Wood Preservation

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Timber in various forms is subjected to biodeterioration. Traditional crafts are mostly affected by wood rotting fungi; and mechanised boats by marine wood boring and fouling organisms. Fishermen resort to various types of indigenous preparations, majority of which are found not giving proper protection as established by CIFT's investigations. Chemical wood preservatives with toxic ingredients, when properly treated can give adequate protection to wooden structures against decaying organisms. Such treatments are generally expected to enhance the life by 3-5 times under marine conditions.

Seasoning of wood to 15-25% moisture content is a prerequisite of preservative treatment. Seasoning is the removal of water or drying to a suitable moisture content warranting equilibrium with, the prevailing atmospheric conditions in service. Seasoning can be done either by air seasoning process of stacking the timber in a clean and dry place under shade or by kiln seasoning - artificially controlling heat, relative humidity and air circulation on timber stacked in chambers called seasoning kilns. Seasoning protects timber against primary decay.

Chemical preservatives are either pure chemical compounds or mixtures of compounds which are toxic to biological agencies.

Chemical preservative treatment is required for:

a) Sapwood of all species of timber
b) heartwood of all non-durable species
c) heartwood of durable species to be used in severe conditions; and
d) all wooden marine structures

A good preservative should have high toxicity to biological agencies, high permanency, high penetrability, not reduce the strength of treated wood and be cheap and easily available.

Timber species vary in their treatability and are graded into five classes based on the degree of resistance offered by the heartwood of the species to the penetration of preservative solutions.

These are:

a) heartwood easily treatable;
b) heartwood treatable, but complete penetration not always obtained;
c) heartwood only partially treatable;
d) heartwood refractory to treatment, and
e) heartwood very refractory to treatment

Wood preservatives:

Chemical preservatives are of the following four types, each consisting of any one of more of the chemicals mentioned against it.

1) **Oil type:** This type comprises various forms of creosote. The most widely used is the coaltar creosote, which is a coal tar distillation product and consists of liquid and solid aromatic hydrocarbons, tar acids and tar bases. Tar acids and tar bases are the toxic compounds and hydrocarbons act as carrier or reservoir for them. Creosote has the advantages of being an indigenous product with high toxicity, relatively high permanence and non-corrosive. Its major disadvantage is that creosoted timber cannot be painted.

2) **Organic solvent type:** Comprise organic or inorganic salts dissolved in suitable organic solvents. Copper napthanate, zinc napthanate, pentachlorophenol, benzene hexachloride etc. come under this group. These are clean to handle, have high permanency and can be painted but some are inflammable.

3) **Water soluble leachable type:** These are organic or inorganic salts soluble in water. Zinc chloride, sodium fluoride, boric acid, sodium pentachorophenate,

benzene hexachloride are examples of this type. These are comparatively inexpensive, easy to transport and odorless but are subjected to leaching.

4) **Water soluble fixed type:** Mixtures of various water soluble salts with the addition of a fixative salt, usually sodium or potassium dichromate. Treated timber should be allowed to dry for 3-6 weeks to complete fixation. Copper-chrome -arsenic compound, copper- chrome- boric compound, acid cupric chromate and chromated zinc chloride come under this type.

All wood working has to be finished before treatment. Timber has to be seasoned to 15% moisture content for non-pressure processes and to 25% moisture content for pressure processes.

Treatment methods:

Treatment methods can be mainly grouped into two: non-pressure processes and pressure processes.

Non-Pressure Processes

Surface application: This is done by brushing or spraying the preservatives on the timber. For oil type preservatives, moisture content in timber shall not be more than 14% and with aqueous solutions 20-30%. Surface treatment has a limited scope as the penetration will be very less.

Immersion: Consists of either dipping or soaking. Dipping is for short duration. Soaking is the immersion of wood in the solution for sufficiently long period until required absorption is obtained.

Hot and cold process or open tank process:

The timber is submerged in the preservative solution which is then heated to 90°C and maintained at the temperature for a suitable period. Then immediately it is cooled until the required absorption is obtained. During heating, the air in the timber expands and is partially expelled, during cooling the residual air in the timber contracts creating partial vacuum which causes the preservative to be sucked into the timber. This treatment also ensures partial sterilization of timber against micro organisms. In the absence of pressure

treatment this is recommended. With CCA type preservatives two separate baths are used to avoid precipitation of chemicals.

Boucherie Process: Treatment of sapwood of all green timbers is possible. The pole is held in an inclined position at 45° angle and to the butt end of it a rubber hose connected to preservative solution is placed at a higher level. Due to hydrostatic pressure, the preservative displaces the sap in the timber which is then forced out at the thin end.

Pressure Processes:

In this type treatment is done by forcing the preservative into the wood by pressure and vacuum applied in a closed cylinder. With this process penetration of even resistant species is to a much greater depth compared to non-pressure processes. There are two main types of pressure processes.

Full-cell or Bethel Process:

Used when the highest volumetric absorption of preservative is desired. Timber charge is introduced into the cylinder, made air tight and applied vacuum upto 56 cm of mercury column maintained for sufficient duration followed by introduction of preservative into the cylinder, application of antiseptic pressure (3.52-12.3 kg/sq.cm) for sufficient time, withdrawal of preservative and a final application of vacuum. Specified retention of toxic can be had by a proper selection of concentration of toxic chemicals, duration of pressure and vacuum periods. Final vacuum free the timber from dripping preservatives.

Empty cell process : aims at maximum penetration of the preservative with minimum net absorption. Two processes, viz. Lowry process and Rueping process are commonly used.

Lowry Process: The process is same as that of the full-cell process except the initial application of vacuum.

Rueping Process: In this case, an initial air pressure of 1.76 to 5.2 kg/sq.cm is applied and maintained during filling of the preservation. The rest of the steps are like full-cell process. This process is very suitable for treating timber of mixed species.

Fortification of creosote with copper or arsenic makes it more toxic and consequently prolongs the efficiency of the preservative. Fortified creosote imparts toxicity of wood against bacteria, fungi and termites and also retards the formation of cracks on the wood due to weathering. CIFT has successfully developed copper creosote and arsenical creosote.

Creoscor developed at CIFT is a high efficiency oil borne wood preservative prepared by heating together heavy creosote oil, copper compound and plant resins. This is used as a second coat over copper creosoted timber. Creoscor protects the craft and also give a smooth surface which reduce frictional resistance to motion of the craft in water.

For structures to be used in high hazard areas treatment of CCA to a retention level of 32 kg/m3 and creosote to 320 kg/m3 is recommended. The dual treatment technique of treating wood with a water borne preservative (CCA) followed by an oil borne preservative (creosote) is very suitable for areas of extreme borer hazard. It also helps to minimise surface cracks and splits on wood. The choice of treatment process and type of preservative depend on treatability class of timber and service conditions.

Good quality timber such as teak and aini are becoming scarce on account of high price and limited availability. There are many less durable species of timber such as mango (*Mangifera indica*), haldu (*Adina cardifolia*) etc. When properly seasoned and treated with preservatives such wood can be good substitutes for teak and aini. The overall requirement of timber for marine use by 2000 AD is over 40 million m^3 and suitable preservative treatment will reduce this to 17 million m^3.