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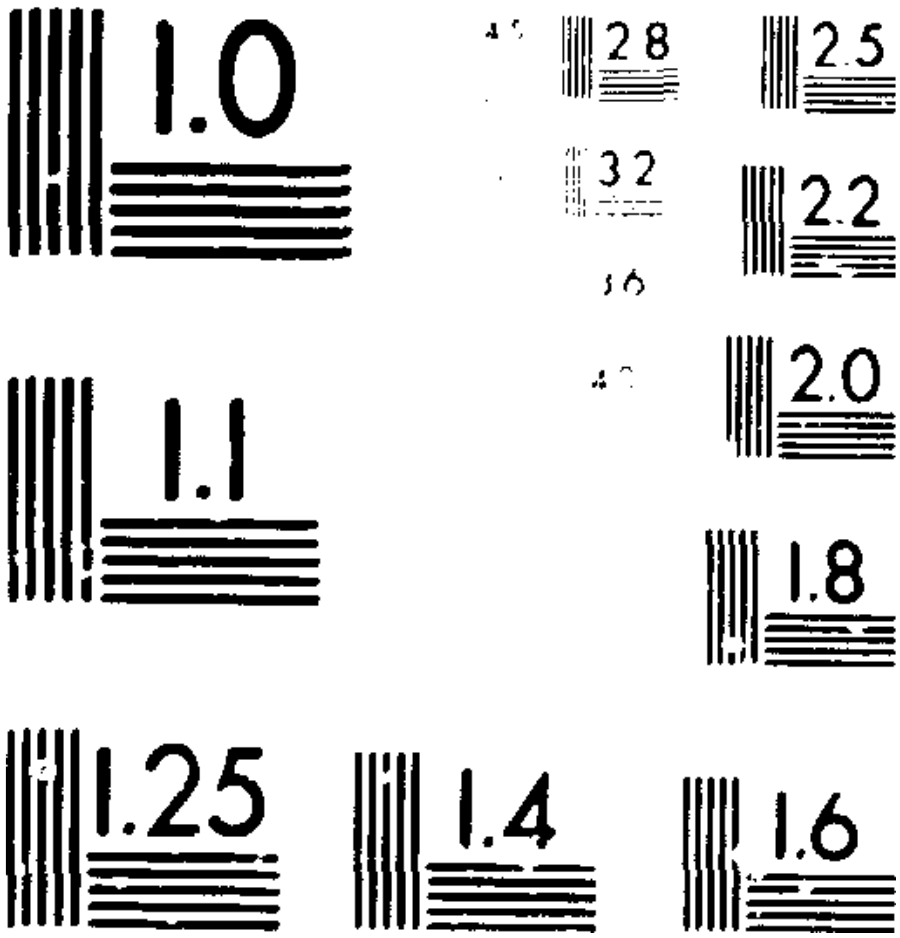

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WOOD PRESERVATION *

by

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INTRODUCTION

Wood preservation, in its widest sense, implies the protection of wood against any factor whatsoever that may damage and ultimately destroy it. No timber is immune to deterioration if exposed to atmospheric conditions. The serviceable life span of an organic matter like wood varies with the species concerned, the age of the wood when green, the natural properties or durability of the wood, the use to which the wood is put and so on. A study of wood preservation should, therefore, cover a very wide field of investigation but most work in recent years has been concentrated on the chemical treatment of wood and wooden products with the object of extending their life and improving their serviceability. Gamma rays too have been used to preserve wood, but this is beyond the scope of this paper.

Wood is not necessarily a rapidly perishable material. In fact, it has lasted for very long periods in Egyptian tombs, in old buildings and excavations of early civilizations. Under certain conditions, even the most durable timber like teak and western red Cedar may not last long if left in a warm, damp and ill-ventilated environment.

The chief causes of the deterioration of wood that is in use, as opposed to deterioration during seasoning, are:

(a) fungal infection;
(b) insects like termites, beetles, marine borers;
(c) mechanical failure; and
(d) fire.

It is in the protection of timber from damage by these agencies that wood preservation finds its main uses. Usually, preservatives are applied to non-durable timbers to make them become more resistant to the agents of deterioration, so that they can replace naturally durable timbers which are becoming more expensive and rarer on the market. It must be emphasized, however, that the mere application of a wood preservative does not necessarily ensure immunity to attack by insects, fungi and marine borers; much depends on the method of application and the type of preservatives used. If the absorption is good, the service life of the timber may be very long, depending on the quality of the preservative and the conditions in which the timber is used. On the other hand, if the preservative is merely brushed on, the period of immunity will be short.

Let us now consider, in turn, the preservation of wood against

(a) fire;

(b) wear or failure;

(c) insect and fungal attacks.

FIRE PROOFING

Wood, no doubt, is highly combustible but non-inflammable. It is true that under certain favourable conditions any wood, even the poorest firewood, may be burnt to ashes but it will not be readily ignited. Thin boards are more readily destroyed by fire than large cross-section timbers. The latter may continue to support a building, even after a prolonged period of fire, because the exposed surfaces become covered with a layer of charcoal that retards combustion. Experience has shown that a building constructed of heavy timbers has a greater fire resistance than many structures of steel. On the one hand, iron and steel expand and buckle at high temperatures, while on the other, bricks and stones chip and crack. Moreover, wood is not a good conductor of heat and may delay the spread of fire by slowing down the transmission of heat from one area to another.

Nevertheless, wood does burn at comparatively low temperatures particularly when it is air-dried. Wood heated to a temperature of about 250°C will decompose producing inflammable gases and charcoal. There are a number of substances that will increase the fire resistance of wood. These substances, generally known as fire retardants, are of two types:

(i) those injected by pressure impregnation; and

(ii) those applied to the surface by brushing and spraying.

Those injected by pressure usually make use of a fire-retardant chemical that under heat, will increase the yield of solid charcoal and water vapour at the expense of inflammable vapours. The latter are produced in insufficient quantities to feed the fire. The best known of these chemicals are monammonium phosphate, boric acid, borax and diammonium phosphate.

Fire retardant paints have a limited value and practical application. They are not as good but still they may help. The following formula for a fire retardant paint has been proposed by the British:

Sodium silicate	50 kgs
Kaolin	70 kgs
Water	50 litres

Such a paint should be applied by two brush coats or by spray to cover about 3 m^2 per litre.

Fire prevention and control methods include the usual precautions against fire, such as the provision in buildings of fire buckets and/or chemical fire extinguishers. In sawmills and cabinet makers' shops, the fire hazard can be greatly reduced by keeping the site as free as possible of sawdust and waste.

WEAR OR FAILURE

Wear or failure can occur in two ways:

(i) mechanical wear;

(ii) weathering.

The most common form of mechanical wear is abrasion caused either by the feet of pedestrians continually passing over a floor, or by the wheels of vehicles passing over bridges, wharves, warehouse floors, etc. A soft timber may be completely worn out. The only practical way to prevent abrasion is to use timber which is sufficiently hard and dense to resist it. Among the local timbers that are good for these conditions are Labourdonnaisia glauca (rare), Mimusops petiolaris (rare), Eucalyptus robusta (fairly common), Terminalia arjuna (fairly common), Acacia eburnea (fairly common). Burma Teak, Malaysian Kempas (Koompassia malaccensis) and the Australian jarrah (Eucalyptus marginata) are the most widely used timbers where hard wearing qualities are required.

The weathering of wood is caused by several factors, but primarily by repeated movements of the surface layers exposed to changing atmospheric conditions. This type of deterioration may be accentuated by fungal attack, the abrasive effect of rain and windblown particles of dust and sand, and also by chemical changes induced by light and a slow form of oxidation. Weathered timber loses its natural colour, and in general assumes a uniform light grey appearance; in timbers showing annual rings the softer summer wood is worn down and the dense spring wood appears as raised ridges. Treatment with suitable preservative or the application of paint or varnish will protect wood against weathering, provided such protective coatings are renewed regularly.

FUNGI AND INSECTS

Wood preservatives are essentially used to increase the resistance of timber against insect attack and fungal infection. Several substances have been used as wood preservatives, some have proved to be very good, whilst others are worthless but none can claim to be excellent in all circumstances. The following are considered:

(i) the properties of preservatives;
(ii) the types of preservatives; and
(iii) the methods of application.

(i) The properties of wood preservatives:

In using wood preservatives, it is important to bear in mind for what use and under what circumstances the wood will be used. A water soluble preservative may be good for indoor use but useless for outdoor work. On the other hand a preservative with a pungent smell may be good for outdoor work but totally undesirable for household use. The qualities demanded of a good wood preservative are that it should be:

(a) highly toxic to fungi and insects;
(b) permanently fixed in the wood;
(c) able to penetrate the wood easily;
(d) easy to apply and not dangerous to those handling it;
(e) not injurious to men and animals once in the wood;
(f) non-corrosive to the wood itself or to metals;
(g) cheap and readily obtainable;
(h) without tendency to increase the inflammability of the wood;
(i) odourless;
(j) colourless and not affecting paints, varnishes, glues, etc.

The first three properties are essential, but the last two are very important for the furniture and joinery industries. Not one preservative has all these properties.

(ii) Types of Wood preservatives:

There are three classes of wood preservatives:

(a) The tar oil group, comprising creosote and many patented or proprietary oil preservatives;

(b) water soluble salts, for example, zinc chloride, sodium fluoride, copper sulphate, mercuric chloride, arsenic salts, etc; and a number of proprietary mixtures; and

(c) solvant-types consisting of a toxic chemical dissolved in oil or spirit or other volatile liquids.

(a) Tar-oil derivatives:

Creosote is probably the best known preservative and is very widely used. It is a very complex substance with over 200 odd constituents, which may possess valuable toxic properties. It is used in exposed conditions in tropical climates where the humidity is high and the rainfall is heavy.

It was widely used formerly in Mauritius to treat sleepers when the railways were still a common mode of transport.

It cannot be used in the furniture and joinery industry because the timber can no longer be painted or varnished as the creosote creeps out. It becomes highly inflammable as well.

(b) Water soluble salts:

The common water soluble salts are zinc, chloride, copper sulphate, etc. Some of these salts are essentially fungicides whereas others are good insecticides. The copper salts are good fungicides and arsenic preparations are good insecticides.

CCA, which is used in Mauritius, is a mixture of copper/chrome/arsenic. If used properly, it protects wood against decay, borers and termites.

CCA can be used both for indoor works and for outdoor and exposed conditions as the preservative is "fixed" by chemical reaction within the cells of the wood and has a high resistance to leaching. It can be used at various concentrations depending on what use the timber will be put to.

CCA treated timber is clean and may be painted, nailed, glued and varnished. Once the preservative is in the wood, it is safe to human beings, animals and plants. It is not oily and it does not increase the fire hazard. Moreover, the wood does not smell and the substance is non-corrosive.

(c) Solvent types:

These preservatives consist of toxic substances soluble in a volatile solvent. They are more expensive than the water-soluble ones. Most

of them are reasonably permanent for both interior and exterior use.

Besides these three types of preservatives there are certain highly volatile substances like hydrogen cyanide which can be used as fumigants. They are highly toxic and can kill insects like pinhole borers that are present in certain pieces of furniture.

PREPARATION OF WOOD BEFORE TREATMENT

Timber must be in a suitable condition for treatment and this depends on species and the preservative to be used. Some treatments are applicable to green timber, but the majority requires more or less seasoned timber to secure good results. As a general rule, the moisture content should be reduced to 25 percent.

The necessity for seasoning is two-fold:

(a) moisture must be removed from the cell cavities of the wood to allow the preservative to penetrate; and

(b) it is preferable for seasoning defects to develop before treatment, since if such defects occur after treatment, unimpregnated areas of wood may be exposed.

During the seasoning period care must be taken to avoid serious seasoning and fungal defects. All bark must be removed as they are impermeable to liquids and they slow down drying. The wood must be worked, that is planed, mortised, etc. before treatment.

METHOD OF TREATMENT

There are five ways of applying wood preservatives:

(i) by brushing;

(ii) by dipping;

(iii) by open tank;

(iv) by pressure processes;

(v) by the Boucherie process; and

(vi) by dip diffusion.

The first three give very superficial treatment and are not very effective. The fifth one is used for green poles. The fourth one, that is the pressure treatment method is the one used in Mauritius. The sixth one can achieve good penetrations but can take a long time.

Brushing:

Brush coating is simple and inexpensive but is generally only effective for a very short time. If ever slight checks open as the brush treated timber seasons or if the coating is accidentally scrapen off in small regions, untreated wood is exposed and the interior may be attacked very rapidly; brush treated sapwood members are commonly seen reduced to a shell by powder post beetles within a few months. The most serious danger is that the coating will not be complete to start with, so much so, that the wood is exposed to rats and insect damage including termites.

The best preservatives for brushing are the high quality creosotes or proprietary brands of this type, but extravagant claims for the efficency of any preservative that is only brush coated must be regarded with suspicion.

Dipping:

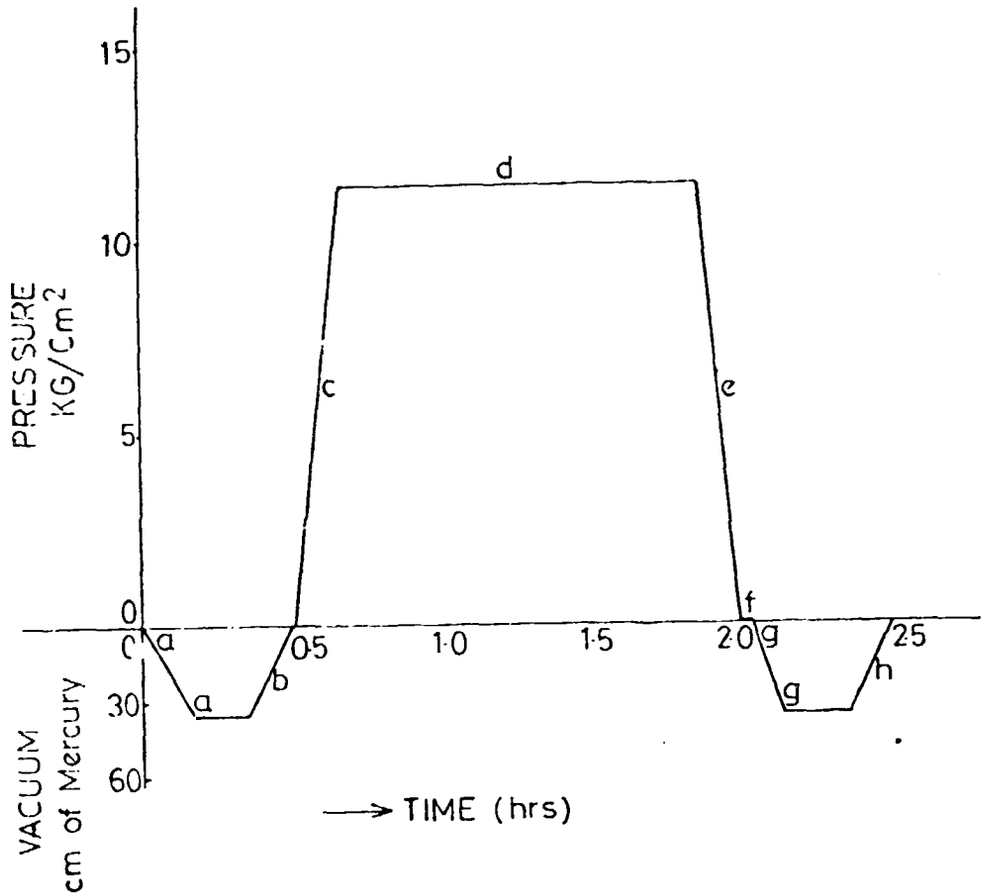
Dipping can be carried out hot or cold. The hot method can only be carried out for those preservatives that can be heated. The dipping tank is filled with hot liquid and the clear timber is immersed in it. Dipping for a short time say up to a quarter of an hour or so, is not more effective than brush coating except in the case of the highly volatile preservatives. This method can only be justified with thoroughly seasoned timber. Dipping may afford quite an appreciable amount of protection to the ends of timber in contact with other timbers, bricks, or concrete as the preservative is more readily absorbed by the section of the timber than on the surfaces. This applies especially to those timbers that can be readily impregnated.

There is no advantage in dipping timbers in the creosote-oil type of preservative for more than three to four hours, but with water-soluble salts absorption by diffusion may go for indefinite periods of time. Hence the process of steeping, which consists in submerging wood in a water solution for a period of several days or even weeks. With this method of treatment, using water soluble salts, the results with green timber are sometimes better than with seasoned timber.

Pressure process:

The main item is a pressure cylinder capable of standing pressure up to 14 kgs per cm^2 or more, and fitted with one door that can be hermetically sealed.

In addition, air and vacuum pumps, hydraulic or centrifugal pumps, mixing tanks and storage tanks must be provided. This process can be varied to suit the type of timber being treated and the amount of absorption required. The method used here is the full cell process,that is a vacuum is applied to the timber before the preservative is admitted to the cylinder. The following graph explains the steps during the treatment.



LEGEND: (a) preliminary vacuum period; (b) fill cylinder with preservatives; (c) build up pressure; (d) maintain pressure level; (e) release pressure; (f) empty cylinder of preservative; (g) final vacuum period - keep emptying cylinder of preservative; (h) release vacuum.

Boucherie process:

The Boucherie process, with modifications, is used exclusively for the impregnation of green poles with water-soluble salts. The poles must be treated within a day or two of being cut and the bark must not be removed. The

preservative is fed through a tube to a water tight cap fixed over one end of the pole, the tank containing the preservative being placed at about two to eight metres above the end of the pole. Under gravity, the solution passes along the wood vessels and permeates the timber; when it drips from the uncovered end of the pole, impregnation is complete.

Dip diffusion:

Some countries are showing great interest in dip diffusion treatments, particularly in remote areas. As soon as the green timber is sawn, it is dipped in a very strong solution of certain chemicals and then stacked without stickers for a long period to allow the salts to diffuse into the water in the wood cells. When sufficient diffusion is judged to have taken place, the timber may be seasoned on stickers in the usual way.

ABSORPTION REQUIRED

The amount of preservative that should be impregnated into a timber depends primarily on the purpose for which it is to be used. The retention normally practiced for CCA preservative is 6 kgs per m^3 for interior work and for furniture and joinery and for exterior off-ground contact 10 kgs per m^3 for exterior and ground fencing poles and very exposed timber. Timbers differ greatly in their amenibility to treatment by any particular impregnation process. Appendix I makes a comparison as poor, moderate and good in the absorption of CCA under pressure for different wood species.

CONCLUSION

As wood is becoming a relatively rare and expensive natural resource, it is best to increase its durability by treating it against decay and insect damage. In so doing, a new value is added to the wood and to the pieces of furniture that are all being manufactured with love and labour.

APPENDIX I

Comparison of the absorption of Tanalith C under pressure by different timber species

Common name	Latin name	Poor	Moderate	Good	Remarks
Araucaria (sapin)	Araucaria cunninghsmii			x	
Badamier	Terminalia catappa		x		
Bois de Natte	Labourdonnaisia glauca	x			Improves the figure
Camphor	Cinnamomum camphora			x	
Cassis	Acacia eburnea	x			
Cedar	Cryptomeria japonica		x		
Cypres	Juniperus bedfordiana			x	Very low concentration in order not to spoil the colour of the wood
Eucalyptus	Eucalyptus tereticornis	x			
Filao	Casuarina equisetifolia			x	
Mahogany	Swietenia mahagoni				Naturally durable
Pine	Pinus elliottii			x	
Tecoma	Tabebuia pallida			x	Same as Juniperus
Gurjun	Dipterocarpus glandiflorus			x	
Imbuia	Phoebe porosa				Naturally durable
Iroko	Chlorophora excelsa				Naturally durable
Kapur	Dryobalanops aromatica				Naturally durable
Kempas	Koompassia malaccensis		x		
Keruing	Dipterocarpus cornutus			x	
Meranti	Shorea spp.	x			
Muninga	Pterocarpus angolensus		x		
Sapelli	Entandrophragma cylindricum				Naturally durable
Teak	Tectona grandis				Naturally durable