressure method gives relatively high retentions and a correspondingly high life. Dipping, which would be equal or superior to brush treatment, gave low retentions and few additional years of service. Similar results have also been obtained with other types of preservatives.

Effect on Greenhouse Use

Though any of the preservatives discussed will effectively retard or eliminate problems of decay, some have adverse properties making them a poor selection for greenhouse uses. For the reasons previously discussed, creosote, penta, or other oil-borne preservatives are not recommended. Of the various water-borne salt-type preservatives that are suitable for greenhouse wood, Table 5 summarizes the characteristics of the more commonly available products.

Treating Plywood

Plywood can also be preservative treated to prolong its life in high moisture conditions. Salt-type preservatives are recommended because they are clean, odorless, and paintable. Many of the same procedures for treating lumber are applicable to plywood. Some slight surface degradation is possible in sanded panels after drying because of surface checking and/or discoloration. Treating firms can give advice and provide the treatments needed.

Gluing Treated Lumber

Studies conducted at the University of Kentucky on gluing treated lumber showed that lumber treated with a water-borne preservative would be a satisfactory choice for glued frames, such as those shown in the Kentucky greenhouse plans. A comparison of glued units using pentachlorophenol and tanalith-treated material to those made with untreated material showed that both types of material could be glued successfully. UK agricultural engineers advise light sanding or wire brushing of the surface to remove surface salt deposits.

Lumber treated with water-borne materials should be redried after treating. Lumber still saturated with treating fluid cannot be glued; it saws with difficulty, and it may warp excessively when it eventually does dry out. Preferably, lumber should be dried in a kiln. In summer weather, if 2 to 4 months are available, lumber can be air-dried. To do this, stack the lumber with sticks between the boards so air can reach all parts.

Summary

Water-borne salt-type preservatives have several advantages for greenhouse use. In addition to possessing a very low toxicity to plants, their effect on plastics is small. They can also be readily painted and glued. For best performance before painting or gluing, remove visible salt deposits on the surface by lightly sanding or wire brushing. Since the life of lumber can be extended as much as 10-fold (25 to 30 years or longer) by pressure treating, such material is highly recommended for all greenhouse use, and particularly for any vital structural components such as roof purlins, rafters, or rigid-frames.

Any added cost due to having wood treated or buying treated wood is relatively small when compared to total building expenses and life-time benefits. Generally, the additional cost is 40 to 80 percent of the basic wood cost which is only 5 to 10 percent of the total house cost. Utilizing preservative treatment is often cheaper than buying the structural grade of redwoods.

Often properly pressure-treated wood is difficult to obtain. Possibly only a very few of the larger lumber suppliers will stock one of the water-borne salt-preservative types. However, if you plan ahead, most lumber dealers can order your material for construction especially for you.The added wood life will be worth the extra cost and effort.

Table 1. Typical life of untreated heartwood in ground contact.

Very resistant (over 15 years average life)		
Black Locust	Osage-Orange	
Resistant (7-15 years average life)		
Red Cedar	White Oak	
Redwood	Cypress	
Slightly resistant (2-7 years average life)		
Ash	Douglas Fir	Red Oak
Beech	Hemlock	Pine
Birch	Larch	Spruce
Cottonwood	Maple	Yellow Poplar

Table 2. Toxicity of preservatives to plants grown in flats

Preservative	Retention lb/cu ft	1st year	2nd year	4th year	Condition of flats 4th year
Penta, 5% in Fuel Oil	.50	Severe	Moderate	None	No decay
Creosote	8.00	Severe	Severe	Light	No decay
Copper Naphthenate, 10% in fuel oil	1.10	Light	Trace	None	Slight decay
Erdalith*	.50	Trace	None	None	No decay
Tanalith*	.50	Light	Trace	None	No decay
Celcure	.75	Light	Trace	None	No decay
Chromated Zinc Chloride (CZC)*	.75	Moderate	Light	None	Slight decay
Untreated pine	--	None	None	None	Not Useable after one year
Cypress heartwood	--	None	None	None	Slight Decay

* Water-borne salt-type preservatives.

Table 3. Minimum standard retention rates for certain water-borne salt-type preservatives

	Minimum retention rate (lb/cu.ft.)	
Water-borne salt-type preservative	**Above ground**	**Ground contact**
Ammonical Copper Arsenite (ACA) "Chemonite"	.25-.30	.45-.50
Chromated Copper Arsenate (CCA)		
Type 1 or A, "Greensalts"	.35-.40	.75
Type II or B, "Osmose K-33 or Boliden Salts"	.25	.42-.45
Fluor Chrome Arsenate Phenol (FCAP)		
Type A or B, "Tanalith, Wolman, and Osmosalts"	.35	Not recommended

Table 4. Effect of treatment method on life of southern pine stakes (2 x 4 x 18 inch nominal) using 5% penta preservative in fuel oil

Treatment method	Average retention lb/cu ft	Condition of stakes after 27 years	Average life, years
Pressure	4.7	Destroyed by decay, fungi, termites	21
	9.6	20% Serviceable, 80% removed	(27+)
18-Hour Soaking	2.4	Destroyed by decay, fungi, termites	12.9
3-Minute Dip	.8	Destroyed by decay, fungi, termites	3.2
Untreated	--	Destroyed by decay, fungi, termites	2.3

Table 5. Some characteristics of preservative treatment for softwoods

Erdalith or Greensalts
Toxic to decay and insects
Paintable, clean, and odorless
Very resistant to leaching
Air dry or kiln dry necessary
Not readily available in most areas

Osmose K-33 or Boliden K-33
Toxic to decay and insects
Paintable, clean, odorless
Very resistant to leaching
Readily available
Air dry or kiln dry necessary before use
Will not bleed through concrete, plaster, or paint

Osmosalts, Tantalith, or Wolman Salts
Toxic to decay and insects
Paintable, clean, and odorless
Somewhat fire retardant
Non-corrosive to metals
Subject to moderate leaching under extreme moisture conditions
Air dry or kiln dry necessary before use
Not generally recommended for below ground use

Chemonite
Toxic to decay and insects
Paintable, clean, and odorless
Very resistant to leaching
Will not bleed through concrete, plaster or paint
Air dry or kiln dry necessary before use
Not readily available in most areas
High cost

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