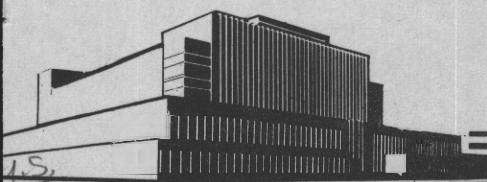
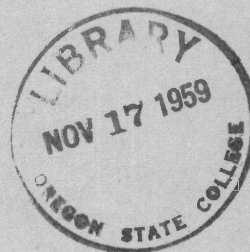


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PRESERVATIVES FOR WOOD PALLETS

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In Cooperation with the University of Wisconsin

PRESERVATIVES FOR WOOD PALLETS¹

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Introduction

In the different fields of pallet use there have been many illustrations to indicate the need for longer service. The Handbook on Wooden Pallet Construction and Usage³ strongly recommends the use of preservative treatment, particularly for pallets to be used outdoors and in cold-storage warehouses, as well as in other situations where the wood is subjected to excessive moisture and to insect attack.

There has been limited interest in the past, as far as preservative treatment for pallets is concerned, possibly because of the extra cost involved in treatment, the necessary interruptions in production schedules, and the lack of appreciation of the benefits of wood preservation. The pallet industry is comparatively new and in some cases its customers are in a position similar to that of the railroads in their early construction stages. The railroads, at that time, were using a readily available and low-cost product for crossties. There was no apparent need for preservative treatment until the cost of early replacement of ties was recognized.

Railroads have learned over the years, however, that the use of untreated ties is poor economy. In 1898, for example, the railroads replaced ties at a rate of 359 per mile. In 1957, after nearly 60 years of preservative treatment, annual tie replacements have dropped to 67 per mile. The labor and material savings resulting from this significant drop in replacements are estimated to total 329 million dollars per year for the class I railroads in the United States. This is daily saving of approximately \$900,000.

¹Based on an address given before the Third Annual Wooden Pallet Promotion Clinic, Madison, Wis., September 23, 1959.

²Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

³Anon. Pallets and Palletization, A Handbook on Wooden Pallet Construction and Usage. National Wooden Pallet Manufacturers Association. 1954. 19 pages, illus.

While pallets of the expendable type do not require preservative treatment, satisfactory service should be expected from pallets used for long-time storage. It is in this field that industry should profit considerably by preservative treatment. While pallets are not expected to remain serviceable as long as crossties, the experience of the railroads should furnish some indication of the value of wood preservation to the pallet industry. Lengthened service life should certainly be considered a strong selling point and a means for meeting competition from wood substitutes.

Reasons for Preservative Treatment of Pallets

The principal reasons for treating pallets for out-of-door and cold-storage uses are:

- (1) Decay protection.
- (2) Cleanliness and sanitation to improve appearance and reduce spoilage of food products.
- (3) Reduction of defects due to moisture changes, mainly weathering, warping, checking, splitting, and nail popping.

For these and other uses, there are sometimes additional reasons for preservative treatment. Pallets used for long-time storage in warehouses, particularly by the military, may be attacked by *Lyctus* (powder-post) beetles, which riddle the sapwood of both partially seasoned and seasoned wood, principally hardwoods that are commonly used in pallets. Storage pallets are also occasionally used under conditions favorable to attack by termites. Moreover, treatment with water-repellent preservatives has been found particularly beneficial in reducing weight pick-up of fruit and vegetable containers due to moisture absorption. This weight pick-up is important to packers who may purchase fruit and vegetables on the basis of weights of loaded bin pallets.

Decay Protection

Deterioration by decay fungi results when untreated wood absorbs and retains moisture in excess of 20 percent. Because of less favorable temperature conditions, wood rots more slowly in the colder areas of the United States than in the southern States and in tropical areas. The sapwood of all species is low in decay resistance, while the heartwood varies considerably from species to species. It is understood that the species most commonly used for pallets are red and white oak, Douglas-fir, birch, beech, maple, elm, ash, hickory, and aspen (popple). The heartwood of white oak and Douglas-fir has moderate resistance to decay, while the heartwood of the other species has low decay resistance.

Experience in field tests in Mississippi⁴ indicates that considerable decay can be expected within a period of approximately 2 years, even with untreated Douglas-fir heartwood exposed to particularly moist conditions. Earlier decay can be expected with the woods of lower decay resistance or when the wood is in contact with the ground. Untreated sweetgum sapwood, for example, shows considerable decay in Mississippi within 8 months. Field tests on stakes⁵ have shown sapwood of untreated southern yellow pine to last approximately 2 years before becoming unserviceable in Mississippi, 1 year in Panama, and 6 years in Wisconsin. On the basis of these and other field tests, considerable decay could be expected in wood pallets in contact with the ground within the period of 3 years, particularly in the warm, moist areas of the southern United States.

Results of tests on various wood preservatives and treatments indicate that brief dip treatments with preservatives recommended by the National Wooden Pallet Manufacturers Association--namely, water repellents containing such preservatives as pentachlorophenol, copper naphthenate, and copper-8-quinolinolate--5 years of service from treated pallets, on an average, would be reasonable to expect. More thorough impregnation applications of preservatives could be expected to provide considerably greater protection.

With this background it is not difficult to show the value of preservative treatment where pallets are to be exposed under conditions favorable to decay. As an example, a bin pallet containing 100 board feet of lumber and produced at a cost of \$10, if used untreated and lasting 3 years, would have an annual cost, including compound interest at 4 percent, of \$3.6030. By dip treating the pallet in a water-repellent preservative, with a treatment cost of \$1.50 and an estimated life of 5 years, the annual cost would be \$2.5829. With a more thorough impregnation treatment costing \$50 per thousand board feet or \$5 for the bin pallet, the total treated cost would be \$15 and it would be necessary only to obtain 5 years of service in order to show the annual cost of \$3.3690, or \$0.2340 less than the annual cost of the untreated pallet. With a 10-year life, the \$15 treated bin pallet would have an annual cost of \$1.8495 or approximately one-half the annual cost of the untreated pallet.

Improved Cleanliness and Sanitation of Wood Surface

Fungi other than those causing decay of wood are responsible for the staining, discoloration, and surface molds on wood. These defects cause pallets to become unsightly; they also contribute to the spoilage of

⁴Verrall, A. F. Preservative Moisture Repellent Treatments for Wood Packing Boxes. Forest Products Journal 9(1), January 1959.

⁵Blew, J. Oscar, Jr. Comparison of Wood Preservatives in Stake Tests. Forest Products Laboratory Report No. 1761.

fruits, vegetables, and other food products that may be held in bin pallets or in contact with flat pallets. These mold and stain fungi develop under moist conditions similar to those required for development of decay fungi. They feed on components of wood as well as on materials absorbed by the wood from fruits, vegetables, or other foods held by the pallets. The preservatives mentioned as effective in the control of decay fungi are also effective in controlling the fungi responsible for staining and surface molds. These preservatives also contribute to the control of bacteria that cause spoilage of foods.

Protection Against Lyctus Beetles and Termites

When damage by Lyctus (powder-post) beetles is noted in pallets or pallet stock, it can be controlled either by exposing the wood to a gas--such as methyl bromide, which is poisonous to beetles--or the wood can be heated in a kiln or in steam. Green wood can be sterilized with steam at 130° F., while dry wood requires a temperature of 180° F. Application of these temperatures for approximately 2 hours is required for 1-inch lumber and a somewhat longer period for thicker material. Fumigation and sterilization, while effective for controlling powder-post beetles in wood, do not provide lasting protection. Such insecticide as chlordane and DDT, and such wood preservatives as pentachlorophenol and copper naphthenate provide more lasting protection against these beetles, as do various wood preservatives discussed later. The value of copper-8-quinolinolate for protection against beetles is not known, but it is understood that an effective insecticide, Dieldrin, can be added to copper-8-quinolinolate when protection is needed against insect attack.

Subterranean termites are responsible for most of the termite damage to wood in the United States and, where pallets require protection from these insects, soil poisons⁶ are useful when applied around the storage area, or the wood should be treated with an effective wood preservative. For termite protection, however, the application of the preservative should be by one of the more thorough impregnation methods rather than by brief dipping, and the preservatives should be applied as recommended in such recognized standards as Federal Specification TT-W-571. The preservatives used should also be those recommended in that specification.⁷

Water Repellency

Effective water-repellent preservatives made it hard for water to wet wood, to spread over surfaces of wood, or to penetrate into the wood

⁶Johnston, H. R. Soil Poisons for Subterranean Termites, Southern Forest Experiment Station Occasional Paper 152, 1956.

⁷U. S. Federal Supply Service. Wood Preservative; Treating Practices, Federal Specification TT-W-571.

structure as free water. They therefore prevent rapid absorption of moisture by wood when it is exposed to rain or dew. They are especially effective in keeping water from penetrating into joints between wood members. Water can enter such joints readily; but, once inside, it cannot evaporate again readily and is therefore largely retained by the wood. On the other hand, water-repellent preservatives, unlike coatings of paint or varnish, are of little value for retarding the absorption of moisture from damp air and do not alter materially the changes in moisture content of wood with changes in relative humidity of the atmosphere. When pallets may be exposed at times to rain, dew, or other contact with liquid water, treatment with water-repellent preservative will minimize dimensional changes, warping, checking, splitting, and loosening of nails.

Field tests on wood field containers for produce⁸ have shown that water repellents effectively prevent moisture pickup by the wood during a rain storm to the following extent:

<u>Item</u>	<u>Weight</u> <u>Pounds</u>
Average weight of wood container -	7.50
Weight of untreated container after rain -	9.7
Weight of container treated with water repellent after rain -	7.7

The tests on treated field boxes⁸ indicated a high degree of water repellency during the first 2 years of outdoor exposure and a moderate level of repellency for an additional 2 years. During the fifth year of test, however, the effectiveness of a water repellent on box weight was negligible.

Seasoning of wood is important for the control of the above-mentioned defects. Treatment with a water-repellent preservative is not a satisfactory substitute for seasoning, and a water-repellent application cannot be expected satisfactorily to control defects that are due to moisture changes if the wood is not adequately seasoned before treatment. For satisfactory results, therefore, seasoning of pallet wood is essential before treatment.

⁸Kurtenacker, R. S., Scheffer, T. C., and Blew, J. O. Condition of Preservative Treated Field Boxes After 5 Years of Outdoor Exposure, Forest Products Laboratory Report No. 2054, April 1956.

Wood preservatives fall into two general classes: oils, such as creosote and pentachlorophenol in oil solutions; and waterborne chemicals that are applied as water solutions. The preservatives recommended in the Handbook on Wooden Pallet Construction and Usage² are of the oil type, in which the preservative is carried in a solution with a petroleum oil product, such as mineral spirits containing a water repellent. Water-repellent preservatives containing copper naphthenate give the wood a green color and a characteristic odor. Those with pentachlorophenol are light to nearly colorless and the odor imparted to the treated wood is slight. Copper-8-quinolinolate also contributes little color and odor and is the preferred preservative where pallets are to hold food products. Creosote and preservatives in the heavier petroleum oils, particularly when applied by impregnation processes, may adversely influence such properties and could not be used for the treatment of wood to be used in close proximity to foods. The oil preservatives, however, generally have high resistance to leaching and therefore are suitable for outdoor exposures, particularly under very wet conditions. Creosote and oil solutions with the heavier, less volatile petroleum oils would have very limited application to the pallet field although for long storage periods under very severe conditions, as for example in the Tropics, pressure treatment of pallets and especially the blocks, bottom deckboards, or other parts of the pallets most subject to decay and insect attack, provide a high degree of protection.

Waterborne preservatives are commonly used in other wood products and occasionally might be worthy of consideration in the treatment of pallets. Waterborne preservatives leave the wood surface comparatively clean, paintable, and free from objectionable odor. They do not have water-repellent features, however, and would therefore be more suitable for pallets used under dry storage conditions or for long-time exposure to continuous moisture in cases where water repellents have limited effectiveness and where preservative oils would be objectionable. The common waterborne preservatives that are recommended in the above mentioned Federal Specifications include the following:

- Acid copper chromate (Celcure)
- Ammoniacal copper arsenite (Chemonite)
- Chromated copper arsenate (Greensalt or Erdalith)
- Chromated zinc arsenate (Boliden salt)
- Chromated zinc chloride
- Copperized chromated zinc chloride
- Fluor-chrome-arsenic-phenol (Tanalith and Osmosar)

²U. S. Forest Products Laboratory Wood Handbook, Agric. Handbook No. 72, U. S. Department of Agriculture. 528 pp., illus. 1955.

The above mentioned waterborne preservatives are generally applied by pressure impregnation under recognized pressure treatment standards. Some of the waterborne preservatives such as zinc chloride, borax-boric acid, and combinations copper-chromium and arsenic compounds have been applied with effective results by diffusion or double diffusion processes. These applications are made on green wood and may therefore be worth considering by pallet producers who wish to treat their own materials.

It should be recognized that the effectiveness of any wood preservative is dependent on the thoroughness of the application and the extent to which the wood is penetrated and the preservative is well distributed. Brief dipping applications, though limited in effectiveness, are no doubt beneficial and well fitted for most pallet requirements. Longer soaking in preservative oils provides much greater protection than brief dipping. Vacuum applications of preservatives are even more effective than long soaking and may be worthy of consideration where pressure impregnation equipment is impracticable. The effectiveness of preservative treatment is also influenced by having the wood properly prepared and seasoned prior to treatment. Except for diffusion applications, the wood should be at a moisture content below 30 percent for best treatment results. It is highly advisable to cut pallet stock to final dimensions before treatment, since cutting after treatment often exposes untreated wood to attack, particularly in the case of treatments by brief dipping. It is also desirable to segregate wood species when treated by the more thorough impregnation process.

Conclusion

Preservative treatment can be used to advantage for numerous pallet uses. There are also various preservatives and methods of application from which the pallet manufacturer and user can select the combination best suited to end-use requirements. Preservative treatment should not be overlooked as an effective means by which the pallet manufacturer can improve his product and make it more serviceable to the user.

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List of publications on
Glue, Glued Products
and Veneer

List of publications on
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