Section V

Timber Wood Infestation and Preservative Treatments
1. Timber Wood Infestation and Preservative Treatments

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**Introduction**

Wood is one of most valuable resources on earth. It is a gift of nature and is the only working material that is self-generating hence wood protection is an economic necessity. Some timbers have excellent resistance to various agents of deterioration and are therefore highly valued for this property - usually summed up as durability. Many others have only moderate resistance or hardly any resistance and it is in these cases, which are very numerous, that wood preservation becomes a necessity.
Use of Timber-Wood in Building Constructions and the other industries

Earlier, the major use of timber was in the construction of bridges, jetties and timber structures as well as for railway sleepers, boats etc. Now a days, the majority timber is been used for constructional activities, inside the buildings/houses i.e. mainly for door-window frames, shutters, furniture and for the industrial use as a packing material etc.

What is Preservation?

Wood preservation means the protection of wood against any factor whatsoever that may damage and ultimately destroy it. Timber preservation refers to the improvement of wood’s natural durability by treatment with chemicals that are toxic to insects, fungi and other decaying agents. Preservative treatment of timber therefore forms a very important part of the national effort to conserve the material resources of the country.

Present day, wood preservation techniques enable us to extend the life span of wood almost indefinitely depending on the preservative and the method used. The efficacy of the preservative treatment depends upon the correct choice of the preservative chemical and the treatment method which ensures the required absorption and penetration of the preservative. A number of chemicals and treatment methods are available which give varying degrees of protection against deterioration from fungal and insect attack.

The primary objective of the preservative treatment of wood is to increase the life of the material in service, thus decreasing the ultimate cost of the product and avoiding the need for frequent replacements.

If we consider the cost of timber used for bridges, jetties and timber structures, the preservation cost constitutes relatively small proportion. At the same time if we consider the different wood articles in daily use, the cost of preservative treatments might be high considering the small scope of work and large cost of overheads.

Protective measures

There are preservative treatments which will prolong the life of inherently non-durable timbers. But in addition to preservative treatment with chemicals, there are
few other measures which can avoid chemical preservative treatments i.e. wood protective measures.

A. Seasoning the timber

Before the use of durable class of timber, the seasoning process also can avoid the chemical preservative treatment but this seasoning process is time consuming and considering the heavy requirement of timber-wood, now a days it is not possible to provide seasoning period.

B. Moisture Content

The moisture content of wood is the amount of water present in it expressed as a percentage of its oven dry weight. This means that a piece of wood which is one-half dry wood fibre and one-half moisture, has a moisture content of 100 percent. Control on moisture content also can be a part of protective measures to avoid chemical preservative treatment.

C. Natural durability

Durability or natural resistance to decay, is extremely variable. Certain kinds of timber are noted for their resistance to fungus attack and are commonly recommended for use where untreated material is to be placed in contact with the ground or in other exposed situations. Some species are considered more or less intermediate in durability while others are readily susceptible to deterioration.

D. Decay hazards

The main causes of timber deterioration are fungi, insects, mechanical failure, fire and weathering.

Fungi: In order to understand the need for timber preservation one must know something about the nature of the fungi responsible for wood decay and the conditions under which they flourish. It is important to realise that fungal decay may be proceeding quite rapidly in timber on which no signs of fungal growth are visible.

Decay Requirements: The conditions necessary for the development of decay producing fungi in wood are

• a suitable substrate or a suitable supply of food
• adequate moisture
- a favourable temperature
- adequate supply of air or oxygen

E. Protection of Timber Wood used for Foundations in Building

The most important need for protection in timber construction arises at the point of ground support. A ground level problem is the probability of attack by subterranean termites. The design must effectively isolate wood from the ground. In the case of a permanent timber structure, it should as far as possible be isolated from the ground. This will most usually be done with a steel shoe, steel plate, steel posts or bars or with a concrete base. Some of the measures taken to establish resistance to penetration by termites in foundation construction in buildings are:

a) by having concrete foundations properly reinforced to prevent large shrinkage or settlement cracks;

b) by capping with a minimum of 100 mm of reinforced concrete on block or brick foundation or piers

c) by having metal shields or caps where appropriate.

The mechanical barriers will prevent subterranean or soil termites from entering the building but they will not prevent attack by free flying pests such as powder post beetles and drywood termites. Infestation by such pests should be prevented either by using naturally resistant timbers or by pre-treating the timber with wood preservative.

F. Contact of wood with soil

The houses built well above the ground is the safest in avoiding most of the decaying problems in wood. Ventilation openings in foundation walls beneath buildings of the above type should provide crawl spaces large enough and so distributed as to prevent dead-air pockets forming. These pockets give rise to humid conditions which favour termite activity and fungus formation.

Embedding wood in concrete near the soil is an invitation to decay. Wood posts resting on concrete floors should be protected from floor moisture by placing them on raised concrete bases or by using treated or naturally durable wood. However use of such material is again a supplement to good construction practices. If a wooden floor is laid on a concrete slab, there should be a damp proof membrane on the slab.
Insects

Several different groups of insects attack timber and without knowledge of the biology of these groups of insects effective measures for protection cannot be undertaken. The insects includes beetles, termites, moths, etc. according to the stage at which they attack the wood - as trees, logs, timber in service, etc.

Nearly all the insects that cause serious damage to timber belong to one or the other of the two orders or classes:

(Coleoptera) - The Beetles and
(Isoptera) - The Termites

From the aspect of wood preservation it is most convenient to consider insects according to the stage at which they attack the wood, however protection against termites presents many special problems as they are able to attack the timber at any stage. In many tropical countries, they cause untold damage to all kinds of timber structures.

The Beetles

Ambrosia beetles

The pin hole borers or Ambrosia beetles are a more serious problem in the tropics than they are in temperate countries. They do not derive any nourishment from the wood itself but feed on certain moulds which grow on the walls of the tunnels which they make in the wood. Since these moulds can grow only in unseasoned timber, it follows that the beetles themselves cannot breed or survive for long in seasoned timber. What is of import any is that neither the adults nor the larvae eat the wood.

Therefore the preservative chemical required to control these beetles should be of a contact poison and not of a stomach type.

Power Post Beetles

These beetles are so named because of the powdery frass caused by the adults boring into the wood. They are capable of attacking comparatively dry timber but the attack is confined to the sapwood because starch appears to be an essential element in their diet. Well air seasoned timber is not attacked by these beetles.

The larvae or grubs of these insects bore through the wood for food and shelter, leaving the undigested parts of the material in the form of a fine powder. When an
infected piece is moved around, this powdery residue falls out of holes made in the wood surface by winged adults as they emerged to spread the infestation.

Carpenter Bees

These are not a very common type of pest in buildings but when they do occur they continue for generations in the same timber and complete destruction may be caused.

The carpenter bees construct tunnels of which partitions with cells are made of wood dust mixed with saliva.

Common Furniture Beetles

This beetle which is called "Anobium punctatum" is normally found in temperate climates. They are small, dark brown beetles which emerge during the summer months and fly quite actively, particularly on warm days. These beetles do not bore again into the wood.

The Death Watch Beetle

These beetles are normally found in temperate climates. It is primarily a pest of timbers in old buildings in which damp has been allowed to reach the woodwork. The tapping sound which the adults make inspring and early summer is probably a mating call.
**Longhorn Beetles**
In most cases these beetles commence their attack on living trees. Eggs are laid in the bark and larvae bore tunnels into wood parallel to the long axis of the tree.
These larvae may persist in the wood after the tree is felled because they are tolerant to dry conditions.

**Termites**
Termites are social insects living in large colonies and they are classed into two main groups –

a) ground dwelling (subterranean) termites and
b) drywood termites and Damp wood termite

**Ground Dwelling Termites**
Ground dwelling or subterranean termites are, by nature, soil inhabiting and enter wood from the ground. They require a constant supply of moisture for their existence and provide access to the soil by the internal workings in the wood or by means of covered surface runaways or shelter tubes. They can severely damage timbers in contact with the ground and may extend attack to the roof timbers of high buildings. To reach such timbers they may travel through cracks in cement or brickwork or build runaways over the surface of various materials. These termites always avoid the light and conceal themselves in the wood or their runaways. The presence of subterranean termites in a building or other structure may not be discovered until the more seriously attacked pieces of wood begin to show definite evidence of failure.

Damage by subterranean species above ground level may be prevented by ensuring that all means of access are eliminated. It should also be noted that ground dwelling termites will die if they are denied access to their underground home. Thus, if these termites have entered a building through outside galleries it is sufficient to break the galleries and prevent their reformation to kill all the termites in the building.
Drywood Termites and Damp Wood termites

Both Drywood and dampwood termites build their nest inside wood. But dampwood termites require moist wood and drywood termites need wood that is dry.

Dry wood termites:

Drywood termites are able to work in wood of fairly low moisture content, consequently may be found in thoroughly seasoned timbers and the woodwork in upper parts of buildings as well as in more moist material. The drywood termite is a much more insidious operator.
Drywood termites are a group of termites that build their nests within moisture-free wood.

Drywood termites are sometimes called powder post beetles or furniture termites due to being found commonly infesting furniture.

Drywood termites live inside wood that has no contact with water. They have this ability to absorb and consume water from the wood that they eat.

**Dampwood termites**

Dampwood termites feed on wood with high moisture content. If any home has damp wood, termites can infest it and build nests. When dampwood termites infest homes, their point of entry is often wood-to-ground contact. Dampwood termites typically infest damp and decaying timber. Dampwood termites do not create shelter tubes like subterranean termites.

The destruction of wood in the sea is mainly due to the activity of marine borers which are widely distributed throughout most parts of the world although more prevalent and destructive in the warm regions rather than the cold ones.

Marine borers are of two types - SHIPWORMS (bivalve molluscus) and GRIBBLE (small crustaceans). Although there are a number of marine fungi which can cause
slow superficial decay of timber, these are of minor importance, except in so far as they pave the way for the borer attack.

**Shipworms**

The shipworms known as Teredo are the most destructive of the marine borers. They start life as tiny free swimming larvae which appear to be attracted to wood on which they soon settle down and begin to bore. The damage they cause is somewhat sporadic and its intensity seems to depend mainly on the temperature of the water. In warm water they can cause surprisingly rapid damage. They cannot live in fresh water but they can survive in blackish water if it is saltish.

**Wood Preservatives**

Wood preservatives are chemical substances which, when initially applied to wood, make it resistant to attack by decaying agents. The protective effect is achieved by making the wood poisonous or repellent to the organisms that would otherwise attack it. Preservatives vary widely in character, cost, effectiveness and suitability for use under different conditions of service.

There is no one ideal preservative suitable for use on every kind of wood in every sort of situation. For any particular purpose the choice is often limited and sometimes there is only one that is wholly suitable for a particular job. The effectiveness of a preservative depends primarily upon its toxicity, or its ability to make the wood poisonous to the organisms that feed upon it or enter it to obtain shelter. In deciding what preservative to apply, thought must be given to any special requirements imposed by the situation in which the treated wood will be used.

For timber to be used in the vicinity of food stuffs the absence of any odour will be essential. Where the fire risk is serious a non-flammable preservative that can be combined with a fire retardant is desirable and so on.

Wood preservatives are commonly classified into four main groups:

a) the oily type  
b) the organic solvent type  
c) the non-fixed water soluble type  
d) the fixed water soluble type
Organic Solvent Type

Solvent type preservatives consist of active chemicals which are toxic to decaying agents, dissolved in an organic solvent such as a petroleum distillate. These organic solvents have low viscosities and are able to penetrate rapidly into dry wood, so that they are particularly suitable for use in preservative formulations that are designed for superficial application by brush, spray and immersion. It should be noted that the preservative action depends solely upon the toxic deposit and the solvent has no preservative action. In India, the use of Dieldrin and other organochlorines such as DDT is banned.

After the ban in use of Aldine/Heptachlor and Chlordane, Chlorpyrifos was the only termiticide approved and recommended for all kinds of termite management (with other termite species).

Now Chlorpyrifos & Bifenthrin are two termiticides currently registered with CIB (Central Insecticide Board) as well as both are recommended by The Indian Standards (IS)

Chlorpyrifos 20% or 50% E.C. (Organophosphate) is proved highly toxic for termites and content contact poison with vapor action.

Bifenthrin 2.5% E.C. (Pyrethroid) is a proved termiticide which claims its environmentally friendly approach and the contact poison and repellent effect.

Advantages of Solvent Type Preservatives:

- They leave the wood in a clean condition.
- They penetrate well into permeable timber.
- They do not leach out.
- Treated timber can be painted and glued soon after the solvent has evaporated.
- They do not cause swelling or distortion of the wood as they do not contain any water.
- They are very useful in remedial treatment of wood in buildings which have been attacked by insects or fungi as they are easily absorbed by most building timbers when applied by brush or spray.

Disadvantages of Solvent Type Preservatives

- Solvent type preservatives are relatively very expensive.
• They increase the flammability of the wood for a short time after the preservative has been applied.
• Certain foodstuffs can become tainted
• It has got contact poison with vapor action, so the rest of application of this termiticide is high in the case of indoor treatment.
• The treatment for the timber which is been used for the food industry or pharmaceutical as well as for any domestic purpose is not recommended and advisable.

For soil treatment water can be used as a base for dilution and for all kinds of timber-wood treatments, Oil based base is required to avoid moisture or direct contact of water with timber wood.

The evaporation of the base is also fast in the case of Oil Based application and the there is less presence of chemical consumption of the surface of treated timber wood.

**Preparation of material**

**Factors Affecting Penetration and Absorption**

The amount of preservative necessary for adequate protection is mainly governed by the end use of the timber. For instance, timber to be used in ground contact would need a higher absorption of the preservative than for a roof timber. However, absorption in itself is not a complete measure of the treatment, as it is important to have a complete and uniform penetration to a depth as deep as possible. Inadequately penetrated wood may be subjected to an early failure as a result of an extension of a check or a split beyond the treated zone. The main factors affecting penetration and absorption are:

a) the anatomy of wood  
b) the treating procedure  
c) the preparation of material

**Wood Preserving Processes**

The objective of wood preservation is to introduce the preservative into the wood so that a deep continuous layer of treated wood contains sufficient preservative to prevent decay and insect attack. Various treatment methods may be used depending on the timber species and the end use. Most of the preserving processes may be
grouped into either pressure processes or non-pressure processes. Non pressure processes are carried out without the use of artificial pressure while pressure processes are in which the wood is placed in a treating cylinder and impregnated with preservative by applying pressure or vacuum and pressure.

**These preservatives are applied by brush, spray, dipping measures.**

**Spraying**
Spraying offers a more liberal and effective covering of the timber than brushing. The possibility of the preservative penetrating into holes, cracks, splits, etc. is more in spraying. This method is often employed when it is required to apply the preservative to large areas and also to roof members with wood worm which enables the preservative to reach the timber which is inaccessible to brushing.

**Immersion or Dipping**
Immersion or dipping involves immersing the timber in the preservative for a short time and the same treatment is known as steeping or soaking when immersion extends to several hours or days. Immersion gives a better chance of the preservative reaching the holes, cracks and splits. The degree of penetration depends on the duration of immersion, the timber species and also on the type of preservative. Absorption is rapid during the first few hours only and it takes a long time to get an appreciable penetration. In any case, it is more expensive than brushing as it requires large tanks and more preservative.

**Hot and Cold Method**
This process is sometimes known as open tank process or thermal process. Next to the pressure treatment this offers a very satisfactory method of impregnation.

In this process seasoned timber is immersed in a bath or preservative which is heated for few hours and allowed to cool while the timber is still submerged in the liquid. Sometimes the cooling is done by transferring quickly the timber from the hot bath to a cool bath of the preservative. During the heating period the air in the cells expands and much of it is expelled as bubbles. During the cooling period the remaining air in the cells contracts creating a vacuum and the preservative is drawn into the wood. Therefore, practically whole of the absorption takes place during the cooling period.
Remedial Treatments

Remedial treatment for termite control is of two types: removal of living termites and the other treatment of timber as well as the removal of living termites and inhibiting termite activity.

Fumigation: One way of removing the living termites is fumigation. The method is to cover the building to be fumigated with special tarpaulins or other suitable material such as PVC coated nylon which is impervious to the passage of the fumigants. All seals are made with the cover properly secured to the base with sand bags or other convenient method. The fumigants normally used methyl bromide. It is released from a cylinder through tubes which are connected to a number of points in the building. In order to disperse the gas uniformly inside the building, a blower or an electric fan is used. If fumigation is not possible, the infested timber should be removed and replaced by treated material and the rest of the woodwork can be brushed or sprayed at frequent intervals with an insecticide such as Chloropyrifos or Bifenthrin.

This activity is restricted in India only for authorized license holder fumigators. There is separate license issued by the central government authority (department of agriculture). The fumigation activity is a risky method of preservation and required skill operators with all the safety precautions.

Desiccant Dusts

Desiccant dusts are normally applied to all surfaces of building structures as a uniform film of the dust. These dusts to be effective, must remain on the surface of the timber and must not be absorbed by it. Termites in their galleries are not affected by the dust but as the larvae leave the timber they are destroyed by the dust.

The desiccant dusts are used in buildings which are under construction as well as to prevent reinfestation by drywood termites after a building has been fumigated.

Soil Treatment

Ground Dwelling Termites In the case of ground dwelling termites, it is necessary to find out where the termites are entering into the building or the structure in question. The link between the origin of the termites and the building should be removed and if possible a barrier either mechanical or chemical or both should be inserted.
Slab on Ground Construction
The soil around the perimeter of the building should be poisoned, taking care to ensure not to affect the foundation. A trench about 300 mm is dug around the perimeter of the building and the preservative is sprayed at the rate of six litres per metre run.

Environmental Health and Safety Aspects

Hazards from Preservatives: Hazards from preservative chemicals depend mainly on their toxicity to human beings. In addition it depends on their form (solid or liquid), method of packing and storing and the way they are diluted and applied to wood. There are three ways these chemicals can enter the body, these are inhaling, swallowing or from contact with the skin.

Inhaling when breathing, toxic chemicals in the form of vapour or dust, can pass through the nose or mouth in to the eyes. This could happen in different ways, some of which are: dusts from powdered chemicals, vapours from organic solvents and oils mists from spraying equipment.

Swallowing
Traces of preservative chemicals can pass into the stomach through contamination of food, water or other liquids. This could happen by not washing the hands and face properly after coming into contact with chemicals or eating food on which invisible chemical dust has been deposited. Contact with Skin (Preservative chemicals can enter the body through the skin especially if the skin is damaged, needless to mention that the eyes are the most sensitive.

Protective Measures
Ensure that the hazards from preservative chemicals are well understood. Display precautionary notices stating the hazards and correct procedures. Display precautionary wording on labels of containers and packages. Wear suitable protective clothing, follow the recommended code of hygiene especially go through the instructions given by the manufacturers.

Store preservatives in the correct manner:
Do not allow unauthorized persons to get into the treatment area or chemical stores. Ensure First Aid help is always available.
Training to the staff and the operators:
Do not remove the treated timber from the treatment area until the preservative has stopped dripping. Do not enter the treatment area without changing into safety clothes.

Clean thoroughly the used drums and rinse them with water before they leave the treatment site. These drums should not be used for any other purpose. Even if it is sold for scrap metal, they should be very well cleaned before disposing.

Use impervious rubber or plastic coated gloves:
Wherever necessary use face masks, goggles, head and footgear.
Rubber gloves (heavy Duty), Face screen, Respirator, Protective mask, Protective clothing, Gauntlets, coated. P.V.C. heavy Safety helmet, Cup goggle, Rubber knee boot

Treatment operator:
Use suitable impervious aprons or clothing. They should be made of impermeable material such as plastic. Nylon overalls are neither sufficiently impermeable nor sufficiently absorbent to offer any worthwhile protection. Change working clothes after work and launder clothing regularly.

Supply washing facilities
Washing facilities like hot and cold water and soap shall be provided for frequently wash hands and face.

Keep the work area clean.

Use wet wash down techniques during close down periods.

Do not eat or drink in the work area.

Pollution
Pollution can occur from three sources, namely wood preservatives, preservation process and the treated timber. However, pollution mainly occurs from preservative chemicals and preservation processes and rarely from the treated timber. In most cases the pollution problem originates from the preservative chemicals themselves. The extent of pollution differs widely with the type of preservative and the treatment process employed. The disposal of waste from treatment requires much care. CCA
Preservative solutions are toxic and should never be released into streams or canals. CCA treated timber should not be burned and especially it should never be used for cooking or in a barbecue.

**Treatment Area**

It should have sufficient area for seasoning, storing and for housing the machinery for timber for treatment in addition to the preservative treatment operation itself.

Design of treatment area is not difficult as long as the treating is done in a permanent place. In designing a treatment area, the following should be considered:

- It should be well drained and fairly level. All surface water in the area including rainwater should be made to flow into a tank and collected. The size of the tank should be designed to cater adequately for excessive rainfall. Waste water should not be allowed to go astray.

- Store room for the chemicals should be sited so that accident spillages will not pollute the environment and designed in such a way that the spillages should be able to be recovered for reuse. Posters giving details of safety precautions and First Aid should be displayed. These details are normally available with the manufacturer of the preservative chemicals.

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**Total no. of diagrams, figures and tables in this chapter:**

- Chart: 0 nos., Diagram: 0 nos., Figures: 4 nos. Tables: 0 nos.