Building materials II

Lecture 7

Preservation of Timber

Now **from what do we have to preserve timber**?:- We have to preserve timber from fungi which causes decay, insects which causes diseases and weathering or atmospheric factors.

Now we saw why to preserve timber, from what to preserve timber, now **how to preserve timber?:-** to preserve timber there are two important types to preserve timber. First is the **physical protection and second is the chemical protection**. Now what happens in the **physical protection** is for example if this is the timber log the protective coating forms a physical barrier round the timber. So this physical barrier stops the fungus, or insects or atmosphere from attacking the timber. And thus the timber is protected and preserved.

Now the second type is creating **chemical protection**:- In chemical protection what happens is , protective coating goes inside the timber portion and the timber piece and makes the timber piece toxic to fungus or insects. So the fungus or insects don't attack the timber, the timber becomes poisonous for them.

Did you know that **hardwood is more resistant to decay than softwood** ? This is majorly because **hardwood is more dense than softwood which makes it more stronger also and it also attracts fungus and insects lesser than softwood**. Because these insects and fungus majorly look for sap or majorly look for moisture in the food that is their food. So hardwood since it is more dense contains lesser sap when properly seasoned so there is lesser of food for fungus and insects. So it is better protected from insects. So it is better protected from decay.

Now **Preservation of timber:-** This whole process or the whole idea of preservation can be explained in two different components. One is the **preservatives that is used for preservation** and second how to apply the preservatives. Now when you talk of preservatives the most commonly used **preservatives for timber are tar oil and then there are many water based preservatives and solvent based preservatives.**

And when it comes to **application of preservatives,** these methods are most widely used- **brushing, spraying, dipping and pressure treatment.**

Now lets look into **the different preservatives**. **Tar oil:-** Tar oil is the **most widely used preservative** for timber. It is normally **a dark liquid**. Now since it is a dark liquid it will change the colour of the timber also. If you are using the tar oil on a lighter timber piece, after application of the tar oil the timber will look darker in shade. That Is considered as a visually or aesthetically considered as a disadvantage unless you require a darker piece of wood. Now **tar oil is made from coal tar mixed with chemicals. The timber preserved with tar oil is suitable for outdoor use. Tar oil has a black or brownish tint. The most commonly used or**

the best example for tar oil is creosote. Tar oil can be applied by brushing, spraying, dipping or pressure treatment on the wood.

Now what are the **advantages of using Tar oil**:- Tar oil is **highly toxic to fungi and insects**. Now tar oil comes in the category of creating a physical protection for the timber. It does not make the timber poisonous, but itself is **poisonous**. So it creates a physical barrier between the timber and the attacking forces like fungi and insects. Also tar oil has a high degree of penetration. Tar oil is also **long lasting and more durable** and is also **easily available and not that expensive**.

Disadvantages of tar oil are:- It has a **very strong pungent smell**. It is also **toxic to plants**. So if you are using this timber with plant species or like in a fence or in a garden then it will be toxic to the plants there as well. And usually once you apply the tar oil **its difficult to paint over it again**. Now all preservatives are judged by how much they penetrate into the timber pieces. Because the more the penetration the better the protection, the better the preservation and conservation of the timber. So when you see that tar oil like I said earlier has a very high degree of penetration compared to the other types of preservatives.

Now lets see **Water based preservatives** and what is it ,what are its advantages and disadvantages?:- So **water based preservatives are made from a mixture of toxic salts which could be copper or zinc and obviously the base is or the binder of the preservative is water**. Zinc chloride is also more widely used, zinc chloride salt is more widely used. When this preservative is applied to wood, the water evaporates leaving the toxic salt, a thin film of the toxic salt on the timber piece to act as preservatives. Usually water based preservatives are don't easily penetrate into the timber pieces so it is preferred to pressure impregnate them into the timber pieces. Unlike tar oil, water based preservatives are create a chemical protection. Tar oil creates a physical protection while water based preservatives create a chemical protection meaning it makes the wood toxic. Water based preservatives are majorly used in structural timber and also furniture.

Advantages are :- its clean, odorless unlike tar oil which has a pungent smell it is very odorless, colourless, it can be painted over and over again once the preservative film peels off or fades away you can paint over it again.

The **Disadvantages of water based preservatives** is that – Timber needs to be dried out by kiln after treatment and this can cause swelling, because timber has a very high capacity to absorb moisture. So because of the water base it can absorb the water from the timber and swell. Salts can be washed out from the wood. So like during the course of time these preservatives can be washed out the salt that creates the film on top can be washed out and then it needs to be re-painted again and again.

The preservative **solvent based preservative**:- These solvent based preservatives are made from toxic chemicals dissolved in a liquid other than water. Usually these solvents the carriers of these

chemicals are white spirits. After treatment the solvent evaporates leaving the preservative in the wood. This can be applied with a brush or with a spray gun. It has better impregnation than water based preservative but lesser than tar oil. Majorly these kinds of preservatives are used in furniture and external wood work.

Advantages of using a solvent based preservative is that it is resistant to leaching. It can be painted over and over and it can be used indoors. It is not very toxic, it can be used indoors.

Disadvantages it is again it has a very strong smell like tar oil. It has a very strong smell. Certain solvent can be of a fire hazard and when you compare solvent based preservatives to water based preservatives, solvent based preservatives are more on the expensive side.

Now we saw 3 types of preservatives- tar oil , solvent based and water based preservatives, when we **compare each** , in tar oil , tar oil is the only preservative that forms the barrier. It forms a physical barrier, while what happens in water based and solvent based is the water or the solvent dries off after you apply. But the chemicals in solvent based and the salts that the water was carrying those make the film on top of the timber piece while the water or the solvent dries off. Tar oil also has the most penetration in the timber pieces compared to solvent based and water based. It is first the tar oil which has the highest penetration, next is solvent based and the last , the least is water based. Because tar oil has good penetration, it can be applied through either brushing, painting, pressure treated or dipping method. While solvent based has a moderate penetration, it can be applied with brush or dipping. But the water based preservative which has the least penetration has to be applied through pressure treated, pressure treatment, because that will ensure its maximum penetration. Now when it comes to maintenance, tar oil though it is very durable it has a long life, in case it fades off it cant be painted over. But that is not the case of water based and solvent based. Both in solvent based and water based if the preservatives fades of you can paint it over. Water based is the only preservative which is odorless, next is solvent based which has a moderately strong smell and tar oil which has a really pungent smell. So because of this solvent based is preferred, solvent based as well as tar oil is preferred to be used onlyin external work while for furniture and all usually water based preservatives are used. Though solvent based if used in some places for furniture as well. If you see the price wise the most expensive is solvent based , then it is water based preservative then the least expensive is tar oil. When you see the physical property, tar oil is not preferred to be used in furnitures because of the dark colour it gives, it renders a darker tone to the timber piece. Usually where a lighter wooden furniture is required, a wood panel wall which needs to have a lighter colour, tar oil is not used and it is preferred that water based preservative is used. Now you understand the three different preservatives – tar oil, water based and solvent based , I just told you the comparison between the 3 and where to use what kind of preservative.

Methods of Application

Now let's move onto **the methods of applications of the preservative**. To select a preservative is important and to select a method to apply these preservatives is as important. So majorly there are 4 types of methods that are most widely followed.

First is **spraying**. The spraying equipment usually consists of a tank with a pipe at the end of which there is a nozzle. The tank is filled with the preservative and with the nozzle the timber pieces to be preserved are sprayed on.

Next is the most commonly used least expensive method that is **brushing** which everyone of you might already know with a brush the preservative is applied.

Next is **dipping or immersion or baths**:- Basically in this there is a large tank filled with the preservative material. In this large tank the timber pieces are immersed in whole. Usually the dipping is the timber pieces are just dipped and taken out. Immersing is where the whole timber piece is immersed for a certain period of time. See a baths also is the same process as immersing.

And finally **pressured treatment**:- pressure treatment is where the preservatives are applied through pressure. We look into these four methods in detail now. But before that we have to follow certain safety precautions of applying these preservatives. First you have to understand that these preservatives are usually toxic, not only to fungus and insects but also to humans. And when applying a preservative, the preservative are present in the ambient atmosphere around and can be inhaled through air, by breathing and it can cause certain diseases or problems for human beings. So certain precautions are supposed to be followed while applying preservatives.

Lets see what are the **safety precautions**;- All preservatives must be handled with care. If there are any instructions on the can it should be read very carefully. at all times ensure it is safe for use in the room or house and that it will not harm people, animals or environment in any way. When working with any chemicals you should wear all the appropriate protective clothing. Like I said these preservatives contain salts or chemicals which are quite toxic , so you have to wear all the protective gear in the proper manner, like you have the goggles, you have the mask, and you have your gloves. Remember that safety and care of the environment also applies to the disposal of cartons and which hold the preservatives. So once you are done with the preservatives, you have to make sure that these cans and containers that contain the preservatives are also disposed off in the proper way and not just in a way which can be harmful to people or animals.

When you are architect or practicing or going to site that you have designed, and you are supervising the construction, you have to make sure if they are doing any preservative work or they doing any painting work, you have to make sure that the workers who are doing this work are well protected. Because it is not only the building that you should not be only concerned about the building that you are building but also the people who are building it.

Now the **methods of application:- Brushing and Spraying**:- now brushing and spraying both are surface application methods. They don't come under the category of pressure method, there is no pressure involved. For brushing it is applied using a brush or a spray gun. This method is the easiest to use and is not too expensive. If they go through the proper safety procedures anyone can brush or spray or apply the preservative to a timber piece. A thorough brush or spray treatment with coal tar creosote. Coal tar creosote is a type of tar oil, the best example of tar oil. So if a thorough brush or spray treatment with coal tar creosote can add 1 to 3 years to the life span of timber poles or posts. Brushing and spraying compared to the other methods of application provide little penetration due to capillary action. Timber piece in itself has lots of small pores. That small pores create capillary action and because of that natural capillary action they take in the preservative. Though this capillary action happens, the penetration is quite less when compared to the other methods of application. By applying preservative through brushing or spraying they don't penetrate deep into the wood and the treatment needs to be repeated regularly to keep the wood protected. Usually 2 or more coats of preservatives are applied, if the timber piece is being brushed or sprayed. 2 or more coats give better protection than 1. To be applied until the prior coat has dried. So when you are applying the 2^{nd} coat , you have to make sure that the 1^{st} coat is completely dry then apply the 2^{nd} coat.

Second method of application is by **Dipping or Immersion or Baths**:- Even this method is surface application type. There is no pressure involved in this type. Clean and seasoned timbers are totally immersed in a tank of preservative fluid. The wood absorbs the preservative over a short time. The immersion for a short time or dipping for a longer period is called steeping. Dipping is when you immersed the wood for a short time while when you immerse the wood for a longer time it is called steeping. immersion treatment is used for all types of wood preservatives, but it is most usual with organic solvent or low viscosity creosote. The immersion process penetrates better than brushing or spraying and can be even more effective when the preservative is heated. So basically when you take timber pieces and dipping you just dip and take out so it requires shorter time. When you immerse it for a longer time it is called steeping. Now when you heat the preservative before immersing the timber in it, the heated preservative has better penetration than a cool preservative or a normal room temperature preservative. Again these give 2 types of baths, so when you heat the preservative and immerse it is called a hot bath. So if you see here hot bath, timber is immersed in preservative and together they are heated up to around 80 degree Celsius until the timber is hot throughout and then the whole is then allowed to cool down together. So basically the preservative and the timber both are heated together and then after they reach a particular temperature, both are allowed to cool down together. Sometimes the treatment may be carried out more rapidly using two baths one hot and one cold. So the timber is first put into hot bath, the whole thing is heated up and then cooled down. Before it is cooled down it is taken and put into cold bath.

What is cold bath?;- The process involves the soaking of dried wood for 2-7 days in a vat containing the unheated liquid oil preservative, cold soaking has been popular because of its simplicity and low cost.

Application of hot and cold bath:- where both is done together ,where both is used together. This is mostly used for the treatment of fence posts, hurdles. It is important to guard such treated timber against fire. Now before moving onto explaining the pressure treatment process of timber we will first try to compare brushing and spraying to immersion. Now brushing and spraying has almost equal level of penetration which is lesser than obviously the immersion. In immersion again you have dipping method where it is dipped for a smaller period of time and a longer duration of time is called steeping. And immersion has again hot bath and cold bath which can be done separately .you can just use a hot bath or a cold bath or you can use both of them together first you can use the hot bath then before it cools down you take out the wood and put it in the cold bath. This using of both simultaneously speeds up the process of treatment. The preservative gets more penetration into the timber pieces.

Now lets see the **method of application** that is **pressure treatment**:- the pressure treatment method is the most affected method that forces the preservative into the wood under pressure. It is the most commonly used method for unseasoned timber. Now this pressure can come from inside or outside. Inside is where vacuum is created outside is where pressure is put. Now lets see a video to understand the process of pressure treatment. Air is first removed from the cylinder by applying a vacuum. The cylinder is then filled with wood preservative solution. Pumps are used to release and raise the pressure to force the solution into the wood. When adequate solution has been forced into the wood to ensure proper penetration, the pressure is released and solution in the cylinder is transferred back to the storage tank. A final vacuum is then used to pull any excess treatment solution out of the wood which is also transferred to the storage tank. The wood is removed from the cylinder and the chore is completed.

Now what should be the **characteristics of a good preservative**? It should be strongly toxic to insects and fungi. It should penetrate readily into the timber. It should not be soluble in water nor should it change compositon under any ordinary climatic condition. It should cover a large surface area with a comparatively small quantity of preservative. It should have no destructive influence on the strength of the timber. It should be harmless to human beings. It should not be toxic. It should not render the timber treated with it more inflammable. It should not be non-corrosive to metals because timber is usually used in combination with metals screws and stuff. It should be pleasant in colour and give an attractive appearance to the wood work and it should be easily applicable also. It should be highly resistant to water and dampness and finally it should be economical and available readily.

Now **fire resistance of timber**:-timber is a combustible material but in construction it has significant insulating properties and burns in a slow, predictable and measurable manner. These

factors timber performs strongly against fire and gives designers the ability to confidently create strong, durable, fire resistant timber constructions.

So **what happens when timber is subjected to fire?** When exposed to the heat of a fire – a thermal breakdown into combustible gases, a layer of charcoal forms. Basically when timber is subjected to fire, a layer of charcoal forms. This charred layer acts as an insulator. Thus the timber burns very slowly. The temperature of the inner un charred core remains low, enabling it to continue to carry its load. Initially the rate of charring is fast but as the char depth increases it provides a stronger protective layer to the timber slowing the overall combustion rate. The timber kinds of protect itself from fire. This self protecting nature of the charring layer increases the likelihood of the timber structure surviving fire as the un charred inner core remains unaffected and strong, maintaining its strength and with it its structures stability.

For fire resistance **what materials can be used to improve the fire resistance of timber**? Diammonium phosphate, mono ammonium phosophate, mono magnesium phosphate and phosphoric acid are some of the chemicals that can be used and applied on timber to increase its fire resistance.

Now lets see **how does these chemicals protect timber and make it more fire resistance**,:- The melting point of these chemicals is quite low and it melts when subject to fire and forms a barrier to the supply of oxygen to the inside. You all know that to fire to continue it needs oxygen. Now the chemical decomposes under heat yielding non-inflammable gases that dilute the inflammable gases. This retards the ignition of inflammable point. The chemical then vaporizes at sufficiently low temperature, absorbing sufficient heat that the temperature of the wood does not rise to decomposition point. Did you know timber cannot be made fire proof but timber can only be made fire resistant.? Timber in any case will catch fire. But We can only increase its fire resistance but we cannot make it fire proof.